TORONTO

Issued for Tender Specification

DIVISION 1

GENERAL REQUIREMENTS

TORONTO

SECTION 01000

GENERAL REQUIREMENTS

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PART 1 GENERAL

1.1 SECTION INCLUDES

.1 This section covers the geotechnical, hydrogeological, designated substances information provided to the Contractor and other general requirements of the Contract.

1.2 DESIGNATED SUBSTANCES

.1 Hazardous Materials Surveys have been carried out in the Contract Area. A copy of the reports are provided in Appendices B through F:

.1 Designated Substances and Hazardous Materials Assessment, Standby Generator Upgrade Project, Prepared by Safetech Environmental Limited, dated August 23, 2018. Appendix B.

.2 Hazardous Building Materials Re-assessment 2024 for R.C. Harris Treatment Plant , 2701 Queen Street East, Toronto, ON prepared by OHE Consultants December 2024. Appendix C

.3 Project specific Designated Substance and Hazardous Materials survey report within the power tunnel area for R.C. Harris Water treatment plant , 2701 Queen Street East, Scarborough, ON prepared by ARCADIS April 25, 2024. Appendix D

.4 Indoor Air Quality Assessment Report within the power tunnel area for R.C. Harris Water Treatment plant, 2701 Queen Street East, Scarborough, ON prepared by ARACDIS April 25, 2024.Appendix E

.5 EACC Mould Abatement Guidelines 2015 by Canadian Chapter of the EIA. Appendix F.

1.3 NATURE OF SITE

.1 R.C Harris, Toronto's largest water treatment facility, is an architectural masterpiece designed in a classical version of the Art Deco style, and is the largest unified ensemble of Art Deco Buildings in Toronto. Constructed in the 1930s, the facility is designated under Ontario's Heritage Act "as being of historical and architectural value." The site was also declared a National Historic Civil Engineering Site and recognized as a Canadian Water Landmark by the American Water Works Association.

.2 Toronto Water has implemented and maintains a Drinking Water Quality Management System under which R.C. Harris meets its commitments to provide safe drinking water, regulatory compliance and system reliability.

.3 The Contractor shall make a careful examination of the site including inside all buildings where work is required and shall take all such steps as are necessary to ascertain the conditions under which the Works are to be carried out. No extra money shall be payable to the Contractor due to soil, designated substances and/or groundwater conditions adversely affecting the Contractor's work or any other matter affected by the characteristics of the Site.

.4 The Contractor, at the time of tendering, shall conduct such investigations concerning subsurface ground and groundwater conditions if require, including conditions inside the WTP as deemed necessary to become informed of the subsurface ground and groundwater conditions that will be encountered during construction.

1.4 DAMAGE TO EXISTING EQUIPMENT, UTILITIES AND STRUCTURES

.1 All service roads and parking areas inside the facility shall be maintained in their original condition during construction. Any adverse impact and damage by the Contractor's forces or vehicles shall be dealt with immediately and without any cost to the City.

.2 Take the necessary steps to ensure that no damage is caused to existing equipment including pipes, valves, pumps and associated appurtenances, structures, buildings, foundations, roads, sidewalks, property, utility services, and other similar items during the progress of the Work.

.3 Obtain the necessary drawings from the City and perform any necessary sub-surface investigations in order to determine the exact number and location of all existing utility services, structures, underground pipes, cables, utilities and other similar items.

.4 The locations for existing equipment, structures and underground pipes, cables, utilities, and other similar items as shown on the Contract Drawings do not relieve the Contractor of this responsibility.

.5 If any damage is caused, repair and make good such damage at no additional cost within a reasonable time and to the complete satisfaction of the Engineer.

1.5 OCCUPYING THE SITE

.1 The Sites applicable to this Contract are in established residential neighbourhoods. Carry out work with discretion and limit construction noise.

.2 Use only those areas designated by the City for the access, except in so far as is necessary for the execution of the Works, and in so doing, do not unnecessarily obstruct the normal traffic of, to, from or about the Site; and do not unreasonably allow any vehicles or materials to stand in front of, or near to, any buildings on the Site or any access thereto. Ensure that the site and all parts of the facility remain accessible to the City.

.3 Confine operations within areas designated for construction, storage and access as directed by the Engineer.

.4 Limit access to and from the site as instructed by the Engineer.

.5 Maintain safe access to any existing facilities for the operations staff at all times.

1.6 CONTRACTOR USE OF PREMISE

.1 Arrange with the City and Engineer for storage areas and access to the Works.

.2 The Contractor may utilize parts of this site, as allowed by the owner for material storage and site trailers. The area allowed for materials and equipment storage including

Contractor's trailers may not be sufficient for the Contractor's requirements. Should this be the case, the Contractor shall arrange for storage and site trailers outside the site at no extra cost to the Contract. The City shall not consider any requests by the Contractor for additional reimbursement in this respect.

.3 Confine operations within working limits for construction, storage and access.

.4 Carry out the construction of the Works in such a manner that a minimum of inconvenience is caused to the City and occupants of properties adjacent to the Works.

.5 Store materials separately on the Site at locations agreed upon with the Engineer, suitably protected to prevent their deterioration or the intrusion of foreign matter. In the opinion of the Engineer, remove any material which has deteriorated or been damaged immediately from the Site at no additional cost to the City.

.6 During construction of the facilities, liaise with the Engineer and the City to schedule work to minimize the impact on the plant operations.

.7 Obtain written approval from the Engineer for tie-in work to the existing facilities. The City will operate any valve, switch, or other controls on existing facilities.

.8 Obtain written approval or confirmation of arrangement from the Engineer for access to conduct works outside the contract limits, within the other contractor's contract limits.

.9 Prior to mobilization, the Contractor shall submit a construction site layout plan to the Engineer for approval. The Plan shall show locations of trailers and storage areas, site access and egress, etc.

1.7 WORKING WITH OTHER GENERAL CONTRACTORS

.1 Other Contracts may be awarded by the City for work to be done adjacent to and/or within limits of construction.

.2 Cooperate and make suitable working arrangements with other Contractor(s) to ensure satisfactory completion of work with no conflicts or construction delays to this contract as a result of the other construction, or to the other contracts as a result of this construction. Obtain approval in writing from Engineer for all arrangements made with other Contractor(s). The Engineer will determine coordination and execution for work in the event that Contractors are unable to reach satisfactory working agreement.

.3 The Contractor is to discuss with the manager, Construction Health and Safety Branch, Ministry of Labour, with regard to the type of fencing to be used to separate the adjoining construction contracts.

.4 A red plastic mesh fence at least 1.2 m high, supported by steel posts without breaks or unsupported sections may be suitable provided that prior written approval of the Ministry of Labour is obtained by the Contractor. The fencing is to be maintained erect and in good repair through the duration of each contract and this should help to ensure the health and safety of the workers.

1.8 OWNER OCCUPANCY

.1 The City will occupy premises during entire construction period for execution of normal operations and preventive maintenance activities e.g. monthly power failure and standby power generation tests. During these tests, the Contractor may experience momentary power outages.

.2 Cooperate with the Engineer, City in scheduling operations to minimize conflict and to facilitate the Engineer's, City's usage.

.3 Maintain free access and parking for the City.

1.9 PARTIAL OWNER OCCUPANCY

.1 If necessary, schedule and substantially perform designated portions of Work for Owner's occupancy prior to Substantial Performance of entire Works.

.2 Provide additional warranty for all equipment, materials and workmanship placed into service and used by the City to maintain operations in accordance with the sequence of construction until issuance of Substantial Performance for the entire Works. The City will occupy designated areas for the purpose of operations.

1.10 CONSTRUCTION PROGRESS SITE MEETING FREQUENCY

.1 Site meeting frequency shall be weekly if the performance and schedule are not to the satisfaction of the Engineer, City at no additional cost to the Contract. Otherwise, construction progress site meetings shall be scheduled on a bi-weekly basis.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01110

SUMMARY OF WORK

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PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work to be carried out under this Contract is for the installation of standby Generator for critical loads and in general includes but is not limited to the following:

.1 Supply and Install one (1) standby power generator system to the R.C. Harris Water Treatment Plant (WTP) including the installation of one (1) new water-cooled natural gas fueled generator system, associated new natural gas supply, air-intake, and exhaust system, cooling water supply and return, drain connections, cooling system, associated electrical instrumentation and SCADA/process control system and integration, associated structural and architecture rehabilitation. The scope includes cable and power tunnel upgrades including removal and replacement of cable trays, water leak treatment and creation of a sump pit with a pumping system.

Plant Name	Plant Address
R.C. Harris WTP	2701 Queen Street East, Scarborough Southwest, Toronto

.2 Summary of work as follows:

a. Conduct Preconstruction Survey and Post construction survey of all facilities and provide detailed report with photo documentation.

b. Electrical Improvements: The works includes but not limited to:

(a) Provide, Install, test, commission, and place into operation of one (1) new Standby generator system, complete with new automatic transfer switches, new cables, wiring, cable trays, conduits and supports as required along with the transferring of loads from the main existing system buses to the new standby system buses, as indicated in the contract documents, specifications and drawings, meeting all applicable CSA Standards and Codes. The work includes provision for temporary rigging/hoisting system for generator lifting into designated location.

(b) Provide a new and complete short circuit, protection coordination and arc flash study for the single line works under this Project. The existing studies are provided in Appendix O. The new studies shall include the Standby generators side, and Normal utility side systems including the existing buildings main 13.8 kV switchgears down up to the 600V distribution system. This new study shall be signed and sealed by a Professional Engineer licensed in the Province of Ontario to be hired by the Contractor, and shall be provided, reviewed and approved, prior to shop drawing submittals and approval of any relevant electrical equipment.

(c) The Contractor shall provide products, and perform installations, start-up, testing, commissioning procedures, as well as training services and warranty, and all other requirements as indicated in the contract documents, specifications and drawings according to all applicable CSA Standards and Codes. The Contractor shall include all required costs to do so into the tender price. The Contractor shall submit Factory and Site Acceptance Test procedures for all new electrical equipment for review and approval.

(d) Provide one (1) new indoor (pad-mounted) natural gas generator system, one (1) remote annunciator panel for remote generator monitoring and annunciation, and associated materials and connection for portable load bank (load back excluded), complete as indicated in the contract documents, specifications and drawings according to all applicable CSA Standards and Codes. Including delivery of the customized generator set to the designated indoor generator room from the building entrance via existing vertical chute and horizontal wall openings and assemble the generator parts on site.

(e) Provide new Automatic Transfer Switches (ATS's), Motor Control Centers (MCC's)/Panelboards/Distribution panels, breakers and associated materials, complete as indicated in the contract documents, specifications and drawings meeting all applicable CSA Standards and Codes.

(f) Provide all required power distribution, including retrofit of existing 600V Motor Control Centers as a result of the removal of existing cable feeder as required and all control components and connections from the new Motor Control Centers to the automatic devices, interlocking etc.

(g) Provide all control components and connections from existing specified RPU's to new natural gas standby generators, new automatic transfer switches and new MCC's/Panel boards/Distribution panels as specified.

(h) Provide new cables/wiring, conduit runs and cable trays for critical and essential circuit protection, and associated installation hardware, materials and supporting systems where required for a complete functional system, are to be completed with wiring as indicated in this specification and/or shown in the Contract documents and drawings according to all applicable CSA Standards and codes.

(i) Provide a Sequence of Construction by the Contractor for the installation of the new Standby generator/ATS system, taking into account minimizing of the required hydro shutdowns at all times throughout construction. The Successful bidder shall arrange for the rental of a temporary generator, where required, to provide backup power during shutdown and system changeover. The estimated temporary generator size is 150kW, 600V, 3 phase, 60Hz.

(j) Testing and Commissioning of all equipment installed shall be completed as per all required procedures and requirements mentioned and indicated in this specification and in the contract documents and drawings according to all applicable CSA Standards and Codes. The Contractor shall also submit Factory and Site Test procedures for review and approval.

(k) Provide two-year (2) minimum warranty from Total performance on all equipment provided under this project on labour and material unless otherwise indicated in this specification.

(l) Demolition and Removal of all existing cables, and associated materials complete as specified and /or shown in the contract documents, specifications and/or drawings according to all applicable CSA Standards and Codes. Demolition of cables and wiring of existing electrical equipment shall be subsequent to the successful testing and commissioning of the overall new generator systems including generators/ATS's performance and new MCC's/panel boards/distribution panels and circuit connections. Demolition work shall be incorporated into the Contractor's Sequence of Construction documentation.

(m) All other work and coordination effort required (with other works: Mechanical, Structural, Hydro and Enbridge Utility where required), to deliver a complete functional system to satisfy the intent of the design, whether or not detailed on the Contract documents, drawings and/or described in this specification.

(n) Provide all cable tray/conduit systems as specified complete with supporting material and hardware.

(o) Provide all grounding required by the Ontario Electrical Safety code – latest edition whether or not shown explicitly in the Contract documents, specifications and drawings. This includes all required grounding to the generator, new exhausts and metal parts.

(p) Provide removal and replacement of cable trays identified in the drawings at the power tunnel. The work includes temporary re alignment and re-placement of existing cables to the new cable trays.

(q) Provide existing FHA-ELS-MCC-0400A/B upgrade c/w control signals for Filter Building CV (Control Valve) control upgrade including cables, conduits, wires, pull boxes, control panels, etc.

c. Structural Improvements: The works includes but not limited to:

(a) Constructing a fire separation with the applicable fire resistance rating enclosure around the generator set room, meeting all applicable Codes. The walls will extend to the deck/roof above and will be constructed of concrete masonry units. Providing fire stopping for all service penetrations through the walls around the generator room. A top of the wall deflection connection to be provided as shown on drawings.

(b) Construction of a concrete ramp and finishes at the entrance door to the generator room as indicated in the contract drawings

(c) Coordination of all the work under structural scope with other engineering scope and with existing services in the project area.

(d) Support for new vent stacks.

(e) existing Monorail beam partial removal, reinstatement and splicing as shown on drawings.

(f) Create a sump pit at the power tunnel.

(g) Provide leak treatment around cables penetration at power tunnel as shown on drawings and specified.

(h) Any other work specified in the Contract documents.

(i) Structural supports and protection for air intake ducts as shown on drawings.

d. Architectural Improvements: Works associated with the special mounting bracket, existing tile preservation, roof penetration, and new stake architecture features to preserve R.C. Harris WTP heritage features, as identified in the specifications and drawings. The work includes but not limited to:

(a) Constructing a fire separation with the applicable fire resistance rating enclosure around the generator set room, meeting all applicable Codes. The walls will extend to the deck/roof above and will be constructed of concrete masonry units. Providing fire stopping for all service penetrations through the walls around the generator room.

(b) Provide one (1) hollow metal double door and frame into the generator room with the required fire protection rating as indicated in the contract documents.

(c) Construction of a concrete ramp and finishes at the entrance door to the generator room as indicated in the contract drawings

(d) Coordination of all the work under architectural scope with other engineering scope and with existing services in the project area.

(e) Any other work specified in the Contract documents.

(f) Provide of Heritage preservation features as identified in the drawings including roof air intake and exhaust enclosures.

e. Building Mechanical Improvements: Works associated with providing the new standby generator water cooling system in both Screen building and RMF pipe gallery, generator air intake and exhaust systems, new natural gas piping from new natural gas meter to new standby generators, as identified in the specifications and drawings. The work includes but not limited to:

(a) Provide mechanical services to the natural gas fired genset installed in the Pipe gallery. These include cooling water supply and discharge, combustion air supply, engine exhaust duct, natural gas supply, enclosure ventilation and cooling and pipe gallery ventilation.

(b) The natural gas fired genset is supplied and installed under Division16.

(c) Modify the existing plant's natural gas supply pipework by removing the piping from the wall in the vicinity of the generator building and reroute around the building and return to the plant wall.

(d) Modify the existing pipe gallery ventilation duct by removing the duct from the wall in the vicinity of the generator building and reroute around the building and return to the plant wall.

(e) Provide standalone water-cooled air-conditioning system for the generator building mounted on the floor outside the Generator room and provide connecting ductwork, condensate drain and cooling water pipe connections. Provide fire dampers for the supply air and return air openings through the generator enclosure.

(f) Connect to existing plant supply cooling piping and extend piping to the enclosure with flowmeter, pressure reducing valve and necessary solenoid control and isolation valves. Make connections to the generator skid and standalone air conditioning system. Connect to discharge side of genset and air conditioning system and direct piping to drain below the floor slab into the level below.

(g) Connect takeoff from plant natural gas supply piping and extend piping to the enclosure with pressure reducing station and totalizing meter and connect to generator.

(h) Provide combustion air supply to generator building from air intake on the roof of the RMF, through a roof penetration into the RMF, continue down inside wall of the RMF, penetrate the wall of the RMF below grade and trench to the pipe gallery roof and penetrate the roof into the engine building. Complete the air supply ductwork with inline propeller fan, motorized interlocked supply damper and fire damper. RMF roof air intake hood by architectural

(i) Provide engine exhaust ductwork from generator building to roof of RMF building. Connect to engine muffler, penetrate the roof of the engine building, trench underground towards the RMF, penetrate the wall of the RMF, continue up the inside wall of the RMF and penetrate the roof of the RMF. Roof exhaust discharge by architectural.

(j) Provide generator enclosure ventilation inlet louvre and exhaust fan complete with fire dampers and interlocked with the natural gas detector.

(k) Remove roof mounted hoist beam in the vicinity of the generator building as indicated on the drawings and replace portion as noted at the completion of the job. Re assembled hoist beam to retested and re certified as specified.

(l) Provide a float switch to detect water or glycol leaks on the floor.

(m) Provide a local control panel for power and connectivity of mechanical systems in the generator enclosure building as detailed on drawings and specified

(n) Provide sump pump system including piping connection to drain, electrical work for the power tunnel area as shown on drawings.

f. Instrumentation and SCADA Improvements: The scope of work related to the Standby Generator Upgrades includes:

(a) Mechanical Control Panel (FHA-ELS-CP-0101):

(i) Supply and install a new control panel as per Contract Specifications and Drawings. Refer to drawing I005.

(ii) Connect interlock conditions from the new control panel to the exhaust fan, combustion air supply fan, combustion air supply flow switch, combustion air damper, and air damper switch, as shown on the Contract Drawings.

(iii) Commission the control panel and integrate it with the new generator control panel, new gas detection controller, and the existing FHA-SPC-RPU-2022 as shown as per the Contract Specifications and Drawings.

(iv) Coordinate with the generator control panel supplier all wiring interconnections between the two control panels. Perform testing and commissioning for all interconnections in accordance with the City's standards.

(b) Flowmeter Installation and Integration (FHA-ELS-FIT-0101 & FHA-ELS-FIT-0102):

(i) Supply and install a new magnetic flowmeter FHA-ELS-FIT-0101 for the cooling water and a new insertion thermal mass flowmeter FHA-ELS-FIT-0102 for the natural gas supply for the generator in the specified location as per Contract Specifications and Drawings.

(ii) Calibrate and commission the flowmeters and integrate with the existing FHA-SPC-RPU-2022 as shown as per the Contract Specifications and Drawings.

(c) Float Switch Integration (FHA-ELS-LSH-0101):

(i) Supply and install a new float switch FHA-ELS-LSH-0101 for monitoring the generator spill containment in the specified location as per Contract Specifications and Drawings.

(ii) Commission the float switch FHA-ELS-LSH-0101and integrate it into the existing FHA-SPC-RPU-2022 as shown in Contract Specifications and Drawings.

(d) Gas Detector (FHA-ELS-CT-0101 & FHA-ELS-AIT-0101 & FHA-ELS-AIT-0102):

(i) Supply, install, configure, and commission the new gas detection system controller FHA-ELS-CT-0101 as shown on the Contract Specifications and Drawings.

(ii) Supply, install, calibrate, and commission the new gas detectors FHA-ELS-AIT-0101(methane gas) and FHA-

ELS-AIT-0102 (CO gas) wired to the new gas detection controller FHA-ELS-CT-0101 as shown on M201B drawing and specified under Division 13.

(iii) Connect dry contacts for the gas detectors from the new gas detection system controller to the existing FHA-SPC-RPU-2022 as shown in the contract Specifications and Drawings.

(iv) Supply, install, and commission a new combination horn and beacon powered from the new gas detection controller FHA-ELS-CT-0101 as shown in the Contract Specifications and Drawings.

(v) Connect dry contacts from the new gas detection system controller FHA-ELS-CT-0101 to the horn and beacon as shown in the Contract Specifications and Drawings

(vi) Configure the new gas detection system controller FHA-ELS-CT-0101 to actuate the horn and beacon on the following alarms:

- Methane Hi-Hi alarm
- CO Hi-Hi alarm
- Flame detection alarm

(e) Flame Detector (FHA-FDT-AIT-0101):

(i) Supply, install, calibrate, and commission a new flame detector FHA-ELS-FDT-0101 wired to the new gas detection controller FHA-ELS-CT-0101 as shown on M201B drawing and specified under Division 13.

(ii) Connect dry contacts for the flame detector from the gas detection controller to the existing FHA-SPC-RPU-2022 as shown in the contract Specifications and Drawings.

(f) Ambient Temperature Sensor (FHA-ELS-TIT-0101):

(i) Connect dry contacts for the flame detector from the gas detection controller to the existing FHA-SPC-RPU-2022 as shown in the contract Specifications and Drawings.

(ii) Connect the sensor to the existing FHA-SPC-RPU-2022 as shown in the Contract Specifications and Drawings.

(g) Power Monitor Installation and Testing:

(i) Supply and install one Eaton PXM1000 power meters inside each of the existing FHA-SPC-RPU-2022 and

FHA-SPC-RPU-1223 as shown in the Contract Drawings.

(ii) Connect new power monitors to the new gateway in the existing FHA-SPC-RPU-2022 and the existing Multinet-FE gateway in the existing FHA-SPC-RPU-1223 as shown on the Contract Drawings.

(iii) Connect the new power meters into the existing network cabinets as shown on the Contract Drawings.

(iv) Provide all interconnecting cables for network connections including CAT 6 cable and connectors.

(v) Horizontal CAT6 cable segments shall meet the requirements of the TIA-568-C specification for CAT6 cable.

(h) Integration of new Standby Generator and ATS:

(i) Connect new wiring from the new standby generator FHA-ELS-GEN-0100 and new ATSs FHA-ELS-TS-0400 and FHA-ELS-TS-0300 to the existing FHA-SPC-RPU-2022 and FHA-SPC-RPU-1223 as shown in the Contract Drawings. Refer to E202 and E205 for the location details of FHA-ELS-TS-0400, FHA-ELS-TS-0300, FHA-SPC-RPU-2022 and FHA-SPC-RPU-1223.

g. Instrumentation and SCADA Improvements: The scope of work related to the Filter CV Shutdown System includes:

(a) Existing FLT-CP-0005 and FLT-CP-0006 Control Panels:

(i) Demolish and remove interior components inside existing control panels FLT-CP-0005 and FLT-CP-0006. Retain existing enclosures and rename/retag them FLT-JB-0005 and FLT-JB-0006, respectively.

(ii) Install new wiring between existing panels FLT-UPS-0001 and FLT-CP-0005 as shown on the Contract Drawings.

(iii) Install new wiring between existing panels FLT-UPS-0002 and FLT-CP-0006 as shown on the Contract Drawings.

(b) Filter CV Shutoff Control Panel:

(i) Supply and install the Filter CV Shutoff Control Panel FLT-CP-0007 supplied under division 13 as shown on the Contract Drawings.

(ii) Install new conduit and wiring between existing MCC-0400 and the Filter CV Shutoff Control Panel FLT-CP-0007 for the monitoring of: Source A power, Source B power, and Tie Breaker switchover, as shown on the Contract Drawings.

(c) Filter CV Panels:

(i) Supply and install new Filter CV panels FLT-CP-0005 and FLT-CP-0006 supplied under division 13 as shown on the Contract Drawings.

h. Instrumentation and SCADA Improvements: The scope of work related to all Contract Drawing series includes:

(a) Field Wiring and Conduit:

(i) Supply and install all conduit and field wiring for equipment supplied under division 13 as shown on the Contract Drawings.

(b) Tagging of Field Devices:

(i) Provide all field device tags listed in The Contract Document And Drawings.

(ii) Provide required tag spreadsheets for all equipment as per specification Section 13040.

(c) SCADA System:

(i) Develop new process graphics, sub-pictures, devices sub-pictures, setpoints, trends, alarm pages, run-hour graphics, HMI database and menus. Comply with the City's SCADA Standards for software development as specified in the City's Process Control System Implementation Guidelines using City's standard modules.

(d) Commissioning and Training:

(i) Comply with the requirements set out in Division 1.

(ii) Demonstrate loop checks for the I/O identified by this scope of work. Before requesting witnessed loop checks, carry out Contractor's own field and loop check tests to verify that the equipment operates as intended. Correct any problems or deficiencies prior to requesting witnessed checks.

(iii) On site loop check must exercise the entire loop, including the field equipment and SCADA screens.

Each loop check must be witnessed by, and successfully demonstrated to the Engineer for sign-off approval.

(iv) Provide Factory Acceptance Test (FAT) to demonstrate the operational functionality of PLCs, SCADA hardware, software and communications. Notify the Contract Administrator/Engineer ten (10) days in advance of FAT such that this test may be witnessed by the appropriate parties. Submit test report after the test duly signed by the Contract Administrator and contractor. Use only pre-approved test format. Comply with the Process Control System Implementation Guidelines for FAT requirements

(v) Provide Site Acceptance Test (SAT) to demonstrate the correct operation of control system with both hardware and software in place. Provide site support services upon request by System Integrator during system SAT. Notify the Contract Administrator ten (10) days in advance of SAT such that this test may be witnessed by the appropriate parties. Submit filled in test forms after commissioning. Comply with the Process Control System Implementation Guidelines for SAT requirements.

(vi) Coordinate closely with the Engineer and System Integrator when carrying out all work to demonstrate overall system integrity, allowing sufficient time for the essential portions of SCADA and PLC software to be installed and tested.

(vii) Maintain record drawings (As-Builts) for all drawings.

(viii) Provide testing and verification services for all Network equipment as per the City's ITM standards and requirements.

1.2 CONTRACT METHOD

.1 Construct the Work under a single lump sum price contract. Scope of work identified in in section 1.1, but not limited to including contract drawings and specifications, will be undertaken by a single contract. City will not assume operation of the new works until testing and commissioning has been completed to the satisfaction of the city.

.2 Provisional items have been identified and will be included in the Form of Tender as individual lump sum items and brought into the Total Lump Sum Tender Price as a single lump sum item.

1.3 WORK BY OTHERS

.1 Enbridge Gas installed the gas service from Queen Street to the metering station, including the meters.

.2 Refer to the CCDC General Conditions and Supplementary Conditions to CCDC, Item GC 3.2 – Construction by Owner or Other Contractors

1.4 WORK SEQUENCE

.1 Construct Work in stages to accommodate the City's continued use of the existing water treatment plant and all associated processes and equipment during construction as described below in Section 1.5. At no time, will an interruption of water supply be allowed without express written approval from the City. Any utility or process shutdown plan are to be submitted 2 weeks prior to schedule of work for the Engineer and the plant review. Plant will provide shutdown form to be used.

.2 Phase construction of Works as required to accommodate other construction activities on site.

.3 Submit all construction submissions including but not limited to shop drawings, shut down requests, test results, O&M manuals in a timely fashion and in accordance with these Contract Specifications.

.4 Coordinate construction of work with Construction Schedule and with City Occupancy.

.5 The construction sequence is to be in conformance with the requirements of the project, the constraints identified below in Section 1.5 and is subject to the Engineer's approval.

.6 Maintain fire access/control.

1.5 CONSTRUCTION SEQUENCING AND CONSTRAINTS

.1 The Contractor is to coordinate the completion of the Work described in Section 1.1.1 as per Section 01140 – Work Restrictions, Section 01310 – Project Management and Coordination, and Specification 01312 – Project Meetings.

.2 Contractor to provide a detailed price breakdown for billing purposes within 2 weeks of order to commence work in both electronic (native software format) and portable document format (PDF). Engineer is to provide a sample prior to contract order to commence. Breakdown is to be based on the specification divisions and provide adequate detail to monitor project basis. Mobilization and demobilization costs will be based on a prorated schedule based on overall timeline. The value designated for these services will be limited to a maximum of 2.5% of the total contract value.

.3 Contractor to prepare a detailed time-task construction sequencing schedule using a computerized scheduling software package for the entire Contract. The baseline schedule is to be submitted within 2 weeks of order to commence work and based on Specific Conditions 5A in both electronic (native software format) and portable document format (PDF). All milestones are to be shown on schedule including the critical path. This includes and plant/utility/power shutdowns. Provide a preliminary schedule for review during the pre-construction meeting.

.4 The Engineer will review and comment on the Contractor's construction sequence and schedule so as to minimize impact on operations, subject to approval of the City.

.5 Contractor to coordinate construction and commissioning sequencing with the Engineer and City to ensure priority is given to the minimum impact to overall facility functions and production requirements.

.6 The following constraints must be considered by the Contractor in preparing the construction schedule for the Contract:

.1 Mobilization will not be permitted until completion of the Generator shop drawing review process in accordance with Section 01330 – Submittals and Section 16500 – Natural Gas Engine Indoor Generator. Note Anticipated generator Lead time is 40 Weeks.

.2 Refer to section 01510 – Temporary Utilities and 01570 – Temporary Controls.

.3 Power supply to the facility must be maintained at all times.

.4 All chemicals and materials used for the production of potable water, including process water (e.g., wash water tanks) must meet all applicable standards set by both the American Water Works Association (AWWA) and the American National Standards Institute (ANSI) safety criteria standards NSF/60 and NSF/61.

.5 Protection from dust and contamination of the WTP and its equipment must be maintained at all times. Appropriate physical barriers, maintenance of negative air pressure, and other measurements around the construction works must be implemented.

.6 The underground construction and relevant excavation shall be scheduled as such that an adequate time period is allowed for potential design modification of the underground construction after excavation and prior to any relevant work starts, such as order of material and equipment, labor schedule, etc.

.7 The contractor must maintain the plant operation and power at all times. The contractor must use standby power generators if switchgears or MCCs will be isolated at any time. The contractor is not allowed to use any existing generators currently on-site to maintain power. The contractor is to minimize the shutdown times of all equipment at all times.

.8 Equipment during the switchover procedure will be out of service for a maximum of two (2) hours, conditional on plant approval

.9 Gradually, only one load at a time will be rewired from an existing panel to a new critical load panel, in a safe and orderly manner.

.10 When all existing loads have been shifted to their new power supplies, then the temporary power supply will be decommissioned and removed.

.11 In addition to the constraints described herein, the following information on the work to be undertaken is provided to assist the Contractor in developing a sequence of work. The information presented is not prescriptive. Work may proceed concurrently or separately in each area and may need to be adjusted to suit plant process timing restrictions, seasonal conditions, and equipment

delivery restrictions. Work may proceed independently in each area exclusive of constraints and tie-in restriction noted.

.12 All the work under this contract must commence and must be completed within the timeframe described in Tender Document, or as otherwise agreed.

.13 Ensure strict adherence to the plant's safety standards and the Occupational Health and Safety Act.

.14 Co-ordinate tie-ins to existing services with Plant and Engineer and comply with Ministry of Labour requirements.

.15 Minimize the number of disruptions to plant operations.

.16 Contractor is fully responsible for equipment operation until it is fully commissioned.

.17 No propane-or powered equipment is permitted inside the plant at anytime. Appropriate containment and mitigation measures must be in place to prevent the release of containments such as hydraulic fluid, oil and grease. This applies to equipment including, but not limited to, scissor lifts, pallet jacks and concrete milling machines. If hydraulic fluid is required, food grade oil must be used.

1.6 HOURS OF WORK

.1 Perform Work in conformity with all municipal bylaws with respect to noise control, hours of work, night work and holiday work.

.2 Work is to be restricted to the hours of 7:00 am to 5:00 pm during normal business days, with no work on holidays or weekends without written permission from the Engineer.

.3 Large delivery trucks (e.g. flatbeds, concrete trucks, bin trucks) to be restricted to come onsite between the hours of 7:00 am to 5:00 pm during normal business days (including all deliveries to plant), with no work on holidays or weekends without written permission from the Engineer. These trucks are not permitted to idle on neighbourhood streets prior to or after these work hours.

.4 Contractor is also referred to the Specific Conditions clause 5A for evening, Sundays and holiday work.

.5 Contractor Use of Premises

.6 Boundaries of the site are shown on the Contract Drawings. Restrict operations to designated site in order to ensure the safety of the public.

.7 Provide approved security fencing and/or hoarding around the work and storage areas as shown on contract drawings and in accordance with the Occupational Health and Safety Act.

.8 As provided in the Occupational Health and Safety Act, the Contractor must assume responsibility for all personnel on site. The Engineer may authorize others to have access to the site as necessary.

.9 Obtain written authorization from City to enter private lands, which are the subject of easements or rights-of-way obtained by City.

.10 Ascertain and abide by conditions pertaining to use of easements or rights-of-way.

.11 Assume full responsibility for protection and safekeeping of products/equipment under this Contract.

.12 Obtain and pay for use of additional storage, access or work areas needed for operations under this Contract. All storage areas must be approved by the Engineer prior to use. Materials must be stored to ensure the preservation of their quality and fitness for use.

.13 Prior to final inspection, obtain and submit to Engineer written signed releases from all owners of lands affected by easements or rights-of-way, confirming that properties have been left in an acceptable condition and that owners have no further claims in this respect.

.14 Protect all newly constructed work from damage of any form. Any portion of the work, which is damaged, must be rebuilt at the Contractor's expense to the satisfaction of the Engineer.

1.7 CITY OCCUPANCY

.1 City will occupy premises during entire construction period for execution of normal operations.

.2 Coordinate construction works with the City in order to minimize conflict and to facilitate continual operation of the existing R.C. Harris WTP until construction works are completed.

1.8 DRAWINGS AND SPECIFICATIONS FURNISHED

.1 Contractor Responsibilities:

.1 Provide printed copies of drawings and specifications, as required.

.2 Maintain at site one complete set of red-line marked-up drawings. Make available to Engineer at any time.

.3 Maintain record drawings as per Section 01789 – Project Record Documents. Make available to Engineer at any time.

1.9 SUPPLEMENTARY DRAWINGS

.1 Engineer may furnish supplementary drawings to assist proper execution of work. Such drawings will be issued for clarification only and will have same meaning and intent as if included with plans referred to in Contract Documents.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01140

WORK RESTRICTIONS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 Connecting to existing services.

.2 Special scheduling requirements.

1.2 RELATED SECTIONS

.1 Section 01110 – Summary of Work.

.2 Section 01310 – Project Management and Coordination.

.3 Section 01312 – Project Meetings.

.4 Section 01560 - Barricades and Enclosures.

1.3 EXISTING SERVICES

.1 Where Work involves breaking into or connecting to existing services, notify Engineer, City and utility companies of intended interruption of services and obtain required permission as per Section 01310 – Project Management and Coordination and Section 01312 – Project Meetings. Provide updates, as appropriate, throughout the course of work. Duration of interruptions are to be kept to a minimum.

.2 Schedule interruptions during normal working hours.

.3 Provide provision for personnel, pedestrian and vehicular traffic.

.4 Construct barriers in accordance with Section 01560 – Barricades and Enclosures.

.5 Coordination of construction with existing operations as per Section 01110 – Summary of Work.

.6 Coordination of construction with other construction as relevant sections.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01310

PROJECT MANAGEMENT AND COORDINATION

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 Coordinate Work with other contractors under administration of the Engineer or City.

.2 Schedule preconstruction and progress meetings.

1.2 RELATED SECTIONS

.1 Section 01110 - Summary of Work.

.2 Section 01312 – Project Meetings

.3 Section 01751 – Pre-Start-up, Start-up and Commissioning.

1.3 DESCRIPTION

.1 Coordinate scheduling, submittals, and work of the various sections of the specifications to assure an efficient and orderly sequence of installation of interdependent construction elements under instructions of the Engineer.

.2 Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installation, connecting to, and placing in service, such equipment.

.3 Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on drawings. Follow routing shown for pipes, ducts and conduits as closely as practicable; place runs parallel with line of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance and for repairs.

.4 Coordinate completion and clean-up of work of separate sections in preparation of interim milestone dates, Substantial Performance and for portions of work designated for the City's partial utilization.

.5 After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

.6 Coordinate with other contractors working onsite to avoid impacting their operations, and to ensure that facility interfaces are properly joined.

1.4 PROJECT MEETINGS

.1 Project meetings are to be in accordance with Section 01312 – Project Meetings and Specific Conditions 5A.

1.5 CONSTRUCTION ORGANIZATION AND START-UP

.1 Pre-construction meeting is to be in accordance with Section 01312 – Project Meetings

.2 Comply with Engineer's allocation of mobilization areas of site; for field offices and sheds, access, traffic, and parking facilities.

.3 During construction coordinate use of site and facilities through Engineer's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.4 Comply with instructions of Engineer for use of temporary utilities and construction facilities.

.5 Coordinate Field Engineering and layout work with Engineer.

1.6 ON-SITE DOCUMENTS

.1 Maintain at job site, one copy each of the following:

.1 Contract drawings.

.2 Specifications.

.3 Addenda.

.4 Reviewed shop drawings.

.5 Change orders.

.6 Other modifications to Contract.

.7 Field test reports.

.8 Copy of approved base line construction schedule showing critical path with Monthly updates

.9 Manufacturers' installation and application instructions.

.10 Up-to-date record drawing markups including RFI’s and Change Directives.

.11 Labour conditions and wage schedules.

1.7 SCHEDULES

.1 Submit preliminary construction progress schedule in accordance with Section 01330 – Submittals and Specific Conditions 5A.

.2 After review, revise and resubmit schedule to comply with revised project schedule.

.3 During progress of Work revise and resubmit as directed by Engineer.

1.8 CONSTRUCTION PROGRESS MEETINGS

.1 Construction progress meetings is to be in accordance with Section 01312 – Project Meetings and Specific Conditions 5A.

1.9 SUBMITTALS

.1 Make submittals to Engineer for review.

.2 Submit preliminary shop drawings, product data and samples in accordance with Section 01330 – Submittals, for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Engineer.

.3 Submit requests for payment for review, and for transmittal to Engineer.

.4 Submit requests for interpretation of Contract Documents, and obtain instructions through Engineer.

.5 Process substitutions through Engineer for review.

.6 Process change orders through Engineer.

.7 Deliver closeout submittals for review and preliminary inspections, for transmittal to Engineer.

1.10 COORDINATION DRAWINGS

.1 Provide information required by Engineer for preparation of coordination drawings.

.2 Review and approve revised drawings for submittal to Engineer.

1.11 CLOSEOUT PROCEDURES

.1 Notify Engineer when Work is considered ready for Substantial Performance and as per Specific Conditions 5A.

.2 Accompany Engineer on preliminary inspection to determine items listed for completion or correction.

.3 Comply with Engineer's instructions for correction of items of Work listed in Deficiency List and for access to City-occupied areas.

.4 Notify Engineer of instructions for completion of items of Work determined in Engineer's final inspection.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01312

PROJECT MEETINGS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 ENGINEER TO ADMINISTER

.1 Engineer will administer preconstruction meeting, progress meetings, pre-installation meetings, coordination meetings, and plant health and safety orientation training.

.2 Contractor's superintendent, and senior representatives of major Subcontractors, to attend all meetings unless directed otherwise by the Engineer.

.3 Representatives of Contractor, Subcontractor and suppliers attending meetings are to be qualified and authorized to act on behalf of the party each represents.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) days of each meeting.

.5 Except for the preconstruction meeting, all other meeting will be held at the Contractor trailer meeting room.

1.2 CONTRACTOR TO ADMINISTER

.1 Contractor will administer all construction health and safety meetings in accordance with local labour laws and the Contractor's corporate health and safety program.

.2 Representatives of Contractor, Subcontractor and suppliers attending meetings are to be qualified and authorized to act on behalf of the party each represents.

1.3 PRECONSTRUCTION MEETING

.1 Within ten (10) days of award of Contract, a preconstruction meeting will be scheduled between all parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Representatives of the City, Engineer, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.

.3 City will establish time and location of meeting and notify parties concerned a minimum of five (5) days before meeting.

.4 Agenda will include the following:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work and progress scheduling in accordance with Section 01330 – Submittals.

.3 Schedule of submission of shop drawings, samples and colour chips in accordance with Section 01330 – Submittals.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, and fences in accordance with Section 01510 – Temporary Utilities and Section 01521 – Field Offices and Sheds.

.5 Delivery schedule of specified equipment in accordance with Section 01110 – Summary of Work and Section 01330 – Submittals.

.6 Site security in accordance with Section 01110 – Summary of Work, Section 01550 – Access Roads and Parking Areas and Section 01560 – Barricades and Enclosures.

.7 Contemplated changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime and administrative requirements in accordance with General Conditions.

.8 City supplied products.

.9 Record drawings in accordance with Section 01770 – Closeout Procedures.

.10 Operation and maintenance manuals in accordance with Section 01770 – Closeout Procedures and Section 01783 – Operation and Maintenance Manuals.

.11 Take-over procedures, acceptance and warranties Section 01770 – Closeout Procedures.

.12 Monthly progress claims, administrative procedures, progress photographs and holdbacks in accordance with General Conditions.

.13 Appointment of inspection and testing agencies or firms in accordance with Section 01450 – Quality Control.

.14 Insurance in accordance with General Conditions.

.15 Safety issues in accordance with General Conditions.

.16 Environmental issues in accordance with General Conditions.

1.4 PROGRESS MEETINGS

.1 During the course of Work, regular construction progress meetings will be held on a monthly basis. Engineer or City can adjust meeting occurrence based on necessity or as requested.

.2 Contractor, major Subcontractors involved in Work, Engineer and City are to be in attendance.

.3 Agenda will include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems and conflicts.

.4 Problems that may impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revisions to construction schedule.

.8 Progress, schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Pending changes and substitutions.

.12 Review proposed changes for effect on construction schedule and on completion date.

.13 Safety issues.

.14 Environmental issues.

.15 Other business.

.4 The Contractor is to provide no later than two (2) days prior to the meeting an updated construction schedule. This includes:

.1 Updated general project schedule, including the original baseline schedule and any changes to the schedule or milestone dates.

1.5 DELINEATION MEETINGS

.1 The Contractor is to make themselves available for weekly delineation meetings at no extra cost to the Contract. These meetings will be chaired by the City at a mutually agreed upon time and day with representatives of the Contractor, the City and the Engineer.

.2 The General Contractor is to note that other construction contracts could possibly be occurring elsewhere at the water treatment plant. The Contractor is to assume that they are the Constructor in their work area. Should the situation change during the term of the Contract and the City is required to be the Constructor, the Contractor will be notified of the change.

.3 Coordination with other contractors who may be intending to work in the same area at the same time will be required. In the event of this occurring, the City and the Engineer will decide which contractor's work will take precedence. There will be no extra claim on the Contract should this occur because the Contractor is delayed from completing their work. The Contractor must maintain flexibility within their schedule to transition to different work areas to accommodate this plant-wide coordination.

1.6 COORDINATION MEETINGS

.1 The Contractor is to make themselves available for weekly coordination and safety meetings at no extra cost to the Contract.

.2 Coordination meetings will be held at a mutually agreed upon time and day with representatives of the Contractor, the City and the Engineer. Topics to be discussed include:

.1 Review of construction activities planned for next two weeks (i.e. two week 'look ahead' schedule.)

.2 Review of City maintenance and subcontractor activities that may affect Contract work.

.3 Identification and review of projected shutdowns and other activities requiring participation of City personnel. A sample shutdown notification request/coordination form is provided and must be submitted for all shutdowns two weeks prior to the projected activity.

.4 Deficient work.

.5 Shut down requests. Contractor Requests for Equipment for Construction. Provide shut down and coordination request three (3) weeks in advance (two (2) months for shut downs that require dewatering) of actual date to ensure that equipment is available to the contractor for work. Requests are to be formalized in writing. The City will confirm the availability within one week from receipt of the request or provide a more acceptable date for equipment availability. These requests are to be submitted for all operational equipment, pipe, valves, tanks and other equipment pertinent to plant operations. Plant operations is paramount and will override construction tasks in order to maintain and operate the water facility. All attempts will be made to accommodate the contractor's construction schedule.

1.7 PRE-INSTALLATION MEETING

.1 During course of Work, the Engineer will convene a pre-installation meeting for various major equipment. The Contractor cannot begin this work until the meeting has occurred.

.2 Attendance will be required of parties directly affecting, or affected by, work of the specific section. Failure of the Contractor, subcontractor, or Supplier to attend may result in a charge to the Contractor for costs incurred by the City and/or Engineer.

.3 The Engineer will prepare an agenda and preside at the meeting to discuss the following:

.1 Review conditions of installation, preparation and installation procedures.

.2 Review coordination with related work.

1.8 PLANT HEALTH AND SAFETY ORIENTATION TRAINING

.1 The Plant staff will conduct one plant oriented health and safety orientation training seminar for the General Contractor. It will be the responsibility of the General Contractor to incorporate this training session into the Contractor's safety training manual and to distribute it to the subcontractors.

.2 The General Contractor to provide the same training seminar to all personnel working for the contractor and the subcontractors. Specialized customized stickers are to be placed on the hard hats of all site personnel to indicate that they have received the plant health and safety orientation training.

.3 The General Contractor to keep a log of all personnel on site for inspection by the Engineer. The log list to list the name of all workers on site and when they received the training. No workers will be allowed to work on site until they have received the training.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01320

CMP CONSTRUCTION SCHEDULE

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section specifies the scheduling and reporting requirements through the life of the Project. The Specifications are intended to cover all technical and qualitative requirements. Any such requirements shall be carried out as per the Contract Administrator's instructions.

.2 The Construction Schedules shall be the Contractor's working document and shall be used to initially plan, organize and execute the Work. Thereafter, the Monthly Construction Progress Schedule Updates shall record and report actual performance and progress and show how the Contractor plans to complete all remaining work.

.3 Submission of the Contractor's Construction Schedule to the Contract Administrator does not relieve the Contractor of total responsibility for scheduling, sequencing, and pursuing the work to comply with the requirements of the contract documents.

.4 The Contractor shall submit the following during the Project: Pre-Construction Schedule, Baseline Construction Schedule, Monthly Construction Progress Schedule Update, three weeks Look-Ahead Schedule, As-Built Schedule and Revised Baseline Construction Schedule submittal, if required.

1.2 DEFINITIONS

.1 The following are the definition of the major terms used throughout the Project Specifications.

.1 "As-built Schedule" means the final progress Work Schedule with a Schedule Status Date equal to the actual Substantial Performance Date.

.2 "Baseline Construction Schedule" means the current version of the construction schedule that meets the Contract milestone dates and has been agreed with the Contract Administrator. The Baseline Construction Schedule can be revised by an approved Change Order that modifies the Contract Milestone dates.

.3 "Construction Schedule" means, as applicable, any or all of the Current Project Construction Schedules: Baseline Construction Schedule, Revised Baseline Construction Schedule, Look-ahead Schedule and Monthly Construction Progress Schedule Update.

.4 "Critical Activity" An activity or series of activities with zero total float. If a critical activity is delayed, it will delay the Project as a whole.

.5 "Critical Path" The longest continuous path of activities through the Critical Path Method (CPM) Baseline Construction Schedule that determines the Project's shortest possible duration for Project completion.

.6 "Float" Float shall be defined as total float, which is the period of time measured by the number of days each non-critical activity may be delayed before it and its succeeding activities become part of the Critical Path(s). The Contractor and

Contract Administrator may both utilize float to offset delays to the Work. The Float is a shared resource and utilized based on first-come, first-served basis.

.7 "Look-ahead Schedule" means the most up-to-date Look-ahead Schedule submitted by the Contractor representing the Contractor's current strategy for completing the Work in greater detail than is shown in the Monthly Construction Progress Schedule Update.

.8 "Monthly Construction Progress Schedule Update" means the working schedule indicating for a specific reporting period the actual progress, actual Work Milestone dates, actual Work Activity start and end dates, and revised forecast dates, activity durations for all incomplete Work activities and Work milestones.

.9 "Pre-Construction Schedule" means the Contractor's initial schedule produced to set out how the entire Project will be executed at a high level with a focus on the initial activities required to mobilize the Project and commence the works.

.10 "Schedule Status/Data Date" means the date up to which (inclusive) the progress of the Work was measured, and on which the update to the specific Project Schedule is based, indicating the progress of each activity, actual as-built Work Milestone dates, and actual as-built Work Activity durations, start and end dates.

.11 "Work Activity" means any of the design development activities, permitting, licensing, approvals and agreements activities, procurement activities, construction activities, testing and commissioning activities, close-out activities and handover activities or any other activity to complete the Work as defined in the Contract.

1.3 SUBMITTAL TIMELINES AND FORMAT

.1 The Contractor shall submit the Baseline Construction Schedule for acceptance by the Contract Administrator on behalf of the City. This Baseline Construction Schedule shall be used to plan, organize and execute the Work at the outset of the Project.

.2 Subsequently, Monthly Construction Progress Schedule Update will record and report actual performance and progress and show how the Contractor plans to complete all remaining Work as part of the end of each progress report period.

.3 Submittal Timelines

.1 Schedule submittals to follow the below timelines:

a. Pre-Construction Schedule: submission by the Contractor to the Contract Administrator on or before the pre-construction meeting. The schedule is submitted for information and not for approval;

b. Baseline Construction Schedule: submission by the Contractor to the Contract Administrator twenty-One (21) Calendar Days after Commencement of Work as per Contract, followed by fourteen (14) Calendar Days for review, followed by seven (7) Calendar Days for resubmittal of the revised Construction Schedule after incorporating any

comments and finally fourteen (14) Calendar Days for review and approval;

c. Monthly Construction Progress Schedule Update and Monthly Report: seven (7) Calendar Days after the monthly cut-off date;

d. Testing and Commissioning plan: Forty-five (45) Calendar Days before the start of functional testing;

e. Three weeks Look-Ahead Schedule to be submitted each week, by 10:00 am on the first Working Day of the week; and,

f. Revised Baseline Construction Schedule submittal as required.

.4 Submittal Format

.1 All schedules shall be submitted to the Contract Administrator in hard copy, soft copy (PDF file) and the native electronic format (XER files for Primavera P6 or MPP files for Microsoft Project);

.2 The PDF Copy should have the following attributes:

a. Unless otherwise approved by the Contract Administrator, white paper, 279 mm by 432 mm sheet size (11x17 or Tabloid);

b. Title Block: Show the name of Project, Project number, Contract number, update cutoff date, date submitted, revision or update number, and name of the Project Scheduler;

c. The minimum font size is 9, and preferred font type is Times New Roman, and in all cases, the printed text shall be easily read;

d. The Contractor shall identify horizontally, across the top of the schedule, the time frame by year, month, and weeks where possible;

e. The Baseline Construction Schedule will be numbered ‘Rev 0.0’ If revisions are required the revisions will be numbered ‘Rev 1.0’, ‘Rev 2.0’, etc.;

f. The Monthly Construction Progress Schedule Update will be numbered to reflect the Status/Date, which is the last Working Day of each month. The format will be ‘Monthly Construction Progress Schedule Update Month, Day, Year’; and,

g. The PDF shall identify the Activity ID, Activity Name, Duration of each activity and show Early-Start, Early Finish dates, and Total Float for each activity

h. The Gantt Chart format should include the full bar for each activity and represent the critical activities in red color. Critical activities shall only be represented in red color;

i. A legend is to be provided to describe standard and special symbols and bars used; and,

j. The Construction Schedule Data Date to be shown clearly on all printed pages, the Data Date vertical line should be in a distinct color.

1.4 PRE-CONSTRUCTION SCHEDULE

.1 A revised Pre-Construction Schedule shall be developed by the Contractor detailing the major milestones, completion and commissioning of the works and submitted to the Contract Administrator twenty-one (21) Calendar Days after the Order to Commence work has been issued. This is required for the compliance with the ECA (Environmental Compliance Approval) Sewage from MECP (The Ministry of the Environment, Conservation and Parks).

1.5 BASELINE CONSTRUCTION SCHEDULE

.1 Recommended Scheduling Software

.1 The Baseline Construction Schedule shall be created using Microsoft Project V.2010 or similar software.

.2 The scheduling software shall be used to produce a (CPM) schedule in the form of time-scaled diagrams with the critical path activities highlighted.

.2 Schedule Work Breakdown Structure (WBS). The scheduled activities shall be developed into the following major groups of activities

.1 Milestones:

a. At least all Contract milestones should be reflected on schedule; and,

b. All required information, permits, approval and input, should be reflected as milestones that are logically linked to each other, wherever possible, and linked to subsequent related Work. If these milestones are not stated in the Contract but are dependencies, the assumed date shall be reviewed and agreed with the Contract Administrator.

.2 Procurement Activities: Each of the following procurement items should be tied logically to the correct construction activity in the overall CPM Construction Schedule:

a. Permits and Approvals;

b. Submittal Items (such as Shop Drawings, Product data and samples);

c. Approval of Submittal Items; and,

d. Fabrication and Delivery of major Submittal Items.

.3 Construction Activities:

a. Mobilization and other preliminary activities;

b. Construction sequence, phases, constraints, and milestones; and,

c. Inspections and testing.

.4 Shutdowns and Tie Ins:

a. Work by City;

b. Work by Contractor; and,

c. Shutdown windows and interface with existing operations.

.5 Testing and Commissioning:

a. The testing and commissioning activities shall follow the requirements specified under specifications SECTION 01810 TESTING AND COMMISSIONING.

.3 Use of Constraints

.1 The Constraints are allowed only for the Substantial Performance, Project Total Completion and any other milestones identified in the Contract. The prerequisites required to be provided by the Contract Administrator can be constrained if no logic link can be utilized instead

.2 The only type of constraints used should be either "Finish on or before", "Start on or after", "Start no earlier than" and "Finish no later than". Constraints type such as "Mandatory Start", "Mandatory Finish", "Must Start On" or "Must Finish On" should be avoided.

.4 Activity duration break down requirements

.1 Any activity duration should be less than two times the update cycle (i.e. on a Project updated monthly, no activity should be longer than Forty-Two (42) Calendar days in duration), except for the long lead fabrication and delivery items.

.5 Identification of Shutdown windows and interface with existing operations:

.1 The Construction Schedule shall identify the planned major shutdown windows and the Work planned to be carried out during the shutdown period. These windows should be in line with the requirements set out in the Contract Documents.

.6 Coordinating Construction Schedule with Other Contracts Schedules

.1 Where Work is to be performed under the Contract concurrently with or contingent upon Work performed on the same facilities or area under other Contracts, the Construction Schedule shall be coordinated with the schedules of the other contractors.

.7 Construction Schedule Narrative (to be submitted with the Construction Schedule)

.1 The Contractor shall produce a summary narrative to provide a description of the labor, materials, equipment, means and methods that the Contractor intends to use to carry out the Work. The purpose of the narrative is to communicate any assumptions, restrictions or schedule manipulation that the Contractor is relying upon to execute the Work in a timely manner.

.8 Baseline Construction Schedule Acceptance

.1 The express or implied acceptance by the Contract Administrator of the Project Baseline Schedule and any progress schedules such as Updated Construction Schedule shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the Work in a timely manner, and shall not place any obligation or responsibility on the Contract Administrator toward the Contractor nor shall it, in any way, limit or restrict the Contractor's obligations and responsibilities under the Contract.

.2 The Contract Administrator's acceptance shall demonstrate agreement of the following, but not limited to:

a. Contract Time, including dates of Substantial Performance, Project Total Completion and all intermediate Milestones are within the specified times;

b. Specified Work constraints are shown as specified in the Contract Documents;

1.6 MONTHLY CONSTRUCTION PROGRESS SCHEDULE UPDATE

.1 Monthly Construction Progress Schedule Update

.1 Following the acceptance of the Baseline Construction Schedule, the Contractor shall monitor the progress of the Work and update the schedule each month, on the last Working Day of the month, to reflect actual progress and the projected completion date of the Work based on the progress information inserted thereof, without changes to the schedule logic or the original duration of any activity.

.2 Minor changes or corrections may be made to the Monthly updated Construction Schedule if they do not affect the Critical Path. All proposed changes shall be reviewed during the biweekly construction progress meetings. However, no such changes shall be made without the approval of the Contract Administrator.

.2 Actual Dates

.1 Actual start and finish dates shall not be automatically updated by default mechanisms that may be included in the scheduling software systems. The primary source of actual starts and finishes and period percentage completes is the field verification. The Contractor is to ensure that progress is based on a current estimate of remaining duration to complete the Work and not the activity percent complete, which calculates the remaining duration based on the original estimated duration.

.2 Actual start dates: The Actual dates should exactly represent the actual start of Work and not preparation Work unless it is clear in the activity name.

.3 Actual Finish dates: An activity should be not be marked as actual unless it is completed on-site to allow successor Work to progress. If any portions are on hold, the activity cannot have an actual finish date and if possible, reflect the on-hold section and reason in the activity name.

.3 Changes

.1 All significant Change Directives (CD) and Change Orders (CO) are to be added to the schedule under a separate WBS and logically linked to the related activities in the Construction Schedule. Additional activities may be added to reflect the Change and any related Work required to execute the Change. Note that added activities should not duplicable existing activities in the Construction Schedule.

1.7 REPORTING REQUIREMENTS

.1 The Monthly Report Narrative

.1 The narrative is to include as a minimum the following:

.2 Description of the completed Work, delayed Work and planned Work for next period;

.3 Any changes made to the Construction Schedule logic and the reasons for these changes;

.4 Any major events or issues on-site in the period; and,

.5 Any forecasted risks that require the Contractor's or Contract Administrator's attention to mitigate the impact on the progress of the Work.

.2 Three Weeks Look-Ahead Schedule

.1 At the beginning of each week, the Contractor shall submit a three-weeks Look-Ahead Schedule of planned activities and progress, detailing the previous week's progress and planned activities for the three weeks following the date of the weekly submission to the Contract Administrator.

.2 The Three Weeks Look-Ahead Schedule shall be consistent with Baseline Construction Schedule and Monthly Construction Progress Schedule Updates but provide greater detail than the Construction Schedule and Monthly Construction Progress Schedule Updates and prepared in a format that includes references to appropriate the Construction Schedule and Monthly Construction Progress Schedule Updates activity numbers and Work breakdown. All major upcoming items are to be highlighted, especially where coordination amongst Project stakeholders is required (e.g. shut-downs, inspections). Details of the planned resources (including subcontractor resources) required to achieve the production set out in the Three Weeks Look-Ahead Schedule shall be included as part of the weekly submission.

.3 The Three Weeks Look-Ahead Schedule shall indicate the Work planned for each individual Workday.

.4 The Three Weeks Look-Ahead Schedule shall indicate planned non-Work days.

.5 The Three Weeks Look-Ahead Schedule shall not be reviewed as a formal submittal.

1.8 TESTING AND COMMISSIONING PLAN

.1 The Contractor to prepare detailed testing and commissioning plan forty-five (45) Calendar days prior to starting the functional testing.

.2 The testing and commissioning plan shall follow the requirements specified under specifications SECTION 01810 TESTING AND COMMISSIONING.

.3 The Contractor is to notify the Contract Administrator forty-five (45) Calendar Days prior to the commencement of commissioning operations. This is for the purpose of the City notifying the MECP as required by the ECA Sewage Approval.

1.9 COMPLIANCE WITH THE BASELINE CONSTRUCTION SCHEDULE:

.1 The Contractor shall comply with the latest Construction Schedule approved by the Contract Administrator.

.2 If, at any time, the Work is behind schedule with respect to the Construction Schedule currently approved, and if the Contract Administrator believes there is a risk of the Work not being completed within the Contract Time as a result of such delay, the Contractor shall take all necessary measures to mitigate the delay and reflect these measures in the Monthly Construction Progress Schedule Update. If such a delay is greater than one update cycle (in most cases, one month), then the Contractor shall:

.1 Provide Notice in writing and substantiate the rationale for the delay; and/or,

.2 Provide a written mitigation plan to the Contract Administrator of how the delay will be recovered to deliver the Project within the Contract Time remaining.

1.10 REVISED BASELINE CONSTRUCTION SCHEDULE (IF REQUIRED):

.1 The Contractor shall complete the Work in accordance with the agreed Baseline Construction Schedule unless the Contractor issues a written request to the Contract Administrator describing the proposed Construction Schedule change(s) and the reasons for such change(s) and the Contract Administrator authorizes the requested schedule change(s).

.2 When a revision to the Baseline Construction Schedule is required, the current Monthly Construction Progress Schedule Update at the time of the event driving the change shall be used as the basis for schedule analysis and proposed revisions. All resultant revisions are applied to this Monthly Construction Progress Schedule Update, and it shall be saved and called the Baseline Construction Schedule Rev-XX thereafter.

1.11 AS-BUILT SCHEDULE:

.1 An as-built schedule is to be produced by the Contractor when the Project reaches Substantial Performance. The status/data date will be equal to the actual Substantial Performance Date and all activities actual dates should reflect the actual start and finish dates on site. The as-built schedule should also capture all the major Changes and Supplemental Instructions issued during the life of the Project, along with any major events that affected the Baseline Construction Schedule.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01330

SUBMITTALS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

.1 Construction schedule.

.2 Shop drawings and product data.

.3 Samples.

.4 Operating and maintenance manuals.

.5 Record drawings.

.6 Progress photographs.

.7 Certificates.

1.2 ADMINISTRATIVE

.1 Provide to Engineer for review the submittals specified. Submit with reasonable promptness and in an orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 At Engineer's request, prepare and submit a schedule fixing the dates for submission and return of shop drawings, product data or samples.

.3 Do not proceed with Work affected by the submittal until review is complete.

.4 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being examined and will be considered rejected.

.5 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents and stating reasons for deviation.

.6 Verify that field measurements and affected adjacent Work are coordinated.

.7 Contractor's responsibility for errors and omissions in submission is not relieved by the Engineer’s review of submittals.

.8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.

.9 Keep one (1) reviewed copy of each submission on Site.

.10 Contractor to provide and maintain a project FTP site for use in transferring electronic information between all parties and provide access to all parties as requested by the Engineer.

1.3 CONSTRUCTION SCHEDULE

.1 Prepare and maintain a project schedule in the form of a GANTT chart that has been electronically produced. Refer to Spec. Section 01320 for Requirements. Please note Spec. section 01320 requirements for project schedule submittal including time lines supersedes any other requirements in this section.

.2 Provide a separate bar for each trade or operation. Show proposed progress of all activities for main work items and subtrades of Contract. Where applicable, indicate labour, construction crews, plant and equipment to be employed. Show delivery dates of major pieces of equipment.

.3 Provide horizontal time scale identifying the first workday of each week.

.4 Ensure detailed Project Schedule includes a minimum milestone and activity types as follows:

.1 Award.

.2 Shop Drawings, Samples.

.3 Permits.

.4 Mobilization.

.5 Demolition and Excavation.

.6 Civil Works.

.7 Landscape Works.

.8 Irrigation Works.

.9 Process Mechanical.

.10 Valve Refurbishment.

.11 Electrical and Controls.

.12 Testing and Commissioning.

.13 Supplied Equipment Long Delivery Items (e.g., cone valves, etc.)

.14 Tie-ins.

.15 Power Outages.

.16 Chemical Deliveries.

.17 Sedimentation Basin Cleaning.

.18 Training.

.5 Submit one (1) electronic copy of initial schedule within ten (10) working days after order to commence work.

.6 Engineer will review schedule and return reviewed electronic copy within ten (10) working days after receipt.

.7 Resubmit finalized electronic schedule within seven (7) working days after return of reviewed copy.

.8 Distribute copies of the finalized electronic schedule to:

.1 Job site office.

.2 Subcontractors.

.3 Engineer.

.4 City.

.5 Other concerned parties.

.9 Instruct recipients to report to Contractor, within ten (10) working days, any problems anticipated by the timetable shown in the schedule.

.10 Revise and resubmit schedule and work plan within five (5) working days after notification by Engineer that previously reviewed schedule is not being met or if schedule adjustments have been agreed to in writing. Show changes in operations proposed to complete construction work within Contract Time.

.11 If, during course of work, Contract Time is extended, a corrected construction schedule and work plan must be submitted to the Engineer. The updated schedule and work plan must show revised commencement and completion dates of affected parts of work.

.12 No progress payment will be approved until receipt of a schedule or revised schedule acceptable to Engineer.

1.4 WORK PLAN

.1 Provide Work Plan for each key activity, as requested by Engineer, to show construction methods. Relate Work Plan to activities shown on Construction Schedule.

1.5 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data, which are to be provided by Contractor to illustrate details of a portion of Work. Refer to General Conditions for additional definition of shop drawings.

.2 Detail all shop drawings using the metric system. Prepare to a drafting standard equivalent to Contract drawings.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, wiring diagrams, panel layouts with bills of material, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross-references to design drawings and specifications.

.4 Adjustments made on shop drawings by Engineer are not intended to change the Contract Amount. If adjustments affect the value of Work, state such in writing to Engineer prior to proceeding with Work.

.5 Make such changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of any revisions other than those requested.

.6 Shop drawings are to be reviewed and stamped by the Contractor prior to submission and are to be dated. Shop drawings submitted by a subcontractor or supplier directly to the Engineer will not be reviewed.

.7 Maintain a complete Shop Drawing Record showing the review status of all shop drawings on the work. Provide Engineer with a copy of this record on a monthly basis or as requested by Engineer.

.8 Submittals:

.1 For each submittal or submittal package, prepare a Submittal Transmittal Form in a form acceptable to the Engineer. Type or print the appropriate information on the form to fully describe the submittal(s) being sent for review. Retain one (1) copy of the form and the submittal or submittal package for filing and record purposes before drawings are sent to the Engineer. Number each transmittal form in sequential order, for record and tracking purposes.

.2 Submit Submittal Transmittal Form, shop drawings and other submittals electronically in Adobe PDF format to Engineer for review.

.9 Submissions to include:

.1 Date and revision dates.

.2 Project title.

.3 Name and address of:

a. Subcontractor.

b. Supplier.

c. Manufacturer.

.4 Apply shop drawing stamp, signed by Contractor’s authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of Work as applicable:

a. Fabrication.

b. Layout, showing dimensions, including identified field dimensions, and clearances.

c. Setting or erection details.

d. Capacities.

e. Performance characteristics.

f. Standards.

g. Operating weight.

h. Wiring diagrams.

i. Single line and schematic diagrams.

j. Relationship to adjacent work.

.10 Submit one (1) electronic copy of product data sheets or brochures for requirements requested in specification Sections and as Engineer may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

.11 Submit one (1) electronic copy of shop drawings for each requirement requested in specification Sections and as Engineer may reasonably request.

.12 Submittals will be returned via an electronic copy by the Engineer within two (2) weeks of submittal date of receipt (except for Submittals that needs multi discipline reviews and city input ,These will be retuned withing 4 weeks) with one or more of the following notations. Contractor and Manufacturers to take action as noted:

.1 "REVIEWED" - Make and distribute additional copies as required for execution of Work.

.2 “REVIEWED AS MODIFIED or AS NOTED” – This notation indicates that production may proceed as noted by the Engineer. Shop Drawings are to be resubmitted for the purposes of having a completed and updated version of the Shop Drawings that will be included as part of the Operations and Maintenance Manual.

.3 "REVISE & RESUBMIT" – Make the necessary revisions and resubmit revised drawings for review. Show the drawing number of the first such revised drawing and show the latest revision number applicable to the drawing by adding a suffix to the drawing number as - "REV. 1", "REV. 2", etc.

.4 "NOT REVIEWED" - This notation indicates when Engineer has not reviewed the drawing. It may also be used in combination with the notation to revise and

resubmit the drawing where Engineer lacks sufficient information to complete the review and requires resubmitting the drawing for review after revision.

.5 Drawings will be marked "REVIEWED" together with the notation to "REVISE & RESUBMIT" when Engineer requires Contractor to resubmit a revised drawing showing corrections made as a result of Engineer's notations on the shop drawings. This procedure will not relieve Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of Contract.

.13 Use only those shop drawings on the work that bear the "REVIEWED" or “REVIEWED AS MODIFIED or AS NOTED” notation.

.14 Do not revise shop drawings marked "REVIEWED" or “REVIEWED AS MODIFIED” unless resubmitted to Engineer for further review.

.15 Where more than one type of shop drawing has been specified for one item, e.g., wiring diagrams, layout details, and dimensional drawings, the shop drawings set to be submitted together, to enable Engineer to review the drawings as a package.

.16 Catalogue pages or drawings applicable to an entire family or range of equipment will not be accepted as shop drawings unless they are clearly marked to show the pertinent data for the particular materials.

.17 Manufacturers' catalogues, manuals, or price lists will not be accepted as shop drawings. Such materials may be used as supplemental information to the shop drawings.

.18 Indicate the tag number of equipment, instruments and valves and clearly show the features and details applicable to the items being supplied.

.19 Determine which shop drawings have, in addition to those drawings specifically mentioned in the Contract, design elements requiring the seal of a Professional Engineer registered in the Province or Territory where the work is located, in accordance with the applicable provincial or federal engineering acts or other governing legislation. Seal such drawings before submitting them for review. Submit for review engineering calculations signed by the registered Professional Engineer responsible for the shop drawing design elements.

.20 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, an electronic marked-up copy will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, an electronic marked-up copy will be returned and resubmission of corrected shop drawings, through the same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.21 Owner may deduct, from payments due to Contractor, costs of additional engineering work incurred if correct shop drawings are not submitted after one review by Engineer.

.22 Review by Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Engineer approves the detail design inherent in the shop drawings, responsibility for which remains with Contractor, and such review does not relieve Contractor of the responsibility for errors or omissions in the shop

drawings or of the responsibility for meeting all requirements of the Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at the job-site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.

1.6 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples as to origin and intended use in Work.

.2 Deliver samples prepaid to Engineer's business address.

.3 Notify Engineer in writing, at the time of submission, of deviations in samples from requirements of Contract Documents.

.4 Adjustments made on samples by Engineer are not intended to change Contract Amount. If adjustments affect the value of Work, state such in writing to Engineer prior to proceeding with Work.

.5 Make changes in samples, which Engineer may require, consistent with Contract Documents.

1.7 OPERATING AND MAINTENANCE MANUALS

.1 Submit operating and maintenance manuals to Engineer, per Section 01783 – Operating and Maintenance Manual.

1.8 RECORD DRAWINGS

.1 Submit record drawings to Engineer, per Section 01789 – Project Record Documents, upon completion of Work and prior to final inspection.

1.9 PROGRESS PHOTOGRAPHS

.1 On commencement of Work and at monthly intervals thereafter, supply Engineer with digital progress photographs on USB or FTP transfer to Engineer, clearly dated and labelled. Progress photographs are to be submitted with monthly draw request. Digital photographs to have at least four (4) megapixel resolution. Photos to include building and facility egress, storage areas, and public access ways.

.2 Engineer reserves the right to request that the Contractor provide hard copies of the digital pictures as necessary. Pictures are to be printed on suitable photo quality media.

1.10 CERTIFICATES

.1 Immediately after award of Contract, submit Workplace Safety and Insurance Board Clearance Certificate. Refer to Specific Conditions 5A.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01350

HEALTH AND SAFETY

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 The Contractor, for purposes of the *Ontario Occupational Health and Safety Act* (OHSA), shall be designated as the Constructor for this project and shall assume all of the responsibilities of the Constructor as set out in that Act and its regulations. The foregoing shall apply notwithstanding that the successful bidder has been referred to as the 'Contractor' in this and any other related document. The Contractor shall comply with the following:

.1 The Contractor acknowledges that the Contractor has read and understood the *Occupational Health and Safety Act* (R.S.O. 1990, C-0.1, as amended).

.2 The Contractor covenants and agrees to observe strictly and faithfully the provisions of the said *Occupational Health and Safety Act* and all regulations and rules promulgated thereunder.

.3 The Contractor agrees to indemnify and save the City harmless for damages or fines arising from any breach or breaches of the said *Occupational Health and Safety Act*.

.4 The Contractor agrees to assume full responsibility for the enforcement of the said *Occupational Health and Safety Act* to ensure compliance therewith.

.5 The Contractor further acknowledges and agrees that any breach or breaches of the *Occupational Health and Safety Act* whether by the Contractor or any of the Contractor's sub-contractors may result in the immediate termination of this contract.

.6 The Contractor shall allow access to the Work site on demand to representatives of the City to inspect Work sites to ensure compliance with the *Occupational Health and Safety Act*.

.7 The Contractor agrees that any damages or fines that may be assessed against the City by reason of a breach or breaches of the *Occupational Health and Safety Act* by the Contractor or any of the Contractor's sub-contractors will entitle the City to set-off the damages so assessed against any monies that the City may from time to time owe the Contractor under this contract or under any other contract whatsoever.

.2 The Contractor shall provide a list of all controlled hazardous materials or products containing hazardous materials, all physical agents or devices or equipment producing or omitting physical agent and any substance, compound, product or physical agent that is deemed to be or contains a designated substance in accordance with the Workplace Hazardous Materials Information System (WHMIS) as defined under the *Ontario Occupational Health and Safety Act* and shall provide appropriate Material Health and Safety Data Sheets for these substances used for the performance of the required Work, all prior to the performance of the Work.

.3 Where hazardous materials, physical agents or designated substances are used in the performance of the required Work, the successful Contractor shall ensure that the

requirements of the *Ontario Occupational Health and Safety Act* and associated regulations are complied with.

.4 The City reserves the right to cancel any contract for non-compliance with the terms set out herein, health and safety regulations, the Environmental Protection Act, associated regulations, and other applicable legislation.

.5 The Contractor shall perform the Work so as to cause the public the least inconvenience possible. In particular, the Contractor shall not obstruct any street, thoroughfare, or foot walk longer or to a greater extent than necessary.

.6 The Contractor shall take all reasonable precaution necessary to ensure the safety of the Workers and the general public, particularly children who may play in the area of Work.

1.2 CONSTRUCTION SAFETY MEASURES

.1 Contractor must submit a corporate Health and Safety document and the site specific Health and Safety Plan before the Notice to Proceed. The site-specific Health and Safety Plan must address the requirements of all applicable Acts.

.2 Meet the requirements of the most recent editions of:

.1 *Occupational Health and Safety Act*, Regulations for construction projects, O. Reg. 213 (as am. By O. Reg. 631), Part II General Construction.

.2 *Occupational Health & Safety Act*, Health Care and Residential Facilities Regulation, O.Reg. 67, Confined Spaces.

.3 *Occupational Health and Safety Act*, Industrial Establishments Regulation, R.R.O. 1990, Reg. 851 (as amended by O.Reg. 516; 630; 230; and 450), Part I Safety Regulations.

.4 Revised Statutes of Ontario 1980, Chapter 321, Revised Regulation of Ontario 1980, Regulation 691 as amended by O.Reg. 156 and O.Reg. 645, and Ontario Regulation 714.

.5 Canada Labour Code, Canada Occupational Safety and Health Regulations, SOR/86-304 (as amended by SOR/87-623; 88-44; 88-68; 88-632; 89-479; 89-515; 90-180; 91-448; 92-544; 94-33; 94-263; 95-286; 95-533; 96-294; 96-400; and 96-525), Part XI – Confined Spaces.

.6 Workers Safety & Insurance Board (WSIB) and municipal statutes and authorities.

.3 In event of conflict between any provisions of above authorities, the most stringent provision governs.

.4 Where applicable, the Contractor shall be designated “Constructor” as defined by Ontario Act.

1.3 OVERLOADING

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.4 SPECIAL PROTECTION AND PRECAUTIONS

.1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials and regarding labelling and the provision of material safety data sheets (MSDS) acceptable to Labour Canada.

.2 Comply with the requirements of CAN/CGA B-105-M-93 when working in and around hazardous locations/confined spaces.

.3 Conform to Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance.

.4 Provide documentation of tests for gas and oxygen deficiency prior to starting work in hazardous locations.

.5 Comply with the City's Health and Safety Procedures. A City's staff member will provide one hour of training to a specified representative of the Contractor. The Contractor is responsible for providing the same training to all of his staff on-site. Maintain a record of training.

.6 Smoking is not permitted anywhere inside the station, or in hazardous areas or other areas as designated by the City. Post "No Smoking" signs as required.

1.5 SAFETY EQUIPMENT AND HAZARDOUS AREAS AND MATERIALS

.1 Safety equipment such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety belts, ropes, etc., are to be made available to the resident inspection staff. When it is required for the resident inspection staff to enter maintenance holes or other potentially hazardous areas, a Contractor's personnel has to enter the said areas with him and accompanying personnel with safety ropes, etc., shall be present as required.

.2 All work areas suspected of containing explosive or toxic gases or that are oxygen deficient must be routinely tested for presence of same before any work is done. Make safe any work area that is found hazardous before any work may proceed, in accordance with safe practice and applicable statutes.

.3 Post warning signs at hazardous areas or where hazardous materials are stored, and install protective barriers. Instruct personnel in proper safety procedures.

.4 Identify all areas considered to be hazardous locations and comply with all requirements of the Ministry of Labour.

.5 Ensure that all personnel engaged in confined space work or work in hazardous locations that require the use of respiratory equipment, comply with the requirements of the Ministry of Labour and must be clean shaven.

.6 Only non-sparking tools may be used in potentially explosive areas.

.7 Comply with the requirements of WHMIS regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.

.8 The Contractor shall inform the City of the location of these materials and shall ensure that these materials are not kept stored or used on site without the City's prior consent or approval.

1.6 SITE CONDITIONS

.1 Work at site may involve contact with:

.1 Diesel Fuel.

.2 Battery Acid.

.3 Cleaning Solvents.

.4 Paint.

.5 Refer to Div.2 Appendices that includes available environmental reports including the Plant and the power tunnel reports

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01359

SPECIAL PROJECT PROCEDURES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELICS AND ANTIQUITIES

.1 Relics and antiquities and items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found on site or in buildings that are to be demolished, remain the property of City. Protect such articles and request directives from Engineer.

.2 Notify Engineer immediately if evidence of archaeological finds are encountered and await written instruction before proceeding with work in area.

1.2 HAZARDOUS MATERIALS SURVEY

.3 Refer to Designated Substances and Asbestos Reports in Division 2.

.4 Use above information to identify and carry out the removal for any materials required prior to commencement of demolition.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

Toronto Water
R. C. Harris Water Treatment Plant

2701 Queen Street East
Toronto, ON, M4E 1J1
Tel: 416-392-2934 / Fax: 416-392-3839

SHUTDOWN NOTIFICATION

Requested By: _____ - _____ (name)

Submission Date: _____

Approval Date: _____ - _____ (name)

Plant Coordinator: _____ (name)

ATTENTION		
NAME	INFO.	ACTION
Gord Mitchell		
Erik Lepik		
Hong Chang		
Dennis Vibert		
Rinkesh Patel		
Control Room		
FHA Staff		

SHUTDOWN DETAILS				
DATE(s)				
TIME				
NATURE / DESCRIPTION OF SHUTDOWN				
EXPECTED DURATION				

PROCESS AFFECTED - *to be completed by the Plant*	
Specific Process Area Affected	
Equipment Tags (old / new)	
Equipment Status During Lockout	

Requirements Placed On Contractor - *to be completed by the Plant*

OPERATIONAL PREPARATION REQUIRED - *to be completed by the Plant*

MAINTENANCE PREPARATION REQUIRED - *to be completed by the Plant*

POWER & CONTROL OFF - *to be completed by the Plant*				
Lock-out Location				
Name / Date				
Control Available (circle one)	fully automatic	manual remote	manual local	inoperative (none)

POWER & CONTROL BACK ON - *to be completed by the Plant*	
Lock-out & Tag Removed ?	
Name / Date	

RETURN PROCESS TO NORMAL - *to be completed by the Plant*	
Normal Operation Restored ?	
Plant Technician Name / Date	

TORONTO

SECTION 01410

REGULATORY REQUIREMENTS

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PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

.1 Regulations affecting the Work imposed by:

.1 Fisheries and Oceans Canada.

.2 Environment Canada.

.3 Ministry of the Environment Safe Drinking Water Act

.4 Occupational Health and Safety Act.

.5 Municipal by-laws and servicing standards.

.6 Municipal utilities.

.7 Technical Standards and Safety Authority

.8 The Ontario Building Code (OBC), NBC, etc. as applicable.

.9 The Ontario Fire Code (OFC).

.10 CSA 282-15, Emergency Electrical Power Supply for Buildings.

.11 Occupation Health and Safety Act Regulations for Construction Projects, covering safety, hazardous materials and Workplace Hazardous Material Information Ontario.

.12 The Energy Act Ontario.

.13 Ontario Regulation made pursuant to the Power Corporation Act regarding the Electrical Safety Code.

.14 Ontario Power Resources Act.

.15 Environmental Protection Act, Ontario Regulation 309.

.16 Environmental - Air Ontario Regulation 419/05.

.17 Environmental – Noise, Ontario Regulation NPC 205.

.18 Codes and Standards of the National Fire Protection Association (NFPA).

.19 Canadian Electrical Code, latest version.

.20 Ontario Electrical Safety Code, latest version, and Electrical Safety Authority (ESA) bulletins.

.21 Standard for Building Construction Operations FCC No. 301 by Fire Commissioner of Canada.

.22 Provincial Hydro Electrical Safety Codes and Bulletins.

.23 Ontario Reduce, Reuse and Recycle Regulations O.Reg. 101/94 -105/94.

.24 CSA Certificate Standards and Electrical Bulletins.

.25 Ministry of Labour, Occupational Health and Safety Branch Health & Safety Guidelines Engineering Data Sheets.

.26 OSSHA Standards for equipment.

.27 Design Reference Standards as captured within the individual specification sections.

.28 For the purposes of the Occupational Health and Safety Act, the Contractor for this project will be designated “CONSTRUCTOR” and shall assume the responsibility of the Constructor as set out in the Act and its regulations. The Engineer will monitor the quality and quantity of the work, undertake progress payment inspections and inspections for compliance with plans and specifications. The Owner will NOT be a “Constructor” by reason thereof.

.29 Submit the information required under Section 4 of the Ontario Regulation 691/80 to the Director of Construction Health and Safety Branch of the Ministry of Labour, prior to commencing work.

.30 30 Design reference standard as captured within the individual specification sections.

1.2 COMPLIANCE WITH REGULATIONS

.1 Ascertain requirements and regulations of authorities listed above.

.2 Comply with all such requirements and regulations as applicable to the Work.

.3 Requirements set out in this Section are for guidance and information and are not necessarily complete.

1.3 CODES AND STANDARDS

.1 Perform work in accordance with the latest named published editions of codes and standards.

.2 Provide materials and workmanship, which meet or exceed the specifically named code or standard.

.3 Execute Work in accordance with the applicable Federal, Provincial, Territorial and Municipal statutes, laws, regulations to the location of the Work to be performed.

.4 In the event of conflict of above statutes, laws, regulations and codes execute work in accordance with the requirements of the Authority having jurisdiction.

.5 Enforce all safety measures in accordance with the Ontario Occupational Health and Safety Act and applicable local Construction Safety.

.6 Enforce all safety measures in accordance with the Workplace Hazardous Materials Information System (WHMIS).

.7 For the purpose of the Occupational Health and Safety Act, the Contractor for the Works will be designated "Constructor" and assume the responsibility of the Constructor as set out in the Act and its regulations. The Engineer will monitor the quality and quantity of work, undertake progress payment inspections and inspections for compliance with specifications and plans. The City will NOT be a "Constructor" by reason thereof. Refer to Specific Conditions 5A.

.8 Provide the Director of Construction Health and Safety Branch of the Ministry of Labour with the information required under Section 4 of the Ontario Regulation 691/80 prior to commencing work.

1.4 PERMITS

.1 Apply for, obtain and pay for all permits required for the Works, including but not limited to:

.1 All utilities.

.2 Ministry of Consumers and Commercial Relations.

.3 Ministry of Labour.

.4 Permits to take water.

.5 TSSA Permits.

.6 ESA and special inspections.

.7 CSA.

.8 Other relevant City of Toronto permits.

.2 Arrange for and inform the Engineer of inspections required by building permits.

.3 Arrange for and inform the Engineer of all other regular and final inspections required.

.4 For a more thorough list of the City of Toronto requirements, refer to General Conditions 5 and Specific Conditions 5A.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01423

REFERENCE STANDARDS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 LATEST EDITIONS

.1 All references to specifications, standards, or methods of technical associations refer to the latest adopted revision, including all amendments, in effect on the date of submission of bids, except where a date or issue is specifically noted.

1.2 ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standard Institute
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWMAC	Architectural Woodworkers Manufacturers Association of Canada
AWPA	American Wood Preserver's Association
AWS	American Welding Society
AWWA	American Water Works Association
CAN	Canadian National Standard
CBM	Certified Ballast Manufacturers
CBTIC	Clay Brick and Tile Institute of Canada
CEC	Canadian Electrical Code
CEMA	Canadian Electrical Manufacturers Association
CGA	Canadian Gas Association
CGRA	Canadian Good Roads Association
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CITC	Canadian Institute of Timber Construction
CLA	Canadian Lumbermen Association
CMAA	Crane Manufacturers Association of America
CMHC	Canada Mortgage and Housing Corporation
CPCA	Canadian Painting Contractors Association
CPCI	Canadian Prestressed Concrete Institute
CRCA	Canadian Roofing Contractors Association
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSSBI	Canadian Sheet Steel Building Institute
CUA	Canadian Underwriters Association
CWB	Canadian Welding Bureau

CWC	Canadian Wood Council
CSPI	Corrugated Steel Pipe Institute
EEI	Edison Electric Institute
EEMAC	Electrical and Electronic Manufacturers of Canada
ESA	Electrical Safety Authority
FFPC	Federal Fire Prevention Committee
FM	Factory Mutual Engineering Corporation
HEPC	Hydro Electric Power Commission
IAO	Insurers' Advisory Organization
IBRM	Institute of Boiler and Radiator Manufacturers
IEC	International Electrotechnical Commission
IEE	Institution of Electrical Engineers (U.K.)
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IGMAC	Insulated Glass Manufacturers Association of Canada
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Standardization Organization
LEMA	Lighting Equipment Manufacturers Association
LTIC	Laminated Timber Institute of Canada
MCAA	Measurement Control and Automation Association
MMA	Millwork Manufacturers Association
MOEE	Ontario Ministry of the Environment
MTO	Ministry of Transportation Ontario
NAAMM	National Association of Architectural Metal Manufacturers
NBC	National Building Code of Canada
NEC	National Electrical Code
NESC	National Electric Safety Code
NSF	National Sanitation Foundation
NFPA	National Fire Protection Association
NLGA	National Lumber Grade Authority
OCWA	Ontario Clean Water Agency
OECI	Overhead Electrical Crane Institute
OPSD	Ontario Provincial Standard Drawings
OPSS	Ontario Provincial Standard Specifications
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
RLM	RLM Standards Institute
RTAC	Road and Transportation Association of Canada
SAE	Society of Automotive Engineers
SBI	Steel Boilers Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters' Laboratories of Canada
USFG	United States Federal Government
WSIB	Workplace Safety and Insurance Board

1.3 CONFORMANCE

.1 Conform to these standards, in whole or in part as specifically requested in Specifications.

.2 If there is question as to whether any product or system is in conformance with applicable standards, the Engineer reserves the right to have such products or systems tested to prove or disprove conformance.

.3 The cost for such testing will be born by the City in the event of conformance with Contract Documents or by Contractor in the event of non-conformance.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01430

MANUFACTURERS SERVICES

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PART 1 GENERAL

1.1 INTENT OF SECTION

.1 This Section defines the requirements to have the equipment manufacturer's inspect, check, adjust and commission their equipment at the jobsite and train City's personnel. Certification that their equipment is installed to their satisfaction and performing in accordance with specification is also required.

1.2 DEFINITIONS

.1 *Person-Day*: One person for 8 hours within regular contractor working hours.

1.3 SUBMITTALS

.1 Training Schedule: Submit not less than 3 weeks prior to start of equipment start-up and revise as necessary for acceptance.

.2 Lesson Plan: Submit proposed lesson plan not less than 3 weeks prior to scheduled training and revise as necessary for acceptance.

.3 Factory Acceptance Test (FAT) report (includes Certificate of Compliance).

.4 Manufacturer's Certificate of Proper Installation.

.5 Short Circuit and Co-ordination Study (if applicable).

.6 Arc Flash Hazard Study (if applicable).

1.4 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

.1 Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system. Additional qualifications may be specified elsewhere.

.2 Representatives are subject to acceptance by the Contract Administrator. No substitute representatives will be allowed unless prior written approval has been given by Contract Administrator.

PART 2 PRODUCTS

2.1 GENERAL

.1 The following products/equipment require Manufacturer's Services:

.1 Panelboards

.2 Automatic Transfer Switches.

.3 Generator Sets.

PART 3 EXECUTION

3.1 FULFILMENT OF SPECIFIED MINIMUM SERVICES

.1 Furnish manufacturers' services when required by an individual specification section, to meet the requirements of that section.

.2 Perform Factory Acceptance Test (FAT) and prepare report in accordance with Section 16050 – Basic Materials and Methods; Factory Acceptance Test (FAT).

.3 A specific manufacturer, where identified within the specifications, may be required to perform the following:

.1 Short Circuit and Co-ordination Study.

.2 Arc Flash Hazard Study.

.4 Schedule manufacturer's services to avoid conflict with other onsite testing and to minimize disruption to facility operations.

.5 Provide services for periods as specified within other sections of the contract specification. Additional days of service required that are above and beyond allowances called for shall require prior written approval by Contract Administrator.

.6 When specified in individual specification sections, manufacturer's onsite services may include, but not limited to, the following:

.1 Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction for contractor's assembly, erection, installation or application procedures.

.2 Inspection, adjustment, calibration and programming as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.

.3 Revisiting the site as required to correct problems and until installation and operation are acceptable to Contract Administrator.

.4 Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.

.5 Assistance during functional and performance testing and facility start-up, commissioning and site acceptance testing.

.6 Training of City's personnel in the operation and maintenance of respective product in accordance with Section 01820 – Demonstration and Training.

3.2 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

.1 When specified within a specific specification section, submit manufacturer's Certificate of Compliance prior to shipment of equipment.

.2 Certificates of Compliance shall be signed by each equipment manufacturer certifying that the equipment specified conforms to or exceeds specified performance. Include certificate within Factory Acceptance Test (FAT) report.

3.3 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

.1 When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.

.2 Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

.3 This form shall be submitted to the Contract Administrator at the completion of equipment and system commissioning, in accordance with Section 01820 - Demonstration and Training.

PART 4 FORMS

4.1 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

CLIENT _____ EQPT SERIAL NO:_____

EQPT TAG NO:_____ EQPT/SYSTEM:_____

PROJECT NO:_____ SPEC. SECTION:_____

I hereby certify that the above-referenced equipment/system has been:

(Check applicable boxes)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Calibrated and/or programmed to Manufacturer's recommendations, contract specifications and studies, etc.
- ☐ Site inspected and tested.
- ☐ Serviced with proper initial lubricants, is applicable.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ Control and safety interlocks/alarms tested and verified.
- ☐ All applicable safety equipment has been properly installed.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer).

Comments:_____

_____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date:_____, 20

Manufacturer:_____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

END OF SECTION

TORONTO

SECTION 01450

QUALITY CONTROL

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INSPECTION

.1 Quality Control is to be in accordance with General Conditions and as amended or extended herein.

1.2 TESTING AND QUALITY CONTROL

.1 Conduct and provide test laboratory and furnish to the Engineer, when requested and consistent with progress of the Work, the test results specified in the Contract Documents or required by by-laws, statutes and regulations relating to the Work and the preservation of public health, including the following, but not limited to:

.1 Inspection and testing performed exclusively for the Contractor's convenience.

.2 Testing, adjusting and balancing of conveying systems, mechanical and electrical equipment and systems.

.3 Mill tests and certificates of compliance.

.4 Tests for reinforcing steel unidentified by mill test reports.

.5 Concrete cylinder testing, aggregate testing and cement test for both cast-in-place concrete and precast concrete items.

.6 Weld test

.7 Painting and coating

.8 Compaction of backfill and granular base courses.

.9 Contractor to provide the Quality Control Plan for review and approval before proceeding with the work

.2 The City will provide the services of an independent inspection company to perform occasional quality assurance services. The City's tests do not relieve the Contractor from carrying out the required quality control inspections described in section 1.2.1

.3 Contractor's Responsibilities:

.1 Furnish labour and facilities to:

a. Provide access to work to be inspected and tested.

b. Facilitate inspections and tests.

c. Make good work disturbed by inspection and test.

d. Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify Engineer sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of tests.

.3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.4 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Engineer

.4 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work and offsite manufacturing and fabrication plants.

.5 PROCEDURES

.1 Notify the appropriate agency and Engineer in advance of the requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing in accordance with specifications, with reasonable promptness and in an orderly sequence so as not to cause delay in the Work. Provide all necessary welding labour certificate qualifications in advance of welding to ensure proper welding documentation is maintained and acceptable to the inspector.

.3 Provide labour and facilities to obtain and handle samples and materials on site.

.4 Provide sufficient space to store and cure test samples.

.6 The City may request samples. Cooperate with the field inspection staff. Provide concrete and other materials for tests. Provide labour as necessary to assist in the handling of samples.

.7 Provide proper facilities for the storage of concrete specimens at correct temperature, free from vibration or damage in accordance with the instruction of the inspection and testing agent and the governing standard. Provide six minimum/maximum and three concrete thermometers for the exclusive use of the resident inspection staff. Provide boxes for storing and curing and crates for transporting concrete cylinders.

.8 It is not the responsibility of the inspection and testing agents to supervise, instruct in current methods or accept or reject a part of the Work, but only to inspect, test and to report conditions.

.9 Remove and replace Products indicated in inspection and test reports as failing to comply with the Contract Documents at no additional cost to the City.

.10 Correct improper installation procedures reported in the inspection and test reports.

.11 Pay the costs for the re-inspection and testing of replaced work.

.12 Additional testing required to prove the adequacy of construction shall be at the Contractor's expense, where the routine test shows the construction to be inadequate or

where the Contractor's materials and procedures have not been as specified or when work has proceeded without approval or inspection.

.13 Where the Work or Product is specified to be designed, inspected, tested and certified by the Contractor:

.1 Such additional testing or retesting will be performed by a testing agency approved by the City.

.2 Notify the Contract Administrator and the appropriate inspection and testing agent not less than forty-eight (48) hours prior to the commencement of the part of the Work to be inspected and tested.

.3 Ensure the presence of the authorized inspection and testing agent at the commencement of the part of the Work specified to be inspected or tested.

.4 Ensure the inspection and testing reports are issued promptly (normally within 48 hours), and that the Contract Administrator is notified forthwith if the report indicates improper conditions or procedures.

.5 Co-operate with and provide facilities for the City's inspection and testing agents to perform their duties.

.6 Submit four (4) copies of each test report, unless specified otherwise, each copy signed by a responsible officer of the inspection and testing company. Each report is to include:

a. Date of issue.
b. Contract name and number.
c. Name and address of inspection and testing company.
d. Name and signature of inspector or tester.
e. Date of inspection or test.
f. Identification of the Product and Specification Section covering inspected or tested Work.
g. Location of the inspection or the location from which the tested Product was derived.
h. Type of the inspection or test.
i. Remarks and observations on compliance with the Contract Documents.

.7 Correct defective work within the Contract Time; the performing of such work is not a cause for an extension of the Contract Time.

1.3 SURVEY LINES AND LEVELS

.1 The Engineer will supply information to establish co-ordinates and basic bench mark. Verify correctness of stakes and marks. Perform survey and layout work.

.2 Make the work available for checking as required by the Engineer.

1.4 ELEVATIONS

.1 Unless otherwise stated, elevations given on the Contract Drawings or in the Specifications, refer to the datum of the Geodetic Survey of Canada expressed in SI metric units.

.2 Benchmarks will be indicated on site plan and established on site as required.

.3 Verify elevations given, promptly report discrepancies to the Engineer in writing.

1.5 SURVEY MONUMENTS

.1 Maintain survey monuments, iron bars, round iron pipes and stakes for marking property boundaries and locations.

.2 Where monuments, pipes or stakes are located on the line of the trench or within the limits of the work the City will replace them.

.3 Do not remove survey monuments without receiving prior approval by the City. Pay for or replace monuments which are removed without approval.

1.6 SOIL INVESTIGATION

.1 NA

1.7 LAYOUT OF THE WORK

.1 Where several systems and Products are concentrated in an area, and prior to installation, pre-plan the total installation by preparing minimum 1:50 scale reproducible interference drawings detailing the location and identifying each system and Product. Submit the drawings to the Contract Administrator for review as for shop drawings.

.2 Notify the Engineer and request clarification if locations of fixtures, fittings, equipment and services to these items interfere with interior finishes and use of the Work.

1.8 CODES AND STANDARDS

.1 In the case of a conflict or discrepancy between the Contract Documents and the governing codes and standards, the more stringent requirements apply.

.2 Unless the edition number and date are specified, the reference to the manufacturer's and published codes, standards, and specifications are to the latest edition published by the issuing authority, current at the date of bidding.

.3 Reference standards and specifications are quoted in this Specification to establish minimum standards. Work in quality exceeding these minimum standards conforms with the Contract.

.4 Where reference is made to a manufacturer's direction, instruction, or specification it is deemed to include full information on storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the Products pertinent to their use and their relationship to Products with which they are incorporated.

.5 Where reference is made to regulatory authorities, it includes all authorities who have, within their constituted powers, the right to enforce the laws of the Place of Work.

.6 All construction work shall comply with the Ontario Construction Codes.

.7 All mechanical piping system Work, including equipment, must comply in all respects with requirements of the Ontario Technical Standards and Safety Authority, and CSA Standards B51, Pressure Vessels and Pressure Piping Code. Where required, fittings, valves, equipment, etc., must bear a CRN number.

.8 All electrical items associated with mechanical equipment are to be CSA (or equivalent agency) certified (electrically), or bear a stamp to indicate special Ontario Hydro Approval.

1.9 FASTENERS, ANCHORS, BRACES AND SUPPORTS

.1 Provide the fasteners, anchors, braces and supports required to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed Products.

.2 Use fasteners compatible with the structural requirements, finishes and types of Products to be connected. Do not mix products subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where hangers are suspended from concrete slabs, install inserts before concrete is placed using inserts designed for the specific purpose.

.4 Where built-in inserts are inaccessible due to subsequent installation of ducts, pipes or other installations, use anchors appropriate to the load requirements. Locate anchors to avoid damage to reinforcing bars.

.5 Verify that the fasteners, anchors, braces and supports for suspended installations, and the structure to which they are to be secured are designed to support the load requirements, including safety factor.

.6 Where a fastener installation is suspect, have on-site tests of installed fasteners, performed by an independent testing laboratory acceptable to the Engineer, using properly engineered and calibrated force-measuring meters.

.7 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the Products.

.8 Provide reinforcing or connecting supports, where required, to distribute the loads on the structural components.

.9 Do not use wood plugs or hammer-impact fasteners. Anchoring to floor topping fills is not acceptable. Secure the anchors in floors to the floor structure.

.10 Where a performance requirement is specified, submit engineering calculations and written verification signed by a Registered Professional Engineer that the installation has been inspected and is structurally sound and in accordance with design requirements.

.11 Fastenings which cause spalling or cracking of the structure or Products to which anchorage is made are not acceptable.

.12 Space the anchors within limits of load bearing or shear capacity and ensure they provide positive permanent anchorage.

1.10 CUTTING AND PATCHING

.1 Remove and replace defective and non-conforming work.

.2 Where new work connects with existing work and where existing work is altered, cut, patch and make good to match existing work.

.3 Do cutting with power saws or core drilling equipment. Use only hand held pneumatic or impact tools for breakout. Make all cuts with clean, true, smooth edges.

.4 Do not cut, bore, or sleeve any load bearing structure without the written consent of the Engineer. Submit details with each request for consent.

.5 Make connections watertight.

.6 Provide openings in non-structural elements of the Work for penetrations of mechanical and electrical work. Co-ordinate size and location of such openings with the trade involved.

.7 Fit construction tightly to ducts, pipes, conduits and similar Products to stop air movement completely. Where such work penetrates a fire separation element or wall of the building, pack the penetration around the duct, pipe, conduit or similar for the length of the openings with ULC listed fire stopping packing Product as part of the Work specified in Divisions 15 and 16.

.8 Prepare the surfaces to receive patching and finishing.

.9 Refinish the surfaces to match the adjacent finishes. For continuous surfaces refinish to the nearest intersection, and for an assembly, refinish the entire unit.

1.11 LABOUR, PRODUCTS AND WORKMANSHIP

.1 Products named in the Specifications or on the Drawings by manufacturer's name and model number establish the size, quality and performance standards for the Work. In most cases, alternate manufacturers' Products are listed as acceptable for the named manufacturer's Product. Base the Bid Price on the named, manufacturer's Product or the Product of a named alternate manufacturer. If no alternate manufacturers are listed, base the bid price on the named, manufacturer's Product.

.2 The Work has been designed on the basis of the named, manufacturer's Product. The bid price shall not be based on any alternate, non-named, manufacturer's Product. The Form of Tender contains an Alternate Form for placing the name and cost savings for any

Produce or equipment which the contractor would wish to use as an alternate to the named Product of equipment in the specification or on the drawings.

1.12 EVIDENCE OF CONFORMING TO STANDARD

.1 Where materials are specified to conform to a standard - for example, reinforcing steel, G30.12 M Grade 400 - provide mill reports, invoices or other statements, which certify that materials are in fact to the specified standard.

.2 Where the Contractor proposes to use materials not manufactured to a standard, provide test reports, which show that the proposed material meets the requirements of the specified standard.

1.13 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work and offsite manufacturing and fabrication plants.

1.14 PROCEDURES

.1 Notify the appropriate agency and Engineer in advance of the requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing in accordance with specifications, with reasonable promptness and in an orderly sequence so as not to cause delay in the Work. Provide all necessary welding labour certificate qualifications in advance of welding to ensure proper welding documentation is maintained and acceptable to the inspector.

.3 Provide labour and facilities to obtain and handle samples and materials on site.

.4 Provide sufficient space to store and cure test samples.

1.15 REJECTED WORK

.1 Refer to General Conditions.

1.16 REPORTS

.1 Submit four (4) copies of inspection and test reports promptly to Engineer. Provide copies of work being inspected/tested to Subcontractor.

1.17 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

1.18 MILL TESTS

.1 Submit mill test certificates as may be requested.

1.19 EQUIPMENT/SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

.2 Refer to individual specification sections for definitive requirements.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01510

TEMPORARY UTILITIES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INSTALLATION/REMOVAL

.1 Provide temporary utilities in order to execute the work expeditiously.

.2 Make necessary applications to authorities having jurisdiction, obtain required permits, and pay all fees and related charges.

.3 Provide temporary access and parking areas as required.

.4 Remove from site all such work after use.

.5 Restore site to clean, sanitary condition.

.6 Location of all temporary utilities are to be approved by the City and Engineer.

1.2 TEMPORARY UTILITIES

.1 Arrange for the supply of sanitary facilities, water, heat, power, lighting, communication facilities, and any other temporary services required during construction. For power and water source , confirm with plant for connection availability and suitability, otherwise provide your own.

.2 Pay for costs of temporary heat and ventilation used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment as required by the Ministry of Labour under the “Occupational Health and Safety Act” for the protection of workers.

1.3 SANITARY FACILITIES

.1 Provide sanitary facilities for Contractor’s work force in accordance with governing regulations and ordinances.

.2 Sanitary facilities are to be provided such that there is minimum of one toilet and sink for every ten employees on site under the supervision of the Contractor. A minimum of two (2) toilets and sinks are to be provided. Any potable water for sanitary suppliers should be provided by the contractor.

.3 The facilities to include suitable heating for winter use, and interior and exterior lighting.

.4 Provide all sanitary supplies required for use by Contractor's work force.

.5 Post notices and take such precautions as required by local health authorities.

.6 Keep area and premises in sanitary condition.

.7 Disinfect facilities frequently, at minimum once per week.

.8 Contractor to provide power and voltage transformation. Washrooms shall be self-contained with no buried storage and shall not be connected to local sanitary.

Washrooms shall have the sanitary waste removed as required with a maximum of one week between removals.

.9 Remove contaminated soil and material and replace with fresh, clean material.

.10 Dispose of sanitary wastes off-site, in accordance with the applicable regulations, and subject to approval of Engineer.

.11 Prohibit the committing of nuisance. Promptly discharge any employee violating such provision.

1.4 WATER SUPPLY

.1 Water supply from the plant is available. Contractor to supply and install backflow preventer on water supply hook-up and test as per local by-laws. Building security to be maintained at all times.

.2 Potable water will be supplied to the Contractor free of charge. The Contractor shall provide for and pay for means of conveyance, including heat tracing, of potable water to locations where it is required.

.3 If a fire hydrant to be used for temporary water supply, contractor to confirm location of the nearest fire hydrant to site, and obtain and pay for a City of Toronto Hydrant permit. The contractor is responsible for backflow prevention and flow metering. Also note the hydrant permits are available from April 15 to November 15, weather permitting. Contractor is to supply water by other means outside these times at no additional cost to the city.

1.5 TEMPORARY HEATING AND VENTILATION

.1 Permanent heating and ventilation system of building may be used when available. Contractor is responsible for damage to heating and ventilation system if use is permitted.

.2 If permanent heating and ventilation system of building is not available, provide temporary heating required during construction period, including attendance, maintenance and fuel.

.3 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.

.4 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of Work.

.2 Protect Work and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

.4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for safe working environment.

.5 Maintain temperatures of minimum 10°C in areas where construction is in progress.

.6 Ventilating:

.1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants. Equipment to:

a. Conform with applicable codes and standards.

b. Enforce safe practices.

c. Prevent abuse of services.

d. Prevent damage to finishes.

e. Vent direct-fired combustion units to outside.

.7 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 POWER AND LIGHT

.1 The City can provide a service connection point for a 60A, 208Vac, 1ph from an existing power panel located within the Scarborough Pump room (adjacent to the Screen room). Make allowance for a minimum of a 60M - 3C#6 TECK cable from the panel to the new trailer location.

.2 Connect to existing power supply in accordance with Canadian Electrical Code. Any temporary power system using existing electrical installation shall be independently metered, recorded (kWh) and paid at current market rate.

.3 Temporary power or electric cranes and other equipment requiring in excess of above is responsibility of Contractor, Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal."

.4 "If power is not available from Plant, arrange and pay for (including monthly usage charge) and maintain temporary electrical power supply in accordance with governing regulations and ordinances."

.5 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors, stairs and exterior walkways is not less than 162 lx.

.6 Install temporary facilities for power such as pole lines and underground cables, to approval of local power supply authority.

.7 Locate temporary power at designated location, or at an acceptable location subject to approval of Engineer.

.8 Electrical power and lighting systems installed under this Contract may be used for construction requirements with prior approval of Engineer provided that guarantees are not affected. Make good any damage and replace lamps, which have been used over a period of three (3) months.

1.7 TEMPORARY COMMUNICATION FACILITIES

.1 Provide and pay for temporary high-speed wireless internet hook up, lines, and equipment necessary for own use and separate use of Engineer as per Section 01521 – Field Offices and Sheds.

1.8 MAINTENANCE OF PUBLIC UTILITIES

.1 Arrange Work to avoid interruption of utilities serving the public. Contractor to pay for damages that result from their work.

.2 Where interruption of public utilities is unavoidable, obtain prior approval for interruption from responsible authority.

.3 As required by utility authority, establish and pay for temporary relocation of utility during construction.

.4 Comply with utility authority requirements in giving notice to users and fire department prior to interruption of service.

1.9 TEMPORARY FIRE PROTECTION

.1 During the entire construction period, provide fire extinguishers in each construction shed and temporary office, as well as in other locations reasonably required, and all other fire protection necessary to protect the project and to comply fully with the requirements of insurance underwriters for the project and local provincial and federal authorities.

.2 Provide site security camera to monitor and protect contractor equipment, material and temporary facilities

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01521

FIELD OFFICES AND SHEDS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INSTALLATION/REMOVAL

.1 Provide lockable temporary field offices and sheds as required during construction in locations directed by Engineer.

.2 Remove promptly from Site all such facilities after use as directed by the Engineer, including contractor equipment and construction waste, unless otherwise specified or directed. Restore all areas to conditions at start of Contract to the satisfaction of the Contractor Administrator.

1.2 CONTRACTOR'S SITE OFFICE

.1 Provide temporary office for Contractor as shown on the contract drawings.

.2 Insulate building and provide lighting and power requirements in addition to electric heating system and air conditioner with integral thermostats capable of maintaining a room temperature of 22°C.

.3 Arrange and pay (including monthly rentals) for the use of a minimum of one (1) independent telephone lines to the site office.

.1 One line used for telephone service including automatic voice messaging service.

.4 Arrange and pay (including monthly rentals) for high-speed wireless internet connection complete with required hardware and software.

.5 Equip office with necessary number of desks with drawers, armchairs, drafting tables, drafting stools, 2m x 1m tables, chairs, shelving, lockable filing cabinets, plan racks and coat racks as required for efficient project supervision and delivery.

.6 Maintain in clean condition.

.7 Maintain access to site offices from the main building facility as indicated on drawings.

1.3 ENGINEER'S SITE OFFICE

.1 Provide all materials for and fully erect and service field office for the exclusive use of the Engineer and his staff. The office or, as an alternative, an approved type of trailer, will be a windproof, insulated and watertight structure lined with suitable panelling, conforming with the specified dimensions and layout approved by the Engineer. The office building/trailer shall have a minimum of six (6) working windows and two lockable doors. Erect the field offices on site in an approved location.

.2 Submit detailed shop drawings showing the following as a minimum:

.1 Orientation of offices within overall Contractor’s compound.

.2 Proposed interior layout of office trailers, including all furniture, equipment and other items specified herein.

.3 Heating, air conditioning, telephone and electrical outlets.

.4 Provide new wind-proof and weather-tight trailers of pre-fabricated steel as supplied by Treco, Boxx, Miller, or Atco, with minimum ceiling heights of 2.4 m. Trailers shall be provided with the following features:

a. Fully insulated (R-12 walls, R-20 floor and roof).

b. Vinyl covered “gyproc” walls and ‘T’ bar ceiling.

c. Hollow core interior wooden doors complete with handles.

d. Six (6) - 1000 mm wide X 750 mm high horizontal sliding glass exterior windows with insect screen in each window.

e. Vinyl floors.

f. Pre-painted 30 gauge galvanized steel exterior siding.

g. Pre-painted 30 gauge galvanized steel roof over12 mm plywood sheeting over ‘A’ frame roof trusses.

h. One centralized air conditioning system. System sized to maintain 22°C interior temperature in the summer months, assuming 35°C exterior temperature.

i. Lighting panel and electrical system adequately sized.

j. Electric baseboard heaters 22°C interior temperature in the winter months assuming a -20°C exterior temperature or centralized heating system.

k. Enough fluorescent ceiling lighting fixtures in each room to provide 50 foot candles of light.

l. Exterior pressure treated wooden stairs, ramp and deck at each entrance/exit.

m. Keyed locks on all exterior doors with 2 sets of keys for each door.

n. A minimum of two duplex electrical outlets in each office, and six in meeting room/general areas.

o. Provide unlimited high-speed wireless internet with equipment to provide wireless connection of up to 10 devices.

p. All interior partitions shall be insulated for sound attenuation.

.5 Provide a minimum of two (2) offices (each 12' x 10' minimum) and one (1) meeting room (12' x 20' minimum), each with ceiling lights and windows with screens.

.6 Provide the following furniture and supplies. Some items listed are based on Staples Business Depot catalogue. Alternative suppliers are acceptable providing items of equal value and quality.

a. Offices:

(a) Two (2) Executive Desks, with lock and key on each drawer.

(b) Two (2) Global 2800 Series Premium Vertical Legal (760 mm) file cabinets, 4-drawer, black for general work area, or equivalent.

(c) Two (2) Executive High-back black leather chairs.

(d) Two (2) Bestar Elite Collection bookcase, 5-shelf, Tuscany Brown– Item Number 694497 (Model 68700-1163) with built-in bookshelves, or equivalent.

(e) Two (2) Pro-Line™ II Deluxe Air Grid Back Ergonomic office chairs for guest. Item Number 259483, or equivalent.

(f) Two (2) Quartet Premium Porcelain Magnetic board, 915 mm x 1200 mm – Item Number 519058, or equivalent.

(g) Four (4) Safco Nail-Head coat hooks, 2-Hook Unit – Item Number 706710, or equivalent.

(h) One (1) Precision Drafting Table, Base and Chair.
(i) Brand: Safco Model Number: 3953-3962GR. Overall Dimensions: Approx. 1828mm W x 952mm D.
(ii) One (1) drafting stool (710 mm high).
(iii) One (1) rectangular table for copier, approx. 915 mm W x 720 mm D x 762 mm H.

b. Meeting Room

(a) Ten (10) stacking steel padded chairs.

(b) One (1) small two door kitchen cabinet (for microwave and coffee maker) with laminate countertop, approx. rectangular conference tables, 1219mm W x 609 mm D x 7462mm H.

(c) One (1) rectangular conference table, approx. 3050 mm L x 915 mm W x 740 mm H.

(d) One (1) new 11 cu-ft., 1000 Watt microwave oven

(e) One (1) new 12-cup brew coffee machine

(f) One (1) new electric water kettle.

(g) One (1) new 11 cu-ft. refrigerator.

(h) One (1) new water cooler.

(i) Provide two (2) separate split 15 amp wall duplex outlets, one (1) for a microwave oven, and one (1) for a refrigerator.

.7 Office Supplies

a. Three (3) plastic wastepaper baskets.

b. Paper towel dispenser with 18 month supply of paper towel rolls (Bounty type or equal).

c. A supply of 10 x 500 sheet packages of 8½" x 11" paper and 5 x 500 sheet packages of 11" x 17" paper.

d. Spring water for water cooler, for duration of contract.

.8 Miscellaneous

a. First Aid Kit.

b. One (1) large white board, 6' x 4'.

c. Provide maintenance for all computer equipment, printers, photocopiers, fax machines for the duration of the contract. Provide all required paper, ink cartridges, toner, etc. for all machines.

.9 Washroom Facilities

a. Provide exterior lockable private washroom adjacent to trailer and complete with water flushed toilet, sink with hot and cold water supply, toilet roll rack, paper towel dispenser, mirror and washroom exhaust fan.

b. Maintain a proper supply of toilet paper and paper towels for the duration of the contract.

c. Provide two (2) sets of washroom keys to the Contract Administrator.

d. Washroom rental is to include weekly maintenance/cleanup.

.3 Provide the following for the use of the resident inspection staff:

.1 Two (2) - 25" desktop monitors with HDMI cable.

.2 Internet Service Provider (ISP) Service:

a. Unlimited, High-speed wireless internet connection for exclusive use of the Engineer and Owner field staff.

.3 Provide one (1) combination HP LaserJet M2727 fax/copier/scanner with the following features:

a. Automatic scanning.

b. Automatic feed.

c. Accepts 8½" x 11" paper.

d. Provide sufficient spare laser toner cartridges throughout duration of Contract.

.4 Provide one (1) Canon Image Runner Advance Model C2030 printer with the following features:

a. Digital copying.

b. Network printing via 10/100Base-TX (RJ-45).

c. Color network TWAIN scanning.

d. Two 8½" x 11" cassette trays.

e. One 11" x 17" cassette tray.

f. Base cabinet.

g. Ten laser toner cartridges.

h. 256 MB RAM.

i. Printer Drivers: UFR II LT: Windows 98/Me/2000/XP, Windows Server 2003, Windows Vista.

j. Arrange for a Canon service person setup the printer upon delivery. Canon service personal shall be available upon request for any required troubleshooting.

.4 Provide two (2) Linksys Wireless N Routers and one (1) 8 port wired router.

.5 Be responsible for maintenance of all electrical, mechanical and general maintenance and upkeep of the office for the duration of the project. At a minimum, arrange for one full cleaning of field offices once per week.

1.4 SITE DOCUMENTS

.1 Maintain documents and materials on-site, in Contractor's Site Office, in accordance with Section 01310 – Project Management and Coordination.

.2 Maintain documents in order and make available for viewing by Engineer and Ministry of Labour Inspector at all times.

1.5 STORAGE SHEDS

.1 Provide adequate lockable weather tight sheds with raised floors, for storage of materials, tools and equipment, which are subject to damage by weather.

.2 Provided heated storage structures where required.

.3 Maintain storage sheds in a neat, clean condition. Do a minimum of one full cleaning per week.

1.6 FIRST AID FACILITIES

.1 Provide and maintain on Site, in a clean orderly condition, completely equipped First-Aid facilities readily accessible at all times to Contractor's employees and Engineer. Facilities and staffing are to be in accordance with the Industrial First Aid Regulations of the Workplace Safety and Insurance Board and OSHA regulations.

1.7 SITE SECURITY

.1 It is the Contractor’s responsibility to secure its construction materials, tools and equipment. The Owner is not responsible for providing security services, and is not responsible for any loss, theft or damage to any equipment/material within the Contractor’s working limits.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01550

ACCESS ROADS AND PARKING AREAS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01570 – Temporary Controls.

1.2 INSTALLATION/REMOVAL

.1 Maintain construction access and parking areas as required.

1.3 ACCESS ROADS/ACCESS WALKWAYS

.1 Provide and maintain adequate access to Site. During entire project time line, maintain all access roads in the condition that they were found. All debris and dirt are to be cleaned within two (2) hours of spillage. All public access ways are also to be maintained in good condition and cleaning and repair as required within the same time frame.

.2 Construction vehicles are not permitted to be parked overnight at the water treatment plant, outside of the construction zone. Contractor to provide overnight contact information and be prepared to move any construction vehicles parked overnight if plant staff require access.

.3 Provide snow removal during period of work to all utilized construction accesses including the main plant road, the construction parking and staging area. Spread salt and sand in all areas of ice buildup and heavy foot traffic.

.4 If authorized to use existing roads for access to Sites, maintain such roads for duration of Contract and make good damage resulting from contractors' use of roads. Access roads to Plant Buildings are used by plant staff, plant deliveries and other Contractors. These roadways are not to be blocked for extended periods of time (more than 30 minutes) without proper notice (24 hours in advance).

.5 Prior to final inspection, obtain and submit to Engineer written signed releases from owners of all roads used for Sites access, verifying that roads have been adequately restored and left in a satisfactory condition. Contractor to pay for any damage or mess resulting from contractors' use of on-site or local City-owned roads as related to the associated Contract work.

.6 Trim loads of trucks hauling excavated material, cement, sand, stone, gravel, debris or other loose material before leaving the site, and ensure that the bodies of such vehicles are tight so that no spillage of loads occurs.

1.4 ACCESS TO UTILITY INSTALLATIONS

.1 Do not obstruct hydrants, valve or control pit covers, valve boxes, curb stop boxes, fire or police call boxes, and all other utility controls, warning systems, and appurtenances.

.2 Provide and pay for bridges, walks, or other temporary facilities necessary to ensure that these controls or warning systems are free for use in their normal manner at all times during construction.

1.5 CONSTRUCTION PARKING

.1 Parking will be permitted on Site provided it does not disrupt plant operations and performance of Work, and only as permitted by the Engineer.

.2 Parking is to be limited to the area designated, within the Contract limit of work.

.3 No parking or idling will be permitted along Nursewood Road or Queen Street East.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01560

BARRICADES AND ENCLOSURES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INSTALLATION/REMOVAL

.1 Provide temporary barriers and enclosures as required to protect against injury and damage in accordance with the occupational Health and Safety Act.

.2 Remove from Site all such work after use.

1.2 HOARDING

.1 Hoarding will certainly not be required around the entire site perimeter. Any hoarding installed for laydown areas, etc must be maintained free of graffiti and painted R.C. Harris green. Erect hoarding around entire perimeter of site to protect the public, workers, private and public property from injury or damage. Refer to Section 02201 – Site Preparation.

1.3 GUARD RAILS AND BARRICADES

.1 Provide and maintain secure, rigid guard railings and barricades around deep excavations, open shafts, open stairwells, open edges of floors and roofs.

.2 Provide and maintain at all time all necessary temporary barricades and delineators required to complete the works along roadways safely for both construction and private pedestrian and vehicular traffic.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01570

TEMPORARY CONTROLS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 CONSTRUCTION CLEANING

.1 The Contractor is to have a full-time dedicated janitor to continuously clean the construction areas (exterior and interior) and adjacent areas throughout the working day. Passageways and adjacent areas to doorways and gates that are used by the Contractor to access work areas are also to be kept clean at all times.

.2 The following is to be done on a daily basis:

.1 Sweep site road. During heavy soils transportation also sweep impacted adjacent public roadways.

.2 Broom clean paved and concrete surfaces; rake clean other surfaces of grounds.

.3 Vacuum clean and dust building interiors, behind grilles, louvers and screens.

.4 Clean floors, doors and walls to remove any grease, dust, dirt, or stains.

.5 Clean lighting reflectors, lenses, and other lighting surfaces.

.6 Remove dust on all control equipment and heating elements within the construction area

.7 Remove debris and surplus materials from site.

.8 Remove snow and ice from access to building.

.9 Maintain a cleaning log.

.3 The daily cleaning log is to be made available for review upon Engineer’s request.

.4 A weekly survey of the plant cleanliness will be conducted. Contractor, City and Engineer to be present and to sign off on weekly cleaning inspection log.

.5 Maintain the Work in tidy condition, free from the accumulation of waste products and debris, other than that caused by City or other contractors.

.6 Remove waste material and debris from the site at the end of each working day.

.7 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

.8 Promptly clean up any spillage that occurs on site roads, access roads or public roads, or other areas where construction vehicles are travelling.

.9 If Contractor is negligent in maintaining cleanliness of roads, City will arrange for cleaning to be done at Contractor's expense. If the Contractor is negligent in protecting or maintaining cleanness of catch basins on site roads, access roads or public roads, or other areas where construction vehicles are travelling. City will arrange for cleaning to be done at Contractor’s expense.

1.2 MATERIALS

.1 Use only cleaning materials recommended by manufacturer of surface are to be cleaned, and as recommended by cleaning material manufacturer. This is a WTP and cleaning material need to NSF61 certified.

1.3 FIRES

.1 Fires and burning of rubbish on site is not permitted.

1.4 DISPOSAL OF WASTES

.1 Do not bury, or permit to be buried, rubbish and waste materials on site unless approved by Engineer.

.2 Do not dispose, or permit the disposal, of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers, or drains.

.3 Remove from Site wastes and materials specified or designated by Engineer to be disposed of. Dispose of these wastes and materials at sites provided by Contractor.

1.5 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from surface and ground water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.4 Maintain existing drainage facilities affected by Work in good operating condition at all times during construction.

.5 Clean up all ditches upon completion of work.

1.6 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 In addition to 1.5.1, comply with all requirements of appropriate regulating agencies.

.3 Control emissions from equipment and plant to requirements of authorities having jurisdiction.

.4 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.5 Establish suitable fuelling and maintenance areas and review with the Engineer.

.6 Do not refuel or maintain equipment adjacent to or in watercourses or adjacent to or above water retaining structures.

.7 Do not fuel equipment within thirty (30) metres of any water course unless non-spill facilities are used.

.8 Submit procedures for interception, rapid clean up and disposal of spillages that may occur, for Engineer's review, prior to commencing work.

.9 Be prepared at all times to intercept, clean up and dispose of any spillage that may occur whether on land or water.

.10 Keep all materials required for clean up of spillages readily accessible on site.

.11 Report immediately any spills causing damage to the environment to Spills Action Centre of the Ministry of the Environment.

.12 Coordinate use of herbicides and pesticides with landowners and occupants and Ministry of the Environment.

.13 Do not empty fuel, lubricants or pesticides into sewers or watercourses.

.14 Dispose of all construction debris in an approved location.

1.7 MATERIALS TO BE SALVAGED

.1 Equipment removed and to be replaced under this contract is to be offered to The City for salvage parts purpose for a period of one week. Following this one week period, equipment is to be removed from site following the appropriate disposal methods.

.2 Contractor to recycle materials where possible.

1.8 BLASTING/SUB-SURFACE MATERIAL REMOVAL

.1 Obtain City's approval for blasting. City, in granting approval, does not assume any responsibility for Contractor's methods or for injury, loss of life or damage resulting therefrom.

.2 Obtain insurance coverage for blasting operations prior to commencing such operations.

.3 Repair or pay for any damage resulting from blasting operations.

.4 A pre-construction survey of residences within an agreed upon vicinity of work will be conducted prior to any approved blasting or hoe-ramming, in order to document any potential damage resulting from construction activities.

.5 Perform proper sampling and testing of materials as require by regulatory authorities before disposal off-site at approved disposal Facility. Any access material disposal including dump site need the Engineer prior approval.

.6 No storing of excavated material allowed on site.

.7 Contractor to provide dust control at all times during construction (when necessary) of internal plant roads.

1.9 NOISE CONTROL

.1 Establish and maintain site procedures such that noise levels from construction areas are minimized.

.2 Use vehicles and equipment equipped with efficient muffling devices.

.3 Provide and use devices that will minimize noise level in construction area.

1.10 DUST CONTROL

.1 Prevent dust nuisance resulting from construction operations at all locations on site.

.2 Use water, brine or calcium chloride to control dust.

.3 Minimize use of calcium or brine, particularly in close proximity to watercourse.

.4 Transport dusty materials in covered haulage vehicles.

.5 Public roadways shall be kept clean and free of mud.

1.11 MUD CONTROL

.1 The Contractor is responsible for all dirt and mud that is tracked onto the site and public roadways from vehicles entering or leaving the job site. Immediately proceed with cleanup operation upon request from the Engineer at Contractor's expense. If after repeated requests, or if in the opinion of the Engineer, the Contractor has not or cannot sufficiently remove the mud from the road, the Engineer will proceed with necessary clean up with all costs being charged to the Contractor.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01580

PROJECT IDENTIFICATION AND SIGNS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 CONSTRUCTION SIGN

.1 Erect, within four (4) weeks of Contract award, one (1) 1200mm x 1200mm project sign, as per City Construction Standards, in the location designated by the Engineer. Signs are to be printed directly on 6 mm Alu panel complete with anti-graffiti coating. Signage digital template and content to be provided by the city.

.2 Sign will be supplied by the Contractor. Submit shop drawing for City review and approval. Shop drawings to included signage text/font/size and colour.

.3 Maintain signs in good condition for the duration of Work. Clean periodically.

.4 No other signs or advertisements, other than warning signs, are permitted on site.

.5 Upon completion of construction or within sixty (60) working days of being so notified by Engineer, remove the Construction Signs and restore site of sign to match surrounding area and to the satisfaction of Engineer.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01610

BASIC PRODUCT REQUIREMENTS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 QUALITY

.1 Products, materials, equipment and articles (referred to as Products throughout the specifications) incorporated in Work are to be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Products comprised of multiple components, as specified, are to be purchased as a single system from one supplier. Provision of sub-components, as identified on a manufacturers shop drawings, are to be supplied from the manufacturer. Requests to substitute subcomponents of a system must be made at the time of shop drawing submission. The decision to accept substitution rests strictly with the Engineer.

.3 For all products to be provided as part of this project that come into contact with water within the system have to meet all applicable standards set by both the American Water Works Association (AWWA) and the American National Standards Institute (ANSI) safety criteria standards NSF/60, NSF/61 and NSF/372.

.4 Defective Products, whenever identified prior to the completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.

.5 Should any dispute arise as to the quality or fitness of Products, the decision rests strictly with the Engineer.

.6 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.

.7 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.2 AVAILABILITY

.1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Products are foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In the event of failure to notify Engineer at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Engineer reserves the right to substitute more readily available products of similar character, at no increase in Contract Amount.

1.3 STORAGE, HANDLING AND PROTECTION

.1 Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged Products to the satisfaction of Engineer.

.9 Protect grout, mortar and other materials from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

1.4 TRANSPORTATION

.1 Pay costs of transportation of Products required in the performance of Work.

.2 Transportation cost of Products furnished by City will be paid for by the City. Unload, handle and store such Products.

1.5 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification Section. Submerged or wetted fasteners are to be stainless steel unless other material is specifically requested in the affected specification Section.

.4 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.6 QUANTITIES

.1 Schedules of piping, fittings, reinforcing, or other materials indicating quantity and/or dimension, which are shown on the drawings or in the specifications, are intended only to assist Contractor with quantity take-off. Quantities and dimensions shown therein are not guaranteed to be accurate and must be checked by Contractor prior to placing an order for such materials.

.2 Claims for additional payment resulting from variations between quantities shown on the schedules and those actually installed will not be accepted.

1.7 OWNERSHIP

.1 All materials provided by Contractor for execution of Work will vest in and become the property of City upon delivery to Site, but will remain in the custody and at the risk of Contractor until Final Completion.

1.8 CANADIAN MATERIALS

.1 Materials manufactured in Canada will have preference over those of foreign origin and are to be used in the work wherever they are competitive in quality and price.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01631

SUBSTITUTIONS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 This section covers equivalents and alternatives.

1.2 INTENT

.1 Comply with Subsection 23 - Equivalents and Alternatives of Section 5A – Specific Conditions of Contract.

.2 In the event of any inconsistency or conflict among the provisions of Section 5A, "Specific Conditions of Contract" and this Section, the provisions of Section 5A, "Specific Conditions of Contract" shall take precedence and govern.

.3 The Tender shall be based only on products, materials and equipment specified or listed in the Contract documents.

1.3 DEFINITIONS

.1 The following definitions are listed in Section 5A, Specific Conditions of Contract, Article 21.1:

.1 "First-Named Supplier" and "First-Named Product" mean, respectively, a Supplier and Product upon which the quality and design of the Work has been based, as specified in the Contract Documents.

.2 "Equivalent" means a Supplier or Product that is listed after the First-Named Supplier or First-Named Product in the Contract Documents.

.3 "Alternative" means a Supplier or Product proposed by the Contractor, or an alternate method of undertaking the Work proposed by the Contractor, that is not listed or specified in the Contract Documents.

1.4 FIRST NAMED AND EQUIVALENT EQUIPMENT AND MATERIAL

.1 The Total Lump Sum Price Bid offered in the Tender must be based on the first named or one of the other equivalent named products or suppliers listed in the Contract Documents.

.2 Where more than one trade or supplier's name is given, the design, as shown on the Drawings and as specified, has been based on the first name listed.

.3 The equivalent material and equipment supplied must be equal in quality, material and performance (including maximum and minimum criteria specified or implied) to the material/equipment first named in the specification.

.4 Any design, detailing, and/or construction changes necessitated by the use of equivalent trade or supplier's names given, are the sole responsibility of the Contractor and shall be at the expense of the Contractor. The Contractor shall be responsible for coordinating these additional requirements assuring the proper fit and matching of all equivalent equipment and materials.

1.5 REQUESTS FOR ALTERNATIVES

.1 No ruling on a proposed alternative will be made prior to acceptance of a tender. No alternative shall be made without the prior approval of the Engineer. No tender price shall be based on a presumed acceptance by the City of an alternative.

.2 After the acceptance of a tender, the Contractor may apply to the Engineer to review a non-named product or equipment or supplier for approval, as an alternative for the specified product or supplier. All requests for alternatives must be accompanied by a detailed listing of the expected cost saving to the City.

.1 The cost for the Engineer’s review of the proposed alternative will be paid for by the Contractor regardless of whether the proposed alternative is accepted or rejected. The cost for the Engineer’s review is to be agreed upon prior to commencing the Engineer’s review.

.3 Alternatives shall not be considered when they are indicated or implied on Shop Drawings or product data submittals without a separate written request.

.4 Requests for alternatives shall include any request for changes from the Contractor that require significant design changes, redesign or significant design reviews.

.5 A request for alternatives constitutes a representation that the Contractor:

.1 Has investigated the proposed product or supplier and determined that it meets or exceeds the quality level of the specified product or supplier.

.2 Shall provide the same warranty for the alternative as for the specified product or supplier.

.3 Shall coordinate the installation and make changes to other Work which may be required for the Work to be complete at the Contractor’s expense and at no additional cost to the City.

.4 Waives claims for additional costs or time extension which may subsequently become apparent.

.5 Shall reimburse the City for review or redesign services.

.6 Request for alternatives shall be made by written application to the Engineer and shall include sufficient data to enable the Engineer to assess the acceptability of requirements, including the following:

.1 All submittal information required for the specified equipment, including all deviations from the specified requirements and/or necessitated by the requested substitution.

.2 Materials of construction, including material specifications and references.

.3 Dimensional drawings, showing required access and clearances, including any changes to the work required to accommodate the proposed substitution.

.4 Drawings and details showing changes if the offered alternative necessitates changes to or coordination with other portions of the Work. Perform these changes as part of the alternative material or equipment at no additional cost.

.5 Certification that the proposed alternative will adequately perform the function and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified with the same or better warranty.

.6 Information and performance characteristics for all system components and ancillary devices to be furnished as part of the proposed alternative.

.7 Illustration of the impact that acceptance of the proposed alternative has on achievement of Substantial Completion.

.8 Itemization of all costs including any licenses fee or royalty that shall result directly or indirectly from the acceptance of the proposed alternative. Include redesign and cost of claims of any other contract affected by the resulting change.

.9 Credit or cost increase offered if the proposed alternative is accepted and a waiver of claims for additional expenses which may subsequently become apparent.

.10 Recommended maintenance requirements and availability of spare parts and service.

.11 Written confirmation from Subcontractors and Suppliers on cost, schedule, and technical requirements if requested by the Engineer.

.7 In all cases, the proposed alternative must be justified by the Contractor in its written application to the Engineer indicating reasons why it wishes to substitute and be accompanied by sufficient descriptive and technical information for the Engineer to thoroughly compare articles or group of articles with that specified. Failure to comply with this requirement to the Engineer’s satisfaction may result in rejection of the request due to insufficient information or time to evaluate same.

.8 Allow sufficient time for evaluation of alternatives.

.9 Failure to comply with the requirements under this Section to the City's and Engineer’s satisfaction will result in rejection of the request due to insufficient information.

.10 All applications and submissions related to alternatives shall only be made by the Contractor and not by any Subcontractors or Suppliers.

.11 The acceptance or rejection of the proposed alternative is at the discretion of the City, and the City’s decision is final.

.12 Contractor assumes liabilities and additional costs that may subsequently arise as a result of the accepted alternative.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01640

WMS ENTITY INFORMATION

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PART 1 GENERAL

1.1 SCOPE

.1 This Section contains requirements for the collection and submission of equipment, or Entity, information in the form of a single Entity Information Worksheet (EIW) that captures information for all equipment under this Contract pertinent to the operation and maintenance of plant equipment and is integral to the City's ability to develop maintenance schedules and manage assets.

.2 Collect information and provide in the specified format, for all equipment listed in the attached Contract EIW. The specified format is designed to integrate with the City's Work Management System (WMS) database that collects, stores and manages data for asset management purposes.

.3 The EIW information provided will be utilized by the City to:

.1 Facilitate the on-going asset identification and inventory, asset valuation and procurement, and maintenance and lifecycle analysis of equipment provided under this Contract.

.2 Assist with maintenance of equipment provided under this Contract to ensure warranty requirements are satisfied.

1.2 DEFINITIONS

.1 Entity: means a piece of tagged equipment provided under this Contract, and intended to be managed throughout its life cycle.

.2 Entity Information Worksheet (EIW): means a spreadsheet database that captures information pertinent to the operation and maintenance of equipment provided under this Contract, and used by the City to develop maintenance schedules and manage assets.

.3 Contract EIW means the EIW developed as part of the design for this Project, supplied as part of the Tender, and to be completed by the Contractor as part of this Contract.

.4 Sample Completed EIW: means an EIW completed under another similar project and presented as a representative sample of the content required in the final Contract EIW.

.5 Work Management System (WMS): means a computerized maintenance management system (CMMS) software package used for work planning and scheduling.

.6 WMS Entity Information Workflow: means a flowchart illustrating the sequence of activities and operations required to develop a complete Entity Information Worksheet from its conception, and the roles played by various parties in completing this sequence for any capital project.

.7 Original Equipment Manufacturer (OEM): means a firm that manufactures components or parts included in the finished product made by another firm.

.8 PCS or Process Control System: means a system for real-time monitoring and control of water and wastewater treatment plants, and water supply, and sewage pumping stations by comparing the monitored data to established set points and taking corrective action(s).

.9 OMU or Operational Maintenance Unit: is an arm of Toronto Water responsible for the standardization of work management and maintenance practices. This group consists of a Reliability Engineering Group and Maintenance Planners and Schedulers.

.10 ASPOM: means Area Supervisor Plant Operations and Maintenance.

1.3 RELATED SECTIONS

.1 General Conditions and Divisions 1 to 16 apply to the Work of this Section

.2 Section 13040 – Equipment and Data Tagging

1.4 APPENDICES

.1 The Contract EIW is appended to this Specification Section.

.1 "Contract **25ECS-MI-03HA** Entity Information WorkSheet.xls".

.2 A Sample Completed EIW is appended to this Specification Section.

.1 "13040_Tagging_CCS_WMS_Entity_Information_Spread_Sheet_With_Samples - V2.xls".

1.5 QUALITY ASSURANCE

.1 The Contract EIW shall have all applicable fields (columns) accurately completed for each record (row) of identified equipment, including spare parts, in accordance with clause 3.12 of Section 13040 – Equipment and Data Tagging.

.2 Summarize recommended maintenance requirements from Original Equipment Manufacturer (OEM) manuals, or other written documentation from the manufacturer or service representative. Cover all tasks required to meet warranty conditions, and to optimize equipment performance and lifespan.

1.6 RESPONSIBILITIES

.1 The development of the EIW requires input from several stakeholders, including:

.1 Contractor and Subcontractors;

.2 Engineer and Subconsultants;

.3 OMU Reliability Engineering Group;

.4 ASPOM; and

.5 PCS Group.

.2 The responsibilities for filling in each column of data in the EIW are described in red text in Row 8 of all Tabs of the Contract EIW file provided with this Specification Section, i.e., article 1.4.1.1. In general, the Engineer is responsible for completing all columns in the "General Info" Tab, and the Contractor is responsible for completing all columns in all other Tabs. This is to be used as a guideline for populating the Contract EIW, however, it is ultimately the Contractor's responsibility to develop and maintain an up to date Contract EIW during the course of the Project.

.3 The responsibilities for the review and approval of the collected data as well as the sequencing of review periods are outlined in the Entity Information Workflow chart attached to this Specification Section.

1.7 SUBMITTALS

.1 Submittals shall be in accordance with the project management information system as specified in Section 01330 and Section 01780.

.2 Where the Project requires a single testing and start-up activity, a single submittal of the completed Contract EIW is required.

.1 Submit the EIW within 10 Working Days of a returned shop drawing approval with the applicable data for the equipment included in the approved shop drawings.

.2 The EIW is then to be reviewed and commented on and/or approved within the following 10 Working Days as part of the QA/QC procedure by the Engineer. Complete any subsequent edits requested by the Engineer within 5 Working Days of the request and re-submit to Engineer.

.3 Submit draft final EIW, approved by the Engineer, no later than 20 Working Days prior to commencement of first Dry Run Test. Dry Run Tests will not be permitted to commence until the draft final EIW is accepted by the Engineer.

.4 Within 15 Working Days following acceptance of commissioning of any equipment or system, the EIW data previously entered at the shop drawing stage is to be re-examined by the Contractor for accuracy and updates, including edits requested by the Engineer, and re-submitted to the Engineer.

.5 Within 10 Working Days of the Contractor's post-commissioning review of the EIW data, the Engineer is to perform a QA/QC check and comment and/or approve as necessary.

1.8 MEASUREMENT FOR PAYMENT

.1 Provide a separate line item in the payment breakdown for Contract EIW submittals.

.2 Payment for this item will be released based on the percentage of work complete and the lump sum amount assigned to this line item.

.3 No payment for any work will be made over 90% of the Contract value on this payment item until all documentation for Operations and Maintenance manuals, and WMS documentation are received and accepted as satisfactory by the Engineer.

PART 2 PRODUCTS

2.1 FORMAT AND CONTENT

.1 Provide all information for all Entities requested according to the format in the Contract EIW supplied at the time of Tender. A Sample Completed EIW is appended to this Section for reference purposes and to demonstrate the level of detail expected in the submission.

.2 Provide the Contract EIW in Microsoft Excel 2003-2007 format.

.3 Provide the following information, where applicable, for each Entity identified in the Contract EIW. Conform to the requirements of Section 13040 – Equipment and Data Tagging. In the case of conflict or discrepancy, the requirements of this Section shall govern. Refer to each Entity by its name and tag number.

.1 Complete "Procurement Information" columns for all Entities provided.

a. OEM Name: provided by Contractor

b. OEM Address: provided by Contractor

c. OEM Phone Number: provided by Contractor

d. Supplier Name: provided by Contractor

e. Supplier Address: provided by Contractor

f. Supplier Phone Number: provided by Contractor

g. Purchase Order/Contract #: provided by Contractor. This is the Purchase Order, Contract Number, or other identifier issued to the Supplier.

h. Original Cost_1: provided by Contractor

i. Purchase Date: provided by Contractor

j. Model Number / Style: provided by Contractor

k. Serial Number: provided by Contractor

l. Catalog Number: provided by Contractor

m. Original Equipment Number: provided by Contractor

n. Manufacture Date: provided by Contractor

o. Additional Information: provided by Contractor

.2 Complete "Motor Add-on" columns for all Entities representing or consisting of electric motor assemblies (e.g., pump-motor set).

a. Motor Function: provided by Contractor

b. Serial Number: provided by Contractor

c. Watts 1 (kW, W): provided by Contractor

d. Watts 2 (kW, W): provided by Contractor

e. Horse Power: provided by Contractor

f. RPM: provided by Contractor

g. AC or DC: provided by Contractor

h. Number of Phases: provided by Contractor

i. Cycles (Hz): provided by Contractor

j. Frame Size: provided by Contractor

k. Frame Type (TEFC, DE, ODP): provided by Contractor

l. Amperage (A, mA): provided by Contractor

m. Voltage: provided by Contractor

n. Voltage Abbreviation: provided by Contractor

o. Inboard Bearing Part #: provided by Contractor

p. Outboard Bearing Part #: provided by Contractor

q. Winding Configuration (Y, Delta): provided by Contractor

r. Type (Ind, Sychr, Series, Shunt): provided by Contractor

s. Mount (Horizontal, Vertical): provided by Contractor

t. Shaft (Single or Double Output): provided by Contractor

u. Weight_1: provided by Contractor

v. Additional Nameplate Info – Provided by Contractor

.3 Complete "Valve Add-on" columns for all Entities representing valves or consisting of valves (e.g., valves, strainers, etc.).

a. Process Application: provided by Contractor

b. Valve Type: provided by Contractor

c. Connection Type: provided by Contractor

d. Valve Size: provided by Contractor

e. Body Type: provided by Contractor

f. Pressure Rating: provided by Contractor

g. Seat Material: provided by Contractor

h. Packing Material/Size: provided by Contractor

i. Interior Coated: provided by Contractor

j. Number of Rotations: provided by Contractor

k. Operator Manufacture: provided by Contractor

l. Operator Type: provided by Contractor

m. Operator Model Number: provided by Contractor

n. Operator Size: provided by Contractor

o. Operating Torque: provided by Contractor

p. Clockwise to Open: provided by Contractor

q. Additional Operator Info: provided by Contractor

r. Actuator Name Plate Info: provided by Contractor

s. Additional Valve Info. provided by Contractor

.4 Complete "Pump Add-on" columns for all Entities representing or consisting of pump assemblies (e.g., pump-motor set).

a. Flow Rate (L/sec, USgpm, IMgpm, etc.): provided by Contractor

b. Head (M, FT) _1: provided by Contractor

c. RPM: provided by Contractor

d. Suction Diameter_1 (in, mm): provided by Contractor

e. Discharge Diameter_1 (in, mm): provided by Contractor

f. Seal Type (Mech, Packing): provided by Contractor

g. Number of Stages: provided by Contractor

h. Lubrication (oil, grease): provided by Contractor

i. Impeller Diameter_1 (in, mm): provided by Contractor

j. Impeller Sleeve Diameter_1: provided by Contractor

k. Number of Impeller Vanes: provided by Contractor

l. Impeller Material: provided by Contractor

m. Rotation (CW, CCW): provided by Contractor

n. Inboard Bearing Part # / Type: provided by Contractor

o. Outboard Bearing Part # / Type: provided by Contractor

p. Thrust Bearing Part # / Type: provided by Contractor

q. Additional Nameplate Info": provided by Contractor

r. Drive (Direct, Belt or Gear Box): provided by Contractor

s. Coupling Type and Size: provided by Contractor

t. Belt Type and Size: provided by Contractor

.5 Complete "Heater Add-on" columns for all Entities representing or consisting of heaters.

a. KW Rating: provided by Contractor

b. Voltage Primary: provided by Contractor

c. Voltage Primary Abbreviation: provided by Contractor

d. Number of Phases: provided by Contractor

e. Control Voltage: provided by Contractor

f. Control Voltage Abbreviation: provided by Contractor

g. Style/Type: provided by Contractor

h. Current: provided by Contractor

i. Additional Information: provided by Contractor

.6 Complete "Instrument Add-on" columns for all Entities representing or consisting of instrumentation (e.g., transmitters, analyzers, gauges, etc.).

a. Supply: provided by Contractor

b. Display: provided by Contractor

c. Input: provided by Contractor

d. Output: provided by Contractor

e. Range: provided by Contractor

f. Calibration Range: provided by Contractor

g. Activation Parameter: provided by Contractor

h. Pressure Rating: provided by Contractor

.7 Complete “HVAC Add-on” columns for all entities representing or consisting of HVAC equipment.

a. Type (Draw-Thru or Blow-Thru): provided by Contractor

b. CFM Rating: provided by Contractor

c. Static Pressure Rating: provided by Contractor

d. Drive (Direct, Belt or Gear Box): provided by Contractor

e. Pulley Dimensions - Motor: provided by Contractor

f. Pulley Dimensions - Fan: provided by Contractor

g. Belt Size and Quantity: provided by Contractor

h. Inboard Fan Bearing #: provided by Contractor

i. Outboard Fan Bearing #: provided by Contractor

j. Coupling Type and Size: provided by Contractor

k. Cooling Coil Description: provided by Contractor

l. Filter Type Description: provided by Contractor

m. Filter Dimensions and #: provided by Contractor

n. Evaporator Style: provided by Contractor

o. Evaporator Dimensions: provided by Contractor

p. Humidification Info. provided by Contractor

q. Compressor Name Plate Info. provided by Contractor

r. Damper Info. provided by Contractor

s. Additional Information: provided by Contractor

.8 Complete "Breaker Add-on" columns for all Entities representing or consisting of electrical breakers (e.g., control panels with breakers, starters, etc.).

a. Type: provided by Contractor

b. Insulation Medium: provided by Contractor

c. Load Voltage: provided by Contractor

d. Frame Size Amp. provided by Contractor

e. Modular Trip Unit?: provided by Contractor

f. Trip Unit Type: provided by Contractor

g. Trip Unit Sensor Rating I_n: provided by Contractor

h. Trip Unit OEM Name: provided by Contractor

i. Trip Unit Model: provided by Contractor

j. Separate CT/PT?: provided by Contractor

k. Separate Protection Relay?: provided by Contractor

.9 Complete “Transformer Add-on” columns for all entities representing or consisting of electrical transformers.

a. Primary Voltage (Centre Tap): provided by Contractor

b. Secondary Voltage: provided by Contractor

c. kVA Rating (@max cooling): provided by Contractor

d. % Impedance: provided by Contractor

e. Cooling Type: provided by Contractor

f. Winding Configuration: provided by Contractor

g. Core Construction: provided by Contractor

h. Oil Filled/Dry Type: provided by Contractor

i. Oil Type: provided by Contractor

j. Sudden Pressure relay OEM and Model: provided by Contractor

k. Cable Terminal Type: provided by Contractor

l. NGR Resistance: provided by Contractor

m. NGR Ratings: provided by Contractor

n. Online Gas Monitor Installed: provided by Contractor

.10 Complete “Starter Add-on” columns for all entities representing or consisting of Electrical Motor Starters or Variable Frequency Drives (VFD).

a. Load Voltage: provided by Contractor

b. Load F.L.A.: provided by Contractor

c. Number of Phases: provided by Contractor

d. Starter - Configuration: provided by Contractor

e. Starter - Starting method: provided by Contractor

f. All Overload Element(s) Type(s): provided by Contractor

g. Respective Overload Element(s) Location(s): provided by Contractor

h. Starter Contactor - OEM and Model #: provided by Contractor

i. Starter Contactor - Max Amps.: provided by Contractor

j. Starter Contactor - Coil Voltage: provided by Contractor

k. Contact Insulation Medium (for MV) : provided by Contractor

l. Starter Control Transformer VA: provided by Contractor

m. Starter Control Fuse - OEM and Catalog No.: provided by Contractor

n. Main Fuse - OEM and Catalog No.: provided by Contractor

o. µ-Processor Relay - OEM and Model No.: provided by Contractor

p. Soft starter - OEM and Model No.: provided by Contractor

q. VFD controller - OEM and Model No.: provided by Contractor

.11 Complete "Recommended Maintenance Based on Manufacturer's Recommendations" columns for all Entities, including the following.

a. "Individual work task title" – provide a task name for the specific maintenance task to be completed (e.g., "Exercise Valve", Replace Gearbox Oil", "Manual Calibration", etc.).

b. "Task Description" – provide detailed task description including:

(a) Instructions;

(b) Materials required;

(c) Tools required; and

(d) Safety considerations (e.g., lockout/tagout considerations, PPE requirements).

c. "Trade Requirements" – provide description of trade requirements for each task – including number of tradespersons required (e.g., "2 millwrights").

d. "Estimated Trade Time Requirement" – provide estimate of work time required to complete the maintenance task (e.g., "15 minutes", "2 hours", etc.).

e. "Task Frequency" – provide frequency of task to maintain equipment (e.g., "annually", "weekly", "every 6 months", etc.).

.12 All required Entity cost data shall include the following as individual cost items:

a. Supply cost (i.e., equipment procurement costs) for specialty/custom (higher value) procured equipment (i.e., larger pumps, blowers, tanks, specialty valves, instruments, motors, full skids, UPS). Costs are not required for standard/generic equipment (smaller valves, gauges, off-the-shelf components.

PART 3 EXECUTION

3.1 WMS ENTITY INFORMATION WORKSHEET WORKSHOP[S]

.1 Attend a WMS EIW Workshop within 15 Working Days of initial set of shop drawing acceptance by Engineer. Engineer will coordinate and chair Entity Information Workshop.

.2 Where the project requires phased testing and start-up activities, meet with Engineer to conduct WMS Entity Information Workshop for equipment items and systems corresponding to the current phase. Where the Project requires a single testing and start-up activity a single WMS Entity Information Workshop will be required.

.3 The intent of workshop[s] is to ensure all parties involved in the development and review of the EIW have a full understanding of the scope and proper content of data entries, and have an opportunity to discuss:

.1 roles and responsibilities;

.2 schedule and staging; and

.3 methods of maintaining and updating the Contract EIW as the project progresses (e.g., document management system).

.4 The intent of holding the workshop after the initial set of shop drawings is accepted is to allow the meeting attendees to utilize the accepted Contract shop drawings as examples when reviewing the requirements for populating the Contract EIW.

.5 Workshop will be held in the ECS Field Office. The Consultant will preside at the workshop, record minutes and distribute the minutes to participants within 5 Working Days of the workshop. The Contractor is responsible for distributing minutes to all Subcontractors and other parties affected by decisions made at the workshop.

.6 Workshop attendance required:

.1 Contractor's Site Superintendent.

.2 Contractor's Project Manager.

.3 Contractor's Start-up Manager.

.4 Engineer's representatives.

.5 City's Engineering, OMU and Operations representatives.

.7 Workshop Agenda to include the following.

.1 Review the Contract EIW and Sample Completed EIW provided at the time of Tender for scope of data to be completed by Contractor.

.2 Review initial (draft) of Contract EIW completed by Contractor after initial set of shop drawings.

.3 Review process for further draft submissions, updates and review periods, and final submission.

a. Draft submission is in reference to the initial Contract EIW populated by the Contractor, after acceptance of the initial set of shop drawings.

b. Confirm the frequency and duration of review and approval periods and phasing of submissions of the EIW and the manner of which the reviews will be completed (i.e., regular review of EIW updates against approved shop drawings as part of a QA/QC process).

c. Remind participants of the requirements for Substantial Performance and submission of the final Contract EIW.

.4 A flowchart of the general process is attached at the end of this Section.

.5 The Contractor is not expected to invite vendors to this session but will disseminate information to vendors and Subcontractors following this workshop.

3.2 PROGRESS MEETINGS

.1 Conform to the requirements of Section 01312 - Project Meetings.

.2 Meeting(s) will be held in the Engineer Office or the Plant Training room as available. Engineer will preside at the meetings, record minutes and distribute the minutes to participants within 5 Working Days of each meeting. The Contractor is responsible for distributing minutes to all Subcontractors and other parties affected by decisions made.

.3 Review progress of populating the Contract EIW periodically at regular Progress Meetings, or as required by progress of the Work. Include an agenda item at each regular progress meeting to review the current status of the Contract EIW. Review to include:

.1 Confirmation that any equipment shop drawings submitted since the last progress meeting have had their Entity information included in the Contract EIW.

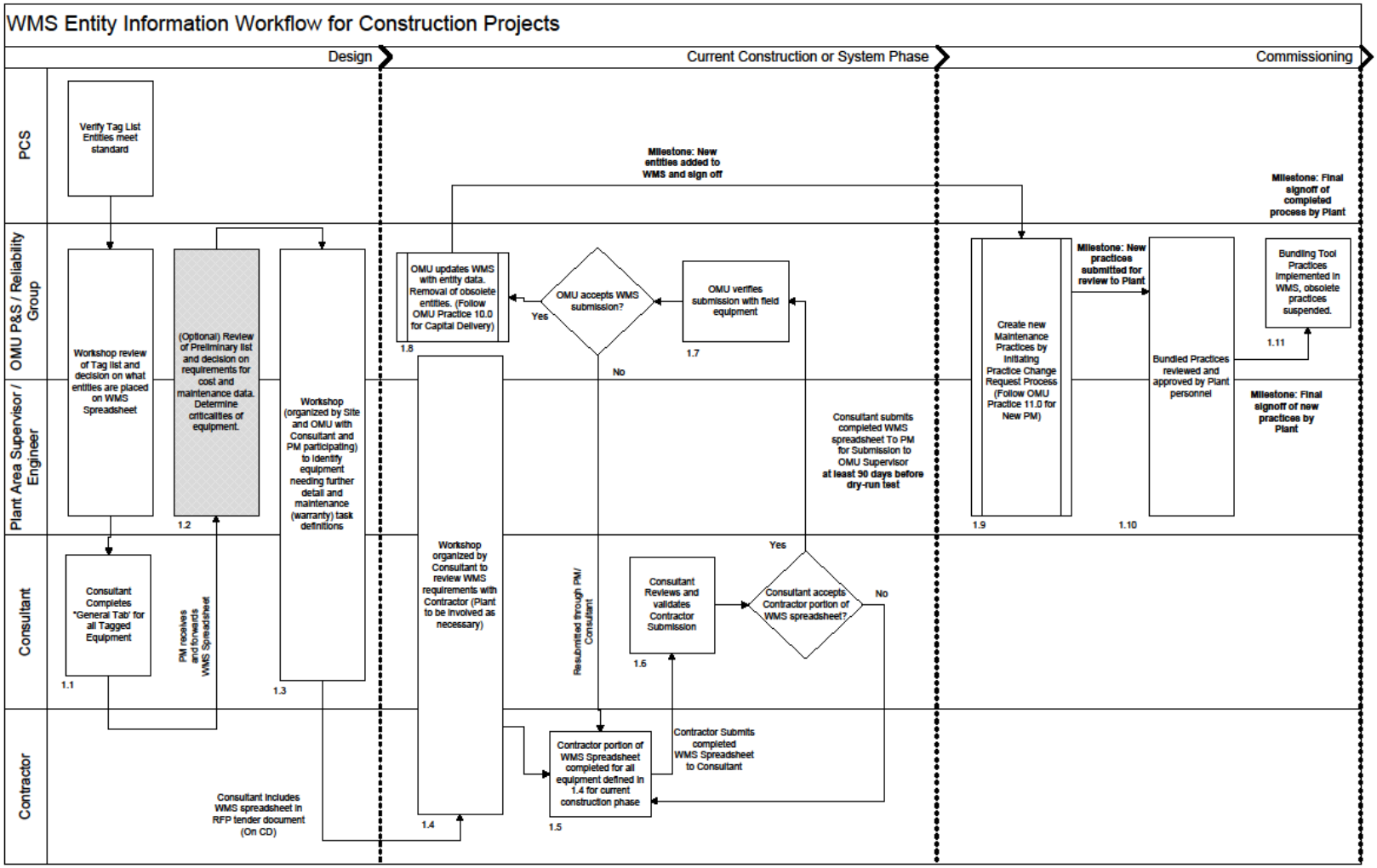
.2 Confirmation that QA/QC procedures and acceptance by the applicable QA/QC authority has been completed since the last progress meeting (see flow chart attached to this Section for further details on QA/QC procedures).

.3 A look ahead at upcoming works and submittals that will be included in the EIW within the period before the next review meeting.

.4 Maintain coordination of efforts, review progress of data entry, discuss requests for edits, and resolve problems that may develop.

3.3 ATTACHMENTS

.1 WMS Entity Information Workflow.



END OF SECTION

TORONTO

SECTION 01701

MOBILIZATION

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PART 1 GENERAL

1.1 DESCRIPTION

.1 Mobilization and demobilization are to be in accordance with specifications below and Specific Conditions 5. Mobilization and Demobilization are to be applied on a prorated contract value basis up to a maximum total value of 2.5% of the contract value.

1.2 MOBILIZATION

.1 Mobilization consists of preparatory work and operations including, but not limited to, those necessary to the movement of personnel, equipment, supplies and incidentals to Site; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on Site.

1.3 DEMOBILIZATION

.1 Demobilization consists of cleanup work and operations including, but not limited to, those necessary to the removal of personnel, equipment, and incidentals from Site.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01705

HEALTH AND SAFETY

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PART 1 GENERAL

1.1 REFERENCES

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.

.2 Province of Ontario: Occupational Health and Safety Act and Regulations.

.3 Specific Conditions 5A.

1.2 DOCUMENTATION

.1 Make documentation available for review by the Engineer. Documents are to be in a clearly visible location inside the Contractors site trailer and work area as required.

.1 A daily sign-in/out log for all persons who will be entering the construction areas within the Plant.

.2 A Health and Safety Plan is to be made available during the entire contract period. The plan is to include at minimum:

a. Results of site-specific safety hazard assessment including confined space.

b. Results of safety and health risk or hazard analysis for site tasks and operation.

.3 Construction Safety Checklists after completion.

.4 Reports or directives issued by Federal and/or Provincial health and safety inspector(s).

.5 Copies of incident and accident reports.

.6 On-site Contingency and Emergency Response Plan: Address standard operating procedures are to be implemented during emergency situations.

.7 Material Safety Data Sheets (MSDS), Safety Data Sheets (SDS), or Product Safety Data Sheets (PSDS)

.8 Personnel training requirements including names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.

.9 Emergency numbers for police, fire and ambulance for the locale of the Work, as well as the names and after-hours numbers for key site personnel related to health, safety or security of the site.

1.3 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

.2 Submit hazard assessment report to Engineer.

1.4 MEETINGS

.1 Attend health and safety pre-construction meeting.

.2 Arrange for Tool-Box safety meetings with Contractor's staff and Subcontractors on a minimum weekly basis and submit reports to the Engineer.

1.5 REGULATORY REQUIREMENTS

.1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

1.6 GENERAL REQUIREMENTS

.1 The Contractor is to assume that they are the Constructor in their work area. Should the situation change during the term of the Contract and the City is required to be the Constructor, the Contractor will be notified of the change.

.2 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications. Health and Safety Plan should be prepared in accordance with Specific Conditions of Contract.

.3 Correct deficiencies and re-submit Health and Safety Plan when so requested by Engineer.

.4 Submit all MSDS, SDS, or PSDS to Engineer and Plant of all chemicals brought onsite prior to use.

1.7 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, municipal, territorial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 COMPLIANCE REQUIREMENTS

.1 Comply with Occupational Health and Safety Act, General Safety Regulation, Ontario.

1.9 UNFORSEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, immediately stop work and follow procedures in place for employee's right to refuse work in accordance with the applicable Acts and Regulations of Ontario. Advise Engineer verbally and in writing.

1.10 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by Engineer or designated safety inspector.

.2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Be aware that Engineer may stop Work if non-compliance of health and safety regulations are not corrected.

1.11 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

.2 Stop Work when necessary or advisable for reasons of health and safety.

.3 Be aware that Engineer or designated safety inspector may stop Work when deemed necessary or advisable for reasons of health and safety.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01730

EXECUTION

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PART 1 GENERAL

1.1 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting and patching means acceptance of existing conditions.

.4 Provide temporary structural supports to ensure structural integrity of surroundings.

.5 Provide devices and methods to protect other portions of project from damage.

.6 Provide protection from elements for areas which may be exposed by uncovering work.

.7 Coordinate and complete the necessary dewatering, cleaning and disposal activities within (inside) the designed construction area prior to commencing work. In addition, coordinate and complete the necessary dewatering, cleaning and disposal activities outside of existing construction area prior to commencing with work.

.8 Maintain excavations free of water.

1.2 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify Engineer, in writing, of conflicts between the specifications and manufacturer's instructions, so that Engineer may establish proper course of action.

.3 Improper installation or erection of Products, due to failure to comply with requirements, authorizes Engineer to require removal and re-installation at no additional cost to the City.

1.3 WORKMANSHIP

.1 General:

.1 Work is to be executed by experienced and skilled workers in the respective duties for which they are employed. Notify Engineer immediately if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in his or her required duties. Engineer reserves the right to require the dismissal from the site, of workers deemed incompetent, careless, insubordinate or otherwise objectionable.

.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with Engineer, whose decision is final.

.2 Co-Ordination:

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for co-ordination and placement of openings, sleeves and accessories.

.3 Protection of Work in Progress:

.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure to provide such protection is to be removed and replaced, or repaired, as directed by Engineer, at no additional cost to the City.

.2 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Engineer.

.4 Remedial Work:

.1 Refer to General Conditions.

.2 Perform remedial work required to repair or replace the parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.3 Perform remedial work by specialists familiar with the materials affected and perform in a manner to neither damage nor endanger any portion of Work.

.5 Location of Fixtures:

.1 Consider the location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Engineer of a conflicting installation. Install as directed.

.6 Concealment:

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Engineer if there is a contradictory situation. Install as directed by Engineer.

1.4 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times as directed by local governing authorities or Engineer, with a minimum of disturbance to pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authority having jurisdiction and stake and record location of capped service.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01741

FINAL CLEANING

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PART 1 GENERAL

1.1 FINAL CLEANING

.1 In preparation for partial or final acceptance of the project, perform final cleaning.

.2 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.3 Remove waste products and debris other than that caused by City or other Contractors.

.4 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.5 Clean roofs, downspouts, and drainage systems.

.6 Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from interior and exterior finished surfaces including piping, glass and other polished surfaces.

.7 Clean lighting reflectors, lenses, and other lighting surfaces.

.8 Vacuum clean and dust building interiors, behind grilles, louvers and screens.

.9 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.10 Broom clean paved surfaces; rake clean other surfaces of grounds.

.11 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.12 Remove snow and ice from access to building.

.13 Inspect valve boxes, manholes and hydrants to check for debris and proper operation.

.14 Operate valves, including those existing prior to construction, to ensure that no damage has occurred or debris accumulated due to cleanup activities.

.15 Where access hatches, handles, and floor boxes are exposed on the floor of interior areas, use a removable putty-style rubber sealing compound per City standards to fill any gaps and spaces which will otherwise collect dirt or are prone to damage. Fill is to be flush with top of floor.

1.2 MATERIALS

.1 Use only cleaning materials recommended by manufacturer of surface are to be cleaned, and as recommended by cleaning material manufacturer. Material to be NSF-61 certified.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01742

CLEANING AND PRESSURE TESTING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section refers to the pressure testing of all water retaining piping (new and existing) where work is carried out under this contract.

.2 Clean and test for leakage all new water and chemical retaining or carrying pipes, conduits, tankage, and equipment. Disinfect any equipment in contact with potable water.

.3 Conduct all testing as specified herein or elsewhere in these specifications or as directed by the Engineer.

.4 Furnish the suitable temporary service connections, testing plugs or caps, pressure pumps, pipe connections, gauges, thrust supports, and all other required equipment and labour necessary for filling the structure, expelling air, and dewatering the structure or pipe.

.5 Coordinate with Engineer and plant staff during testing and disinfection.

.6 Waste water resulting from cleaning, disinfection, hydrostatic and pressure testing must meet the City's storm sewer discharge limits including less than 15mg/L TSS and less than 0.01 mg/L of chlorine before discharge into storm sewer, watercourse, municipal or private sewer connection to any storm sewer.

.7 Refer to the following REFERENCES

.1 AWWA C651, Disinfecting Watermains.

.2 AWWA C652, Disinfection of Water Storage Facilities.

.3 AWWA B300, Standard for Hypochlorites.

.4 ACI 350.1-10, American Concrete Institute – Specification for Tightness Testing ofEnvironmental Engineering Concrete Containment Structures

1.2 SUBMITTALS

.1 Conform to the requirements of Section 01330 – Submittals.

.2 Submit the following two weeks prior to commencing work:

.1 Pressure testing procedure and pre-filled Pressure Test form for each component is to be tested as per Section 01751. Disinfection procedure that will be followed, along with product data sheets of type of hypochlorite is to be used and dechlorination chemical agent that will be used. All chemical products must bear MSDS Labels

.3 Submit final signed-off Pressure test forms.

PART 2 PRODUCTS

2.1 WATER

.1 All water used for the initial Pressure testing will be supplied by the Owner at no cost to the Contractor. However, all water required for retesting, following failure of their initial test, will be supplied by the City at the Contractor's expense (rate will be based on current residential rates).

.2 The Contractor is responsible for the supply and installation of all temporary pipework, pumps and other equipment required to transport the water from the City's point of supply at the existing structure or piping is to be tested.

.3 Provide the City and Engineer with at least seventy-two (72) hours of notice of a requirement for water for testing.

.4 All water used for pressure testing is to be of potable quality as defined by the latest edition of the Guidelines for Canadian Drinking Water Quality.

PART 3 EXECUTION

3.1 GENERAL

.1 Clean and disinfect all new or existing dewatered water retaining structures in accordance with AWWA C652 and City of Toronto ECS Division TS7.30 Procedure for Disinfecting Watermains.

.2 Clean and disinfect all associated process piping and plumbing in accordance with AWWA C651.

.3 Obtain Engineer’s approval before commencing cleaning and disinfection.

.4 Coordinate connections to water supply and flushing of spent chlorinated water to drain with Owner personnel. Neutralize chlorine residual as required prior to discharge.

3.2 CLEANING

.1 Prior to pressure testing, thoroughly clean all water and chemical retaining pipework and equipment. Remove all dirt and loose material.

.2 Cleaning includes all necessary provisions to thoroughly wash down interior surfaces, and to remove all wash down water and solids from the pipe.

.3 Leave all systems operating with work areas clean to the satisfaction of the Engineer.

3.3 DISPOSAL OF TESTING WATER

.1 Dispose of used water into the surface drainage system at a rate that will not cause hydraulic overloading. The Contractor is responsible for the necessary chemical to dechlorinate and equipment required to pump the test water to the drain or into existing sewage collection system.

.2 Remove all scaffolding, planks, tools, and other material not part of the cleaning process, the structure or operating facilities of the tank.

.3 Thoroughly clean all surfaces of the walls, roof, floor and columns with a high pressure water jet to expose a clean white concrete finish.

.4 Use approved cleaning equipment consisting of high-pressure piston pump(s) having a minimum discharge pressure of 3000 psi (20.7 MPa).

.5 All cleaning personnel to wear protective clothing, eye shields and hard hats in accordance with WCB regulations, Industrial Health and Safety Regulations, Section 14.

.6 Spent water, dirt and other foreign material resulting from the cleaning process to be disposed of by Contractor.

3.4 CHLORINE RESIDUAL TESTING EQUIPMENT

.1 Approved chlorine residual testing equipment is Amperometric Titrator from Wallace and Tiernan or Fischer and Porter.

.2 Reduce free chlorine levels in disinfection water following appropriate retention period and prior to any discharge to sewer or the environment.

.3 Water discharged to the storm sewer must have less than 15 NTU and less than 0.05 mg/L of free chlorine. Discharge dechlorinated disinfection water at controlled rate into sanitary sewer or storm sewer.

.4 Use any one of the following neutralizing agents to accelerate chlorine reduction:

.1 Sulphur dioxide

.2 Sodium sulphate

.3 Sodium bisulphate

.4 Sodium thiosulphate

.5 Refill tank, as coordinated with Engineer and City, after disposing of all disinfection water with potable water from the City's Water Supply System.

.6 Collect two water samples from spent disinfection water where it discharges into sanitary sewer, storm sewer, ditch, creek or river.

.7 Analyze samples from item 6 for free chlorine residual and record levels.

.8 Bacteriologically test water as described before placing tank into service.

3.5 INSTRUMENTATION PROTECTION

.1 Remove and isolate all instruments that have a maximum range of less than the test pressure during the pressure test. On successful completion of the system test, lower the pressure and re-pressure if required to a pressure within the range of the instruments. Test the isolated or removed instruments in accordance with other sections of these specifications.

3.6 PRESSURE TESTING

.1 Test all new or modified pressure pipes.

.2 Conduct pressure test at 150% of the maximum allowable operating pressure for an uninterrupted period of four (4) hours.

.3 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least five (5) days after placing concrete or two (2) days if high early strength concrete is used.

.4 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.

.5 Thoroughly examine exposed parts while under pressure and correct for leakage as necessary. Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.

.6 Leakage during the test period is not allowed. Repeat pressure test until all defects have been corrected and no loss of water is observed.

3.7 DEFECTS AND REPAIRS

.1 Repair and retest any defects disclosed in the work or replace the work without additional cost to the Owner.

.2 Repair piping systems with new material. No caulking of screwed joints, cracks or holes will be accepted. Where it becomes necessary to replace pieces or pipe, replace pieces of pipe with the same lengths as the defective pieces. Where repairs are required to PVC pipe, replace the pipe as far as the first detachable fitting in each direction from the defect. Under no circumstances a new section of pipe is to be installed with solvent welded couplings.

.3 Repeat tests after any work has been replaced if, in the judgement of the Engineer, it is necessary.

.4 Conduct all pressure testing in the presence of the Engineer.

END OF SECTION

TORONTO

SECTION 01751

PRE-START-UP, START-UP AND COMMISSIONING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 Be responsible for the performance and commissioning of all equipment supplied under this Contract. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.2 In consultation with the Engineer, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all electrical, mechanical, instrumentation and controls, and SCADA systems.

.3 The commission of all electrical equipment supplied under this Contract shall also refer to related section in Division 16.

.4 Note that major components of the works will require individual pre-start-up and commissioning. This includes, but is not limited to the following:

.1 New standby generators with water-cool system.

.2 New panel boards.

.3 New ATSs.

.4 HVAC equipment.

.5 Monorail Beam adjustments

.6 Power tunnel sump pump.

.7 New instrumentation, new SCADA system, and I/O card.

1.2 RELATED SECTIONS

.1 Section 01110 – Summary of Work.

.2 Section 01140 – Work Restrictions.

.3 Section 01310 – Project Management and Coordination.

1.3 DEFINITIONS

.1 Pre-Start-Up: Pre-start-up consists of the non-operating functions required to bring Work to a state of readiness for placing systems into service. It includes, but is not limited to; cleaning, leakage and pressure testing, cold alignment checks, disinfection, system flushing, lubrication of mechanical equipment, rotation checks, and wiring loop checks. Conduct inspections of all components and sub-components and arrange for inspections of equipment installations by qualified equipment manufacturers' representatives as required by Contract Documents. At this stage, deficiency lists are prepared and Contractor is to remedy outstanding incomplete or incorrect work in accordance with

terms of Contract. Obtain completed Equipment Installation Certification Forms for each specified piece of equipment and submit these to Engineer for review. Once Engineer is satisfied that each piece of equipment in a system or subsystem has been properly checked out and all apparent deficiencies have been remedied, place a red “Ready-to-Start” tag on the equipment designating that the Pre-Start-Up Phase for that particular system is complete. Obtain sign off by all parties.

.2 Start-Up: Once each piece of equipment within a defined system carries a red “Ready-to-Start” tag, then that individual system can be started and tested. The first test will be the Site Acceptance Test. Once this test is completed for the system as per Section 13010 – Process Control, submit the completed SAT sheets to the Engineer for review. Once Engineer is satisfied that the system has successfully passed the SAT, System performance test is required. Conduct performance tests of all equipment in conjunction with the manufacturers’ representatives as required by the Contract Documents and under the witness of Engineer. Correct all deficiencies that are uncovered and retest as required. Prepare and submit Start-Up Completion Certificates certifying that the equipment or system is complete, successfully tested, started and ready for commissioning and continuous operation.

.3 Commissioning: Commissioning consists of placing all the various systems in Work into continuous operation in an orderly manner. Contractor is responsible for the commissioning activities and is responsible to have equipment manufacturer representatives at the site, as well as qualified mechanical, electrical, control and instrumentation personnel. Contractor may be assisted by Engineer relative to process considerations and by City’s operations and maintenance staff. Commissioning is considered to be complete when all systems have been tested and the generators full load tests have been completed, or as specified in the equipment specifications without fault and in accordance with the specified performance requirements. Once Engineer determines that commissioning is complete, place a Green “Ready-for-Service” tag on the equipment designating that the Commissioning phase for that particular system is complete. Obtain sign off by all parties. Prepare and submit Commissioning Completion Certificate certifying that the equipment or system is commissioned and ready for service by City.

1.4 QUALITY CONTROL

.1 Provide the services of an approved independent specialist firm to coordinate the commissioning process identified under this Section of Contract Documents and those of other Sections which interact with work of this Section as outlined herein. The specialist firm to identify and appoint a professional Engineer or qualified operations specialist as Testing and Commissioning Manager to manage, coordinate and supervise the Testing, Start-up and Commissioning Program. Qualifications to include minimum five (5) years experience managing testing, start-up and commissioning of mechanical, electrical, instrumentation, building systems and piping systems. Provide resume to Engineer for review prior to commencement of program.

.2 When specified in individual Sections of Contract Documents, require equipment manufacturer or supplier to provide authorized technical representative(s) with testing, start-up and commissioning experience on their equipment. The Testing and Commissioning Manager to ensure that the necessary technical individuals are present for each system as required to facilitate this process and minimize delays.

.3 Testing:

.1 Provide all required testing equipment and ancillary equipment to verify specified performance.

.2 Calibrate all test equipment to plus or minus two percent (2%) of actual value at full scale.

.3 Employ recognized, industry standard calibration procedures or as specified in individual Sections.

.4 Submit calibration plans and results to Engineer.

.4 Attend and participate in Pre-start-up, Start-up and Commissioning workshops with Engineer and City representatives.

1.5 SAFETY

.1 Ensure all requisite safety equipment, devices, detectors, materials and procedures are in place, tested and operational before commencing.

.2 Conform to requirements of all regulatory authorities having jurisdiction.

.3 Maintain communications with fire, police, environmental and health authorities.

1.6 ENVIRONMENTAL PROTECTION

.1 Comply with all requirements of federal, provincial and local jurisdictions having authority.

1.7 PRE-START-UP

.1 Prepare Pre-start-up Equipment Checkout List, which includes all Process Mechanical, Commodity-retaining Structures, Building Mechanical, Instrumentation and Controls and Electrical Equipment. Group list into logical systems or sub-systems for orderly progression of activities during start-up.

.2 Identify all pieces of equipment by Tag Numbers.

.3 Remove all scaffolding, debris, planks tools and other construction-related material.

.4 Remove all sand, silt, dirt and debris from tanks, channels, chambers, instrumentation and control panels and electrical panels and vacuum clean.

.5 Clean all surfaces of tanks and conduits, including walls, roofs, floors and columns with high pressure water jets or as specified in individual Sections.

.6 Clean interior and exterior of all pipes and fluid-carrying equipment, including pumps and inspect with Engineer present.

.7 Provide photographic evidence (electronic copy) and/or digital video survey of pipes along with written report to Engineer for approval.

.8 Conduct leakage and pressure tests in accordance with individual Sections.

.9 Coordinate chemical deliveries with City and Engineer.

.10 Provide Checkout Tag for each piece of equipment.

.11 Checkout Tags are to be filled in by each applicable trade verifying that all appropriate checks have been made, including but not limited to, cleaning, inspection, leakage testing, lubrication, rotation, calibration, adjustment and wire loop checks.

.12 Equipment Manufacturer's Representatives to inspect equipment in accordance with applicable individual Sections. Certify equipment has been properly installed and is ready to start.

.13 Contractor to submit Equipment Checkout Listing to Engineer. Equipment Checkout Listing to include the following:

.1 System description.

.2 Equipment Name and Tag Number of each component within System.

.3 Supplier's Name of each equipment component, complete with sign-off where applicable.

.4 Mechanical Trade sign-off.

.5 Electrical/Instrumentation Trades sign-off.

.6 Contractor sign-off (all applicable reports, forms and checklists completed).

.14 Attach the following to Equipment Checkout Listing:

.1 Electrical Equipment Installation and Start-up Form.

.2 Manufacturer's Certificate of Proper Installation Form. Refer to Section 01430 – Manufacturer's Services.

.3 Hydrostatic Test Certification Forms for Process Tanks.

.4 Pressure Test Certification Forms for Process Tanks.

.5 Disinfection Certification Forms where applicable.Instrumentation and Electrical Equipment I/O loop Check Forms.

.6 Instrumentation Calibration Forms.

.7 Listing of outstanding contract deficiencies for each system.

.8 Listing of outstanding contract deficiencies for each system.

.15 Request, in writing, a Pre-Start-Up Inspection by Engineer. Once Engineer has conducted the Pre-Start-Up Inspection and is satisfied that each piece of equipment has been properly checked-out, a red “Ready-to-Start” tag will be attached to each piece of equipment in the system. Obtain sign off by all parties.

.16 Provide Operating and Maintenance Manuals as required by individual Sections.

1.8 START-UP

.1 Conduct workshop with City’s Representatives and Engineer to identify and integrate activities of all parties in start-up of Work. Prepare Start-up Plan which includes the following:

.1 Plan objectives.

.2 Facilities are to be started.

.3 Sequence of events and start-up schedule.

.4 Responsibilities of each party.

.5 List of individuals involved complete with contact telephone numbers.

.6 English language description of each systems’ intended means of operation.

.7 Initial operating conditions and parameters.

.8 Intended final operating conditions and parameters.

.9 Laboratory requirements and arrangements for outside testing services.

.10 Sampling and monitoring requirements.

.11 Contingency plans to respond to potential emergencies.

.12 Safety and environmental considerations.

.2 Develop City Training plan and implement.

.3 Conduct SAT Tests for all equipment, witnessed by Engineer.

.4 Conduct Start-Up Test for all equipment, witnessed by Engineer.

.5 Correct any deficiencies uncovered during testing.

.6 Prepare and submit Start-Up Completion Certificates certifying that the equipment or system is complete, successfully tested, started and ready for commissioning and continuous operation.

.7 Prepare systems for Commissioning and coordinate chemical deliveries with City and Engineer.

1.9 COMMISSIONING

.1 Assemble Contractor's commissioning team to respond to requests for assistance by Engineer or City. Team to consist of representatives of Contractor and Contractor's mechanical, electrical and instrumentation staff or subcontractors, as appropriate.

.2 Contractor's representative is to be at site during normal working hours for entire commissioning period. Contractor's representative and the commissioning team may be required to be at site outside of normal working hours during the commissioning period, at the discretion of City or Engineer and is to be available within four (4) hours' notice.

.3 Remove and clean or replace equipment, devices, connected piping, and structure to ensure that they are free of foreign material, unless otherwise directed by Engineer.

.4 Commission work in stages based on commissioning packages. Each commissioning package to consist of fully functional portions or groups of operationally tested systems capable of operating in concert to provide a complete service or function that is of value to City.

.5 Commissioning is to be generally conducted in Local mode first, followed by Area Control Panel Manual mode, followed by Remote Manual (RPU Manual) mode, and thereafter Plant Automatic (RPU Automatic) mode.

.6 Period of time for continuous automatic operation for acceptance of commissioning is as specified in the equipment specifications with all systems operating continuously without fault and all process, mechanical, control and electrical equipment free of vibration, overloading or overheating and functioning in accordance with specified rates, methods and performance.

.7 Failure of any part of Work during the period of continuous automatic operation will require restart of that portion or system of Work, following rectification of the fault or failure.

.8 If it is necessary to suspend start-up, commissioning or continuous operation during the commissioning period due to deficiencies or failure in any system, the full cost of interruption, call-back, testing and resumption of start-up, commissioning, or continuous operation is to be paid by Contractor.

.9 Once Engineer determines that commissioning is complete, place a Green "Ready-for-Service" tag on the equipment designating that the Commissioning phase for that particular system is complete. Obtain sign off by all parties.

.10 Prepare and submit Commissioning Completion Certificates certifying that the equipment or system is commissioned and ready for service by City.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

ATTACHMENTS: EXAMPLE CHECKLIST SIGN-OFF FORMS (16 PAGES)

END OF SECTION

Attachment: Example Checklist Sign-Off Forms

Project Name:	**Project Number:**	
Contractor:	**Date:**	

EQUIPMENT:		**DATE INSTALLATION COMPLETE:**	
MAKE:	**MODEL #:**		**SERIAL #:**
PRE-START-UP	**CHECKED BY**	**DATE**	**REMARKS**
Installation/Mounting Sensor/Transmitter			
Wiring/Conduit Termination and Seals			
Check Fuse Ratings (Supply and Internal)			
Tagging/Nameplate			
Compliance Section 16			
Test (Ground Loop, Continuity, Installation)			
Power Supply			
Check Instrument Air/Adjust Filter/Regulator			
Check Temp. Control (Internal/Heat Tracing)			
Configure Calibration			
Tailback lights			
START-UP Verify Operation Under Max Process Conditions			
Correct Quantities of Expandable Material			
* Indicates (N/A) if not applicable			
Comments:			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Engineer

Date

Supplier

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

Equipment:			
Tag/instrument Number:			
PLC:			
Input Point:			
Manufacturer:			
Model Number:			
Serial Number:			
Calibration Range:			
Service			
Temperature		Chlorine Residual	
Pressure		pH	
Differential Pressure		Density	
Flow		Dissolved Oxygen	
Level		Gas monitoring	
Weight		Others	
Type			
4-20 mA		0-100 VDC	
0-20 mA		Digital Input	
1-5 VDC			
Power Source			
120 VAC		Dry Contact	
24 VDC			
Alarms – Hardwired			
HIHI		LO	
HI		LOLO	
Failure			
Alarms – Software			
HIHI		LO	
HI		LOLO	
Failure			

Test Full Range			
0 %		75 %	
25 %		100 %	
50 %		On/Off (Digital)	
Verification			
Contractor			
Engineer			
City			
Date			
Comments			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Supplier

Date

Engineer

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

EQUIPMENT:		**DATE INSTALLATION COMPLETE:**	
MAKE:	**MODEL #:**		**SERIAL #:**
PRE-START-UP	**CHECKED BY (INITIAL)**	**DATE**	**REMARKS**
Installation and Mounting			
Location to Equip. (Electrical Interference)			
Wiring/Conduit Termination and Scales			
Tagging Nameplates			
Compliance Section 15			
Test (Ground Loop, Continuity, Installation)			
Check Fuse/Breaker Ratings			
Compliance Section 16			
Communications Test:			
Peer Link			
Remote 1/0			
PLC – PC			
Cable Integrity			
Termination Connectors			
Telephone/Link Modem Rack/PLC Switch Settings			
Computer Installation			
Ancillary Equipment Installation			
* Indicates (N/A) if not applicable			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Engineer

Date

Supplier

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

Equipment:			
Tag/instrument Number:			
Associated PLC:			
Area:			
Service			
Constant Speed Motor		Valve – Modulating	
Variable Frequency Drive		Generator/ATS	
Valve – Discrete		HVAC	
Other			
PLC I/O			
Start / Stop		Feedback (4-20mA)	
Control Mode		Setpoint (4-20 mA)	
Status		Others	
General Alarm			
Interlocks – Hardwire			
Motor Protection Relay		Field Instrumentation #1	
Motor Overload		Field Instrumentation #2	
Pump Protection Relay		Field Instrumentation #3	
Others		Others	
Interlocks – Software			
Fail to Start / Open		Uncommanded Stop / Open	
Uncommanded Start / Open		Hardware Alarm	
Tags / Terminal / Drawings			
MCC / Local Panel		PLC Local Panel	
Tags		Tags	
Terminals		Terminals	
Drawings		Drawings	
PLC Cards		As Constructed	
Tags		Tags	
Terminals		Terminals	
Drawings		Drawings	

Verification	
Contractor	
Engineer	
City	
Date	
Comments:	

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Supplier

Date

Engineer

Date

Facility Operation Supervisor

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

Equipment			
Identification Tag No.			
Manufacturer			
Model			
Serial Number			
Rating hp/kw		RPM	
Amps		Supply Voltage	
Phase		Wire	
Insulation Design		Insulation Class	
Temperature Raise		Enclosure Type	
Approvals CSA, NEMA, etc.		Date Received	
Others		Date Started	

	INSTALLATION	A	B	C	D
1	Foundation or Base				
2	Mounting Bolts				
3	Couplings, belts, chains				
4	Shaft Alignment				
5	Gaskets				
6	Motor Megger				
7	Motor Rotation				
8	Supply/Starter Fuse Size				
9	Supply/Starter O/L Size				
10	Interlock Checked				
11	Grounding Installation				
12	Cable or Conduit Installation				

	START UP OF EQUIPMENT	A	B	C	D
1	General Condition				
2	Bearing Temperature				
3	Seals, Packing				
4	Valves, Check valves				
5	Connecting Rods				
6	Couplings				
	Safety Hazards				
7	Lubrication				
8	Seal Lubrication				
9	Shafting, Universal				
10	Clutch				
11	Gear Drives				
12	Control – Local Run				
13	Control – Remote Run				
14	Painting				
	REMARKS				

Legend:

(**A**) Inspected and found acceptable (**B**) Inspected, found defective but corrected

(**C**) Inspected, found defective and not corrected (**D**) Not inspected

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Supplier

Date

Engineer

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

EQUIPMENT:		**DATE INSTALLATION COMPLETE:**	
MAKE:	**MODEL #:**		**SERIAL #:**

PRE-START-UP	**CHECKED BY (INITIAL)**	**DATE**	**REMARKS**
Wiring/Conduit Termination			
Tagging Nameplates			
Fuse/Overload Ratings Checked			
Drive Properly Grounded			
Signal and Input/Output Power Wiring Run in Separate Conduits			
Direction of Motor Rotation			
Input Voltage			
Speed Control Signal			
Output Voltage			
Horsepower Rating			
Max Speed Setting			
Min Speed Setting			
Acceleration Rate Setting			
Deceleration Rate Setting			
Operation and Maintenance Manuals Submitted			
Spare Parts Rec'd			
START-UP – (Manufacturer's Rep. in Attendance)			
Performance per Spec/Data Sheet (Identify)			
Manual Start/Stop			
Auto Start/Stop			
Manual Speed Selection			
Auto Speed Selection			
Drive Run/Fault Indication			
Duration of Initial Run (min. 1 hour)			
Manufacturer's Letter of Confirmation of Equipment Proper Installation Received			
*Indicates (N/A) if not applicable			

SPEED	MOTOR VOLTAGE	MOTOR CURRENT	MOTOR FREQUENCY
Comments:			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Supplier

Date

Engineer

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

Equipment			
Manufacturer			
Model		Serial Number	
Identification Tag No.		Capacity	
Date Received		Date started	

	INSTALLATION	**A**	**B**	**C**	**D**
1	Foundation or base				
2	Mounting bolts				
3	Couplings, belts, chains				
4	Shaft alignment				
5	Gaskets				
6	Alignment/Level				
7	Removal of Shipping Oil/Rust Preventative/Wrappings				
8	Interior Connected Piping Free of Debris				
9	Initial Lubrication				
10	Equip. Safety Devices and Guards				
11	Free Rotation of Shafts				
12	Belt or Chain Drives, Couplings				
13	All Equip. Access. Installed and Functioning Correctly (gauges/drains/pressure relief valves/seal water, etc.)				
14	Devices Requiring MCCR Canadian Reg.# (Identify with #)				
15	Operation and Maintenance Manuals Rec'd				
16	Spare Parts Received				
	Remark:				

	START-UP OF EQUIPMENT	A	B	C	D
1	General Condition				
2	Bearing Temperature				
3	Seals, Packing				
4	Valves, Check valves				
5	Connecting Rods				
6	Couplings				
7	Flights, Scrapers				
8	Safety Hazards				
9	Lubrication				
10	Seal Lubrication				
11	Shafting, Universal				
12	Clutch				
13	Gear Drives				
14	Painting				
Remarks:					

Legend:

(A) Inspected and found acceptable **(B)** Inspected, found defective but corrected

(C) Inspected, found defective and not corrected **(D)** Not inspected

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Engineer

Date

Supplier

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

EQUIPMENT:		**DATE INSTALLATION COMPLETE:**	
MAKE:	**MODEL #:**	**SERIAL #:**	
BODY	**CHECKED BY (INITIAL)**	**DATE**	**REMARKS**
Manufacturer/Model #			
VALVE Identification			
Type/Body Size			
Port Size/End Connection			
Trim Form			
Packing/Stem Seal Adjustment			
Lubrication			
Exterior Finish			
ACTUATOR – Manufacturer/ Model # and Size			
Type			
Open At/Close At			
Fail Position			
Handwheel/Manual Override Position Indicator			
Open/Closed Position Stop Adjustment			
POSITIONER - Manufacturer/ Model #			
All Assess. Installed and Functioning Correctly (Filter/Regulator, Gauge, Bypass, etc.)			
Input Signal/Output Signal			
Calibration			
OTHER – Positioning Indicating Switch Adjustment			
Feedback Potentiometer Calibration			
Devices Requiring MCCR Canadian Reg# (Identify with #)			
Operation & Maintenance Manuals Received			
PERFORMANCE – Manufacturer's Rep in Attendance			
Maximum Flow			
Value % Open @ Max Flow			

Inlet Pressure @ Max Flow			
Pressure Drop @ Max Flow			
Minimum Flow			
Valve % Open @ Min Flow			
Inlet Pressure @ Min Flow			
Pressure Drop @ Min Flow			
Relief Pressure (Safety Valves)			
Reseating Pressure (Safety Valves)			
Manufacturer's Letter of Confirmation of Equipment Proper Installation Received			
*Indicates (N/A) if not applicable			
COMMENTS:			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Engineer

Date

Supplier

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

HVAC System	**Area**		
Total number of zone control		Total number of electric splitter dampers	
Total number of electric control dampers		Total number of makeup air unit	
Total number of exhaust fan		Total number of automatic backdraft damper	
Total number of damper			
Zone no.			
Number of air diffusers		Number of splitter dampers	
Air diffuser no.1 designed output (cfm)		Number of volume dampers	
Air diffuser no.1 actual output (cfm)		Makeup air no.1 rated capacity	
Air diffuser no.2 designed output (cfm)		Exhaust fan no.1 rated capacity	
Air diffuser no.2 actual output (cfm)		Interlocks verified for proper operation	
Complete this for the total number of air diffusers in the zone		Proper temperature control verified	
Verification Performed on:			
HVAC/Mech. Sub-Contractor		Contractor	
Date		Date	
Engineer		City/Operator	
Date		Date	

Project Name:	Project Number:	
Contractor:	Date:	

Date	Division / Clause	Equipment	Accepted by Resident Engineer	Accepted by Facility Supervisor

TORONTO

SECTION 01752

START-UP AND COMMISSIONING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INTENT

.1 This Section contains requirements for the Contractor in carrying out and documenting testing work and training of City staff, as required under this Contract. In addition, this Section contains requirements for the Contractor during compliance, operational and performance testing for all electrical, instrumentation and RPU/SCADA equipment and systems provided under this Contract. This Section also contains site clean-up (progressive and final) requirements for the Contractor under this Contract.

.2 This Section supplements but does not supersede testing requirements found elsewhere in the specifications.

.3 This specification applies to all Divisions in the Tender Document.

1.2 PROGRESSIVE CLEANING

.1 Maintain the Work in tidy condition, free from accumulation of waste products and debris.

.2 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.3 Remove waste material and debris from the site at the end of each working day.

.4 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

1.3 FINAL CLEANING

.1 In addition to the progressive removal of rubbish from buildings, structures and site, and leaving the buildings broom clean, perform the following work before acceptance and prior to applying for a Certificate of Substantial Performance of the Work.

.1 remove waste products and debris other than that caused by the City's Contractors, and leave the Work clean and suitable for occupancy by the City

.2 remove surplus products, tools, construction machinery and equipment. Remove waste products and debris generated or caused by the construction activities

.3 clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass

.4 remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors

.5 vacuum clean and dust building interiors, behind grills, louvres and screens

.6 clean all ducts

.7 flush all heating piping

.8 wax, seal, shampoo or prepare floor finishes, as recommended by the manufacturer

.9 clean all glass, and replace broken glass

.10 remove stains, spots, marks and dirt from all finished work, electrical and mechanical fixtures, furniture fitments, etc

.11 clean hardware

.12 remove paint spots and smears from all surfaces

.13 vacuum clean all building interiors affected by construction operations

.14 make a thorough inspection of all finishes, fixtures, and equipment to make sure of proper workmanship operation

.15 broom clean exterior walks, steps and platform and remove dust, dirt and other disfigurations from exterior surfaces

.16 vacuum inside and outside of all existing power breaker compartment in the switchgears that have been serviced by Contractor, control panels, prior to turning the facility over to the City

.17 vacuum inside and outside of all new and existing electrical panels, RPU panels, etc. which have been affected by dust or dirt due to construction activities

.18 repair any damage to existing roadway, grassed areas, fencing, etc. due to construction activities

.2 Remove all temporary work from the site including but not limited to fencing, sign board, samples, and any other items not considered to be part of the permanent works.

1.4 START-UP AND COMMISSIONING OF EQUIPMENT AND SYSTEMS

.1 Definitions

.1 Start-up (or Compliance Testing): a test or tests in the presence of the Engineer and the City's Operations staff to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical, instrumentation and control, mechanical connections, thrust restraint, proper rotation, initial servicing, and instrumentation calibration.

.2 Commissioning (Operational and Performance Testing): a test performed in the presence of the Engineer and the City's Operations staff and after any required start-up specified, to demonstrate and confirm that the equipment and/or system meets the specified operational performance requirements, while simulating actual operating conditions to the greatest extent possible.

.3 System: the overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment.

.2 Submittals

.1 Submit five (5) copies of the proposed start-up and commissioning schedules and workplan for equipment units, and systems four (4) weeks prior to start of related testing for approval by the Engineer. Revise schedule based on Engineer's review and resubmit five (5) copies of the approved schedule.

.2 Include in the start-up and commissioning schedule the following items as a minimum:

a. A list of all equipment to be tested

b. Tests which will be performed for each related piece of equipment

c. Test plan

d. Test procedure

e. Plan for calibration of instruments

f. Time and date for each test in daily stages

g. List of subcontractors and equipment suppliers which will be present for each test

.3 Testing Preparation

.1 General:

a. Complete Work associated with the unit and related processes before testing, including related manufacturer's representative installation inspection services.

b. Provide related operating and maintenance manuals, and spare parts and special tools as specified before testing any unit or system.

c. Document start-up and commissioning procedures.

d. Designate and provide one or more persons to be responsible for coordinating and expediting Contractor's facility start-up duties. The person or persons shall be present during facility start-up period. The Engineer will also designate a person to consult with the Contractor's facilities start-up person. Coordinate all start up activities with the Engineer's designate. The City will also designate a person to communicate with the Engineer's and Contractor's designates.

e. Provide services of qualified manufacturer's representatives to assist in testing.

f. Provide all electrical power, test equipment and other materials, and labour for testing, start-up and commissioning.

g. Cleaning and Checking: Prior to start-up complete the following work. Start-up will not proceed until all cleaning and checking is completed.

h. Calibrate testing equipment for accurate results.

i. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.

j. Check power supply to electric-powered equipment for correct voltage.

.2 Ready-to-test determination will be based on full compliance with all of the following:

a. Training to be completed before start-up

b. O&M manuals to be submitted and approved before start-up

c. Pre-Start documentation must be submitted and approved before start-up

d. WMS data sheets must be submitted and approved prior to start-up

e. Arc Flash Study must be submitted and approved prior to start-up. Arc Flash stickers must be mounted in place prior to start-up.

f. Notification by Contractor of equipment and system readiness for testing.

g. Acceptable testing plan.

h. Acceptable operation and maintenance manuals incorporating review comments.

i. Receipt of Manufacturer’s Certificate of Proper Installation for new power transformers.

j. Adequate completion of work adjacent or, to interfacing with, equipment to be tested.

k. Availability and acceptability of manufacturer’s representative, when specified, to assist in testing of respective equipment.

l. Equipment and electrical tagging complete.

m. All spare parts and special tools delivered to the City.

.4 Startup (or Compliance Testing)

.1 Begin testing on time based on approved test schedule.

.2 For Start-up Activities in Confined Space locations, provide at least two (2) Contractor's staff who are trained and certified for confined space entry procedures. Provide all necessary confined space entry equipment and conform to the City's confined space requirements.

.5 Commissioning

.1 General:

a. Begin commissioning after satisfactory completion of all start-up tests.

b. Unless otherwise indicated, provide services specified or required all labour, materials, and supplies for conducting the test and taking all samples and performance measurements.

c. Prepare commissioning report summarizing test method. Include test logs, pertinent calculations, and certification of performance.

d. Any analytical laboratory work required for commissioning will be performed by the City.

e. Conduct commissioning as required to demonstrate system performance.

f. In addition to the general electrical commissioning, complete commissioning as specified in each specific equipment section including but not limited to testing specified in Division 13 and Division 16.

g. The City may conduct independent testing to verify test results. If through the independent testing, the testing fails, the Contractor to correct deficiencies retest and pay for retesting.

.2 Construction/Operation Delineation during Commissioning Phase:

a. Contractor to identify all equipment and/or systems that are being installed with a red tag to indicate that the Contractor is installing and responsible for the equipment.

b. After the equipment has been installed, aligned, start-up, tested and certified by the manufacturer/vendor as having been installed properly, remove the red tag from this equipment and/or system and replace with a green tag only as directed by the Engineer.

c. All equipment and/or systems identified with a green tag will indicate that the equipment is fully functional and may be used by the City for operation of the facility.

.3 Facility Commissioning and Performance Testing:

a. Pre-requisite for Facility Commissioning and Performance Testing:

(a) Successful completion of start-up (compliance testing), performance testing (14-day) and training as specified herein.

(b) Submission of five (5) copies of the proposed start-up and commissioning schedules and workplan for equipment units, and systems four (4) weeks prior to start of related testing for approval by the Consulting Engineer.

b. The Contractor shall have supervisory personnel, mechanics, electricians, instrument technicians and other workmen on site during the normal working day and as required at other times to ensure the safe continuous operation of the facility. During other times, the Contractor shall have the above personnel on call to attend to any adjustments and corrections required.

c. Once all equipment and sub-systems have been tested individually and completed to the satisfaction of the City and the Engineer, the Contractor shall perform performance testing on the completed Facility as a whole.

d. The performance testing for process equipment shall be undertaken using foul air in quantities necessary to carry out the testing procedures, including, at the City's discretion, at the maximum design capacity of the system.

e. The Contractor shall operate the Facility continuously for a period of 30 days (this period runs concurrent to the 14 day Performance Testing) without any significant malfunction, and shall demonstrate that they fully meet applicable acceptance criteria as defined herein.

f. A significant interruption will require the test then in progress to be stopped and restarted after corrections are made. Significant interruptions include any of the following events:

(a) Failure of the Contractor to maintain qualified on-site personnel as scheduled.

(b) Failure of any equipment item or system component to meet specified performance requirements for more than two (2) consecutive hours.

(c) Failure of any critical unit, system, or subsystem that is not satisfactorily corrected within six (6) hours after failure.

(d) As may be determined by the Owner and Engineer.

g. Acceptance criteria:

(a) The Facility has operated satisfactorily for 30 days inclusive of performance testing of individual sub-systems, at the rated capacity, on a continuous basis.

(b) Successful demonstration of all four levels of operation/control, as defined herein.

(c) Air system – operation, balancing and control of main fans throughout the specified operating range, odour-removal performance as required

(d) Successful demonstration of all interlock operation and start-up and shutdown sequences.

(e) Successful demonstration of pressure relief, high/low pressure shutdown and protection systems

(f) Acceptable system responses to simulated abnormal/emergency conditions, including, but not limited to, localized power failure, specific hardware failure.

(g) Trending of monitored process variables, equipment parameters and modes of operation of control equipment during testing period.

(h) The operations do not violate any laws, rules, regulations, or other permit conditions.

(i) The operations create no materially unsafe or nuisance conditions or risks.

(j) Operations are in compliance with the Contract.

(k) Operations do not result in process by-products, air or water emissions, traffic, noise, odours, or other environmental impacts that are determined to be unacceptable to the City, in its sole discretion, or to the public safety, health and welfare.

h. System commissioning shall be considered complete and successful when, in the opinion of the City and Engineer, the systems operates in the manner intended at plant design for the specified period.

i. Should the operation be halted for any reason related to the facilities constructed or the equipment furnished, the system commissioning program must be restarted and repeated until the specified continuous period has been accomplished without interruption.

j. Any defects found during the commissioning period must be repaired or the specific part or entire equipment item must be replaced to the complete satisfaction of the City and Engineer and at no cost to the City. This also applies to prepurchased equipment.

k. Obtain baseline operating data on all equipment and process variables. The baseline operating data must be forwarded to the Engineer for the City's records. Baseline operating data to include all equipment .

l. Equipment and process parameters must be archived during system commissioning for the City's reference and records.

m. The above procedures shall be satisfactorily completed prior to the facility being considered ready for use as set out in the Construction Lien Act.

n. Correct deficiencies revealed during initial operation. Correct and adjust equipment operation.

1.5 TRAINING

.1 See section 01820 – Demonstration and Training.

1.6 SPECIAL TOOLS

.1 Supply with each piece of equipment all special tools and accessories required for repair and adjustment.

.2 Turn such tools over to the City as specified above.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

TORONTO

SECTION 01760

WARRANTY WORK

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 This Section specifies requirements for work during the Warranty Period.

1.2 GENERAL

.1 Provide all warranties outlined in the Contract Documents from the time of Substantial Performance of the Works or components of the works.

.2 Perform warranty work required during progress of the work and during the Warranty Period.

.3 Extend warranties on any component of the work that is required to be placed in operation prior to Substantial Performance for the purpose of complying with the sequence of construction.

1.3 SUBMITTALS

.1 Inform the Engineer in writing of the arrangements made for carrying out warranty work during the Warranty Period.

.2 Provide a telephone number, email address and mailing address for receipt of notices relating to matters requiring action by the Contractor during the Warranty Period.

1.4 WORK DURING WARRANTY PERIOD

.1 Perform all warranty work required upon receipt of verbal or written notices from the Engineer.

.2 Repair or make good settlements and defects on surfaces of backfilled trench or excavations.

1.5 REPAIR BY CITY

.1 The City will, without giving notice to the Contractor, repair defects that are dangerous in nature, that constitute an extreme emergency or that affect the operation of the Works. The Contractor will be notified of less serious conditions prior to work being performed.

.2 The Engineer will notify the Contractor of emergency work performed by the City.

.3 The cost of labour, equipment and material to perform emergency work will be charged to the Contractor.

1.6 FINAL INSPECTION

.1 One month prior to the expiration of the Warranty Period, assemble a team to inspect the facility to determine if there are any outstanding deficiencies where remedial work is still outstanding or has been performed unsatisfactorily which must be rectified.

.2 The inspection shall be carried out jointly with the Engineer, the Operator and Maintenance Supervisory staff together with the City's Project Manager.

.3 Arrange for, coordinate and pay for any special access required to inspect the Works, such as the draining of tanks.

.4 The inspection shall include but not be limited to the following:

.1 Field devices

.2 Equipment and performance

.3 Process performance

.4 Building envelope

.5 Life safety deficiencies

.5 The Engineer will update the master deficiency list of all the noted deficiencies and provide a copy to all parties. Complete all outstanding deficiencies, repair noted defects, complete all outstanding warranty items and obtain the Engineer's written agreement that all works are complete in accordance with the Contract Documents.

.6 The cost of the final inspection (Engineer's staff and that of the City and Operator) and the subsequent inspection will be borne by the Contractor as part of tendered price. The cost for any further inspections after that, which are required as a result of the Contractor's failure to complete the remedial work on time, will be deducted from the Contract Holdback retained for the warranty period.

PART 2 PRODUCTS – NOT APPLICABLE

PART 3 EXECUTION – NOT APPLICABLE

END OF SECTION

TORONTO

SECTION 01770

CLOSEOUT PROCEDURES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 Administrative procedures preceding preliminary and final inspections of Work.

1.2 RELATED SECTIONS

.1 Section 01751 – Pre-Start-up, Start-up and Commissioning.

1.3 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and all Subcontractors to conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents:

.1 Notify Engineer in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.2 Request Engineer's Inspection.

.2 Engineer's Inspection: Engineer and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.

.3 Completion: submit written certificate that the following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Certificates required for building occupancy have been submitted.

.5 Operation of systems have been demonstrated to City’s personnel.

.6 Work is complete and ready for Final Inspection.

.4 Final Inspection: When items noted above are completed, request final inspection of Work by Engineer, and Contractor. If Work is deemed incomplete by Engineer, complete outstanding items and request re-inspection. Re-inspection is at the Contractor’s cost.

.5 Declaration of Substantial Performance: When City and Engineer consider deficiencies and defects have been corrected and it appears requirements of the Contract have been substantially performed, make application for certificate of Substantial Performance. Refer to Specific Conditions Section 5A for specifics to application.

.6 Commencement of Lien and Warranty Periods: Date of City's acceptance of submitted declaration of Substantial Performance is to be the date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work. Refer to General for specifics to application

.7 Final Payment: When City and Engineer consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. Refer to General Conditions. If Work is deemed incomplete by Engineer, complete outstanding items and request re-inspection. Re-inspection is at the Contractor's cost. Refer to General Conditions for specifics to application

.8 Payment of Holdback: After issuance of certificate of Substantial Performance of Work, submit an application for payment of holdback amount in accordance with General Conditions.

PART 2 PRODUCT – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01780

CLOSEOUT SUBMITTALS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 This section in its entirety (i.e. all submittal requirements, Operator & Maintenance Manuals, As-Built drawings, binders, electronic submission etc.) shall be completed as an independent submittal package.

1.2 SECTION INCLUDES

.1 As-Built drawings, samples, and specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

.4 Operation and maintenance data.

.5 Spare parts, special tools and maintenance materials.

.6 Warranties and bonds.

.7 Final site survey.

1.3 RELATED SECTIONS

.1 Section 01450 – Quality Control.

.2 Section 01820 – Demonstration and Training.

1.4 SUBMISSION

.1 Prepare instructions and data by personnel experienced in the maintenance and operation of described products and submit two copies of the O&M's for the Engineer's review.

.2 One (1) copy will be returned with comments and one (1) copy will be retained to assist the Engineer and will be returned after delivery of the final copies.

.3 Revise the content of documents as required prior to final submittal.

.4 Ensure spare parts, maintenance materials and special tools provided are new, undamaged and not defective, and of the same quality and manufacture as products provided in the Works.

.5 If requested, furnish evidence as to type, source and quality of products provided.

.6 Defective products will be rejected, regardless of any previous inspections by the Engineer or other agents of the City. Defective products to be replaced at the Contractor's expense.

.7 Pay the costs of transportation related to replacement of defective products.

.8 The City shall withhold $10,000 until an acceptable final manual submission is received. A draft manual is required prior to commissioning.

1.5 OPERATION AND MAINTENANCE DATA

.1 The Contractor shall prepare and submit an organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of all Divisions included in the Contract.

.1 General:

a. Assemble, coordinate, bind and index required data into an Operation and Maintenance (O&M) Manual.

b. Submit two sets of preliminary manuals to the Engineer for review at least fifteen (15) working days prior to the start of training in accordance with Section 01820 – Demonstration and Training. Both sets will be returned with comments.

c. Submit four sets of complete Manuals to Engineer prior to Application for Substantial Performance for the Project. Submission of the Operating and Maintenance Manual will be one of the conditions precedent to the Certifying of Substantial Performance.

d. Organize the data into the same numerical order as the Contract Specifications, i.e., by Division and Section number.

e. Label each section with tabs, protected with celluloid covers, fastened to hard paper dividing sheets.

f. All contents must be typewritten.

g. The Contract Drawings, diagrams and manufacturers' literature must be legible and reflect the actual products installed.

h. Ensure the information depicts "as constructed" conditions.

i. The O & M manuals must contain all start-up reports in conformance with the City’s Project Implementation Procedures (PIP) Manual. Provide all information requested in the PIP Manual.

.2 Binders:

a. Submit four (4) copies printed sets bound in vinyl coated, hard-covered post type binders equal to ACCO 05436-0. Ensure these sets are fully organized and indexed.

b. Each pumping station to have its own four (4) sets of binders.

c. Identify the contents of each binder on the cover and spine.

d. Binders shall be “hot stamped” with white lettering on both the cover and spine.

.3 Contents:

a. Binder 1:

(a) Cover sheet containing:
(i) Date submitted.
(ii) Project title, station location, City’s Name and Project Number.

(b) Names, addresses and telephone numbers of the Contractor and all sub-contractors.

(c) Table of contents of all binders.

(d) List of Maintenance Materials.

(e) List of Special Tools.

(f) List of Spare Parts.

(g) Warranties, guarantees certification.

(h) Copies of approvals and certificates.

(i) Equipment alignment certificates.

b. Remaining Binders:

(a) Cover sheet containing:
(i) Date Submitted.
(ii) Project title, station/building location, City’s Name and Project Number.

(b) Provide data as specified below in individual sections for all Divisions included in the Contract. Where manufacturers' literature covers several models or options, the applicable information shall be highlighted and redundant information crossed out.
(i) For each Product or System: Contractor shall list names, address and telephone numbers and facsimile numbers of Subcontractors, suppliers and manufacturers including local source of supplies and replacement parts, and who can complete repair or maintenance on equipment.
(ii) Name plate information including equipment number, make, size, capacity, model number and serial number.
(iii) Parts list.
(iv) Installation details.
(v) Operating Instructions.
(vi) Maintenance Instructions for equipment.
(vii) Maintenance Instructions for finishes.

(viii) Description of system, components and technical data. Include interfaces, sequences, operational characteristic changes for seasonal operation.
(ix) Lubrication charts.
(x) Schematics, single line, and wiring diagrams.
(xi) Suppliers for replacement parts - name, address and telephone number.
(xii) Test results; witness testing commissioning, test results.
(xiii) Troubleshooting data.
(xiv) Preventive maintenance program complete with suggested check list sheets.
(xv) Test data of degreasing and flushing of piping.
(xvi) Final reviewed and approved copy of all shop drawings and product data sheets..

(c) Submit two (2)USB's, each with an electronic version of the complete operation and maintenance manual. USB to contain all content in pdf format with complete indexing of sections. Each station to have its own CDs.

1.6 AS-BUILT DRAWINGS AND SAMPLES

.1 Site records:

.1 The Engineer will provide one set of reproducible contract drawings at the beginning of the project for As-Built drawings. Provide sets of white prints, as required, for each phase of the work. Mark thereon all changes as work progresses and as changes occur including Change Orders. (This shall include changes to existing systems, control systems and low voltage control wiring, etc.)

.2 On a weekly basis, transfer information to reproducible, revising reproducible to show all work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection at all times.

.5 Store record documents and samples in field office apart from documents used for construction.

.6 Label record documents and file in accordance with Specification Section number. Label each document "AS-BUILT" in neat, large, printed letters.

.7 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.8 Keep record documents and samples available for inspection by the Contract Administrator on a monthly basis.

.2 As-Built drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of As-Built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12mm high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW SYSTEMS AS INSTALLED" (Signature of Bidder) (date).

.3 Submit to the Engineer for approval and make corrections as directed.

.4 TAB to be performed using As-Built drawings.

.5 Submit completed reproducible As-Built drawings with Operating and Maintenance Manuals. Provide with a memo referencing the documents and with signatures and dates of the Contractor (supplier) and the Engineer (recipient) provided on the memo with copies of this memo kept by both the Contractor and the Engineer.

.3 Submit copies of As-Built drawings for inclusion in final TAB report to the Engineer from all disciplines.

.4 The City shall withhold $10,000 until a complete set of As-Built drawings are submitted.

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of drawing prints provided by the Engineer.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements, surveyed with two minimum tiebacks at all PI's.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction. All underground infrastructure shall be surveyed for horizontal and vertical alignment and information shall be recorded on As-Built drawings.

.4 Field changes of dimensions and details.

.5 Changes made by Contract Change Directives.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and Contract Change Directives.

.6 Other Documents: maintain manufacturers' certifications, inspection certifications, field test records, required by individual specifications sections.

1.8 EQUIPMENT AND SYSTEMS

.1 Each item of equipment and each system: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications, final as-constructed diagram.

.3 Include as-constructed installed colour coded wiring diagrams in the manual and also provide an electronic copy in AutoCAD.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer where appropriate.

.9 Provide original manufacturers' parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer where appropriate. Include copies in the manuals and provide an electronic version in AutoCAD.

.11 Provide coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturers' spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Provide a complete tabulation of parameter settings for all equipment, electrical, instrumentation and control systems including all calibration records.

.15 Additional requirements: As specified in individual specification sections.

1.9 SPARE PARTS

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site location and place in storage as directed by the City.

.4 Obtain receipt for all delivered products from the City or Engineer and submit these receipts prior to Substantial Performance.

.5 Contractor to turn over all spare parts, complete with inventory list prior to substantial completion.

1.10 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site location and place in storage as directed by the City.

.4 Obtain receipt for all delivered products from the City or Engineer and submit these receipts prior to Substantial Performance.

1.11 SPECIAL TOOLS

.1 Provide special tools, and keys to any new panels, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to site location and place in storage as directed by the City.

.4 Obtain receipt for all delivered products from the City or Engineer and submit these receipts prior to Substantial Performance.

1.12 STORAGE HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturers' seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at the Contractor's own expense and to the satisfaction of the Engineer.

.6 Exercise all equipment in strict conformance with the equipment manufacturers written instructions during storage and following installation. Provide all equipment exercise logs to the Engineer for review.

1.13 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers.

.4 No warranty will commence until issuance of Substantial Performance on respective work components. The warranty on items used during construction, with the City's permission, for the safe and orderly completion of the works will not commence until Substantial Performance.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

1.14 PAYMENT

.1 The Contractor shall insert a value of not less than $10,000 for all closeout submittals in the breakdown of the lump sum price which sum will be payable in full upon successful completion of all required submittals. Should the Contractor enter a lesser sum in the breakdown, the Consultant will be entitled to revise the breakdown to provide $10,000 for the closeout submittals.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01783

OPERATION AND MAINTENANCE MANUAL

TABLE OF CONTENTS

PART 1 GENERAL

1.1 WMS EQUIPMENT INFORMATION DATABASE

.1 Contractor to fill in all fields as identified in Section 13040 – Equipment Tag List for each piece of equipment supplied under this contract, including spare parts. An excel spreadsheet version will be supplied to the Contractor at the start of the project.

.2 Contractor to submit draft and final versions of the WMS Equipment Information Database as part of the O&M manual submissions for review.

1.2 MANUAL

.1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of Divisions 2 to 16.

1.3 GENERAL

.1 Prepare six (6) hardcopies and USB or FTP transfer to Engineer in both native and searchable portable document formats (PDF) of documentation on a 'per system' basis including as-constructed shop drawings to instruct City's operations and maintenance staff in the operation and associated maintenance of each piece of equipment and system as supplied and installed.

.2 Submit a skeleton of the O & M Manual, including table of contents, section tabs, scale mock-up of printing proposed for the binders, sample of proposed record drawing storage mechanism, and O & M material from the equipment supplier, to the Engineer for approval for each individual process system during the respective pre-startup period as specified in Section 01751 – Pre-Startup, Start-up and Commissioning. No payment over 70% of the Contract value for that particular individual process system will be made until this is received.

.3 Submit Draft O&M Manuals and draft WMS Equipment Information Database before 90% of the work is approved for payment. No payment for any work will be made over 90% of the Contract value of the overall project until the Draft O & M Manuals and draft WMS Equipment Information Database are received and accepted as satisfactory. Submit Final O&M Manuals and final WMS Equipment Information Database before 98% of the work is approved for payment. No payment for any work will be made over 98% of the Contract Value of the overall project until the Final O&M Manuals and final WMS Equipment Information Database are received and accepted as satisfactory.

.4 O & M Manuals to also be submitted in electronic form on a USB or FTP transfer to Engineer both native format (MS Word) as well as searchable Adobe PDF.

.5 Electrical and control schematics are to be submitted in native CAD format and in pdf.

1.4 BINDERS

.1 Provide the material in a black expanding catalogue binder. Binders are to be suitably labelled on spine and cover as noted under Item 1.4 Contents. The catalogue binder is to be Series P5400 as manufactured by Acco Canada Inc. or approved alternative.

.2 Contractor to supply a sample of the binder with spine and cover labelling for Engineer and City approval prior to submission of final O & M Manuals.

1.5 CONTENTS

.1 Arrange the material in volumes as described below. Provide a separate binder for each volume unless directed otherwise by Engineer. Where more than one (1) binder is required to accommodate the documentation for a volume, increase or decrease the number of volumes and renumber as necessary:

.2 Volume 1 - Operating Manual.

.3 Volume 2 - Architectural/Structural.

.4 Volume 3 - Mechanical Operations and Maintenance.

.5 Volume 4 - Electrical and Instrumentation Operations.

.6 Permanently number each set.

.7 Letter the spine of the binder with the full identification title of the project and the front face with the following on the respective binders:

.1 Full identification title of the project.

.2 Volume Number.

.3 Volume Title.

.4 City's name, (i.e., City of Toronto).

.5 Number of Sets (i.e., 1 of 3).

.8 Engineer will prepare the manual content in Volume 1. All other Volumes are the responsibility of Contractor. Provide the binders and the dividing tabs to Engineer for the compilation of Volume 1.

.9 Arrange the binders according to the Construction Specifications Institute MASTERFORMAT - Master List of Sections, Titles and Numbers, utilizing laminated mylar plastic divider tabs, colour coded according to section. Markings on the tabs are to be type written. Tab colours are to be as follows:

.1 Division – white.

.2 Sections – orange.

.3 Subsections – yellow.

.10 Make up each binder as follows:

.1 Tab: Table of Contents - details the titles of various divisions of the manual in the binder.

.2 Tab: Introduction to manual - written explanation of the layout of the manual and intended use.

.11 Include separately the following:

.1 Engineer: name, address, e-mail address, telephone and FAX numbers, name of Project Manager.

.2 Contractor: name, address, e-mail address, telephone and FAX numbers, name of Project Manager.

.3 Major Sub-Contractors: name, address, e-mail address, telephone and FAX numbers, of sub-contractors included in that binder.

.12 Provide the following for each respective discipline:

.1 Tab: Division number xx:

.2 Index - information in that division in order of appearance in the specification.

.3 List of sub-contractors and suppliers - name, address, and telephone and FAX numbers.

.4 Specification section cross-reference.

.5 Drawing List.

.13 Organize the various applicable sections under separate divider tabs labelled division/number as required by the project. A typical outline is as follows:

Tab: DIVISION X - XXXXXXXX

Section XXXXX – XXXXX
Section XXXXX – XXXXXX
Section – XXXXX
Section – XXXXX
Section – XXXXX
Section– XXXXX

.14 Provide the information given below, where applicable, for each system and major piece of equipment. Refer to each piece of equipment by its name and tag number. Where manufacturer's literature covers several models or options, highlight the applicable information, using a non fading marker, and cross out redundant information.

.1 Index of information in that section in order of appearance.

.2 Description of system, components and technical data. Include interfaces, sequences, operations; characteristic changes for seasonal operation.

.3 Maintenance and operating instructions including:

a. Installation instructions.

b. Procedure for starting.

c. Proper adjustment.

d. Test procedures.

e. Procedure for operating.

f. Procedure for shutdown.

g. Safety precautions.

h. List of electrical relay settings and control and alarm contact settings.

.4 Troubleshooting data.

.5 Preventative maintenance program complete with:

a. Suggested check list sheets.

b. List of points to be greased or oiled.

c. Recommended type, grade and temperature range of lubricants.

d. List of wear points to be inspected and/or adjusted regularly.

e. Suggested schedule for lubrication and inspection

.6 Schematic, single line, and wiring diagrams.

.7 Valve tag list.

.8 Recommended spare parts list.

.9 Certification, guarantee, warranty.

.10 Service representatives: Name, address and telephone number.

.11 Suppliers for replacement parts: Name, address, and telephone numbers.

.12 Test results: Witness testing and commissioning and provide reports.

.13 Test data for piping systems (degreasing, flushing, disinfection).

.14 Hydrostatic or air tests performance.

.15 Equipment alignment certificates.

.16 Balancing data for air and water systems.

.17 Inspection approval certificates for all types of systems; plumbing and piping, hot air and ventilating, electrical supervisory, etc.

.15 The material submitted in accordance with the contractual requirements for "As-Constructed Shop Drawings" is generally bulky and difficult to file in a binder. If requested by Engineer, provide copies of all "As-Constructed Shop Drawing" material in a single drawer legal size cardboard file cabinet. Arrange in accordance with the Construction Specifications Institute MASTERFORMAT. Identity any material located in the file cabinet as such in the appropriate location in the binders.

.16 At Engineer's discretion, provide the information in plastic map pockets in appropriate sections in the binders.

1.6 PAYMENT

.1 Payment for Operation and Maintenance Manuals will made upon submission and acceptance by City.

PART 2 PRODUCT – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01784

SPARE PARTS AND MAINTENANCE MATERIALS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual specification sections.

.2 Supply special tools, wrenches, and accessories that are required for removing worn parts, making adjustments, and carrying out maintenance works.

.3 Deliver maintenance materials, special tools and spare parts in designated area as directed by Engineer.

.4 Prepare lists of maintenance materials special tools and spare parts for inclusion in operations and maintenance manuals.

1.2 MAINTENANCE MATERIALS

.1 Deliver specified items packaged to prevent damage.

.2 Identify, on carton or package, colour, room number, system or area, as applicable, where items are to be used.

1.3 SPECIAL TOOLS

.1 Assemble special tools as specified.

.2 Include following:

.1 Identification tag reference.

.2 Identification of equipment or system for which tools are applicable.

.3 Instruction on intended use of tool.

.4 Identify special tools to indicate equipment or system for which tools are intended.

1.4 SPARE PARTS

.1 Assemble spare parts as specified.

.2 Include the following:

.1 Part number.

.2 Identification of equipment or system for which parts are applicable.

.3 Installation instructions as applicable.

.4 Name and address of nearest supplier.

.3 Identify spare parts to indicate equipment or system for which parts are applicable.

PART 2 PRODUCT – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01789

PROJECT RECORD DOCUMENTS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RECORD DRAWINGS

.1 Engineer will provide two (2) sets of clean white prints for record drawing purposes.

.2 Identify drawings as "Project Record Copy".

.3 Maintain record drawings in new condition.

.4 Make record drawings available for inspection on-site by the Engineer on a weekly basis.

.5 Record neatly and accurately deviations from Contract Documents.

.6 Mark all changes in red ink.

.7 Record following information:

.1 Horizontal and vertical location of piping, underground utilities and appurtenances referenced to permanent surface improvement.

.2 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

.3 Field changes of dimension and detail.

.4 Depths of various elements of foundation in relation to finished floor.

.5 Changes made by Change Order or field direction.

.6 Provide red-line markups of as constructed information in both hardcopy and electronic format(PDF) as per city's requirements on a monthly basis aligned with invoicing to Engineer. Accurate and up to date monthly red line markups are required for Engineer to approve monthly invoicing.

.8 For substantial performance of project and prior to final inspection, neatly transfer notations to second set of prints and submit both sets of record drawings and the topographic survey to the Engineer.

.9 If the submitted "Record information" is not complete, provide all additional information required by the Engineer at no additional cost to the City. Substantial Performance will not be granted until all "Record Information" is provided to and accepted by the City and Engineer.

PART 2 PRODUCT – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 01820

DEMONSTRATION AND TRAINING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section contains requirements for training the plant operating staff, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

1.2 QUALITY ASSURANCE

.1 Where required by the detailed specifications, provide on-the-job training of the plant operating staff at the plant at a location specified by the City. The training sessions are to be conducted by qualified, experienced (two (2) years minimum), articulate, factory – trained employee of the various equipment manufacturers. Provide proof of prior training experience upon to the Engineer. Training to include instruction of operating personnel in equipment operation and preventive maintenance and instruct plant mechanics, electricians, and electronics technicians in normal maintenance up to major repair.

.2 Manufacturer's employee is to be familiar with facility operation and maintenance requirements as well as with specified equipment.

1.3 SUBMITTALS

.1 Submit a training schedule and training materials in electronic format as specified ahead of scheduling training sessions at each of the water treatment plants.

.2 Submit the following information to the Engineer. Due to phased testing and start-up activities, separate submittals can be prepared for equipment items or systems. The material is to be reviewed and accepted by the Engineer no later than three (3) weeks prior to delivery of the training.

.1 Lesson plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials are to be included.

.2 Date, time, and subject of each training session and identity and qualifications of individuals to be conducting the training.

.3 Training materials in electronic format.

.4 Training schedule. Concurrent classes will not be allowed.

.5 Training materials in hard copies, Forty (40) copies per training session.

.6 Signed-off City 'On the Job Training Attendance Sheet'. A sample training attendance sheet is provided and must be submitted for after each completed training session and also included in the training manual. The equipment training sign in sheet should match the City's training groups sheet.

PART 2 PRODUCTS

2.1 GENERAL

.1 Conduct training sessions for the operation and maintenance personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training is to take place at the site of the work and under the conditions specified in the following paragraphs. Vendor operation and maintenance manuals are to be available to the owner's personnel at least 30 days prior to the date scheduled for the individual training session.

.2 Continuing Education Units (CEUs) credits as per OETC are to be provided. The number of CEUs credits associated with the training session are to be confirmed 30 days prior to the date scheduled for the individual training session.

2.2 LOCATION

.1 Field training sessions to take place at the R.C. Harris WTP.

2.3 LESSON PLANS

.1 Prepare formal written lesson plans for each training session. Lesson plans are to contain an outline of the material and to be presented along with a description of visual aids to be utilized during the session. Each plan to contain a time allocation for each subject. One (1) complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material will be the property of the owner and must be suitably bound for proper organization and easy reproduction. Furnish twenty (20) copies of necessary training manuals, handouts, visual aids and reference materials at least one (1) week prior to each training session.

2.4 FORMAT AND CONTENT

.1 Each training session is to be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, a training session will cover the following topics for each item of equipment or system:

.1 Familiarization.

.2 Safety.

.3 Operation.

.4 Troubleshooting.

.5 Preventive maintenance.

.6 Corrective maintenance.

.7 Parts.

.8 Local representatives.

.9 Operation and maintenance manuals.

2.5 VIDEO RECORDING

.1 The City may record themselves or retain the services of a commercial video recording service to record each training session. After recording, the material may be edited and supplemented with professionally produced graphics to provide a permanent record. Advise all manufacturers providing training sessions that the material may be video recorded.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

.1 Conduct training in conjunction with the operational testing and commissioning periods. Schedule classes such that classroom sessions are interspersed with field instruction in logical sequence. Arrange to have the training conducted on non-consecutive days, with no more than four (4) hours of classes scheduled for any one (1) day.

.2 Training is to be comprised of the following:

.1 General overview of system for all operations, safety, maintenance, and engineering personnel divided into five (5) identical sessions at the facility in order to ensure all personnel will be able to attend at least one of the five (5) sessions. One (1) of the five (5) sessions is to be conducted for the night shift (after work hours).

.2 Specific training for operations personnel divided into five (5) identical sessions at the facility in order to ensure all personnel will be able to attend at least one of the five (5) sessions. One (1) of the five (5) sessions is to be conducted for the night shift (after work hours).

.3 Specific training for maintenance personnel divided into five (5) identical sessions at the facility in order to ensure all personnel will be able to attend at least one of the five (5) sessions. One (1) of the five (5) sessions is to be conducted for the night shift (after work hours).

3.2 TRAINING SCHEDULE

.1 List specified equipment and systems that require training services at the water treatment plant facility and show:

.1 Name of manufacturer.

.2 Estimated dates for installation completion.

.3 Estimated training dates.

.2 Adjust schedule to ensure training of appropriate personnel as deemed necessary by the Engineer and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment. Schedule may need to accommodate multiple shifts over a working day at no extra cost to the City.

.3 Commence scheduling two months in advance of proposed training dates.

.4 Coordinate with Section 01330 – Submittals and Section 01751 – Pre-startup, Start-up and Commissioning.

.5 Pre-startup Training:

.1 Coordinate training sessions with Plant operating personnel and manufacturers' representatives and with submission of operation and maintenance manuals in accordance with Section 01783 – Operation and Maintenance Manual.

.2 Complete at least fourteen (14) days prior to beginning of facility start-up.

3.3 OPERATOR CLASSROOM TRAINING

.1 As a minimum, classroom equipment training for operations personnel will include:

.1 Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.

.2 Purpose and plant function of the equipment.

.3 A working knowledge of the operating theory of the equipment.

.4 Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.

.5 Identify and discuss safety items and procedures.

.6 Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.

.7 Operator detection, without test instruments, of specific equipment trouble symptoms.

.8 Required equipment exercise procedures and intervals.

.9 Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.

3.4 OPERATOR HANDS-ON TRAINING

.1 As a minimum, hands-on equipment training for operations personnel will include:

.1 Identify location of equipment and review the purpose.

.2 Identifying piping and flow options.

.3 Identifying valves and their purpose.

.4 Identifying instrumentation:

a. Location of primary element.

b. Location of instrument readout.

c. Discuss purpose, basic operation, and information interpretation.

.5 Discuss, demonstrate, and perform standard operating procedures and round checks.

.6 Discuss and perform the preventative maintenance activities.

.7 Discuss and perform start-up and shutdown procedures.

.8 Perform the required equipment exercise procedures.

.9 Perform routine disassembly and assembly of equipment if applicable.

.10 Identify and review safety items and perform safety procedures, if feasible.

3.5 MAINTENANCE CLASSROOM TRAINING

.1 Classroom equipment training for the maintenance and repair personnel will include:

.1 Theory of operation.

.2 Description and function of equipment.

.3 Start-up and shutdown procedures.

.4 Normal and major repair procedures.

.5 Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

.6 Routine and long-term calibration procedures.

.7 Safety procedures.

.8 Preventive maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.

3.6 MAINTENANCE HANDS-ON TRAINING

.1 Hands-on equipment training for maintenance and repair personnel will include:

.1 Locate and identify equipment components.

.2 Review the equipment function and theory of operation.

.3 Review normal repair procedures.

.4 Perform start-up and shutdown procedures.

.5 Review and perform the safety procedures.

.6 Perform City approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

.7 Review and use equipment manufacturer's manuals in the hands-on training.

END OF SECTION

TORONTO Water

ON THE JOB TRAINING ATTENDANCE SHEET

Course Code: _____

SESSION TOPIC: **SITE SPECIFIC SAFETY TRAINING** **Date of Session:**_____

Session Location: **Duration (mins):**_____

Training Leader: _____ **Job Title:** _____

Training Method: ____ Lecture/Discussion ____ Demonstration ____ Other: _____

LEARNING OBJECTIVE(S) Learning objectives should state explicitly what learners will know and/or be able to do as a result of attending the session.	**At the end of the session, participants will demonstrate knowledge in or be able to:**
	1.
	2.
	3.
	4.
	5.

PARTICIPANTS:

Name	Signature	Employee #	Name	Signature	Employee #

How did participants demonstrate learning? (Select 1 or more)		
	__ Participated in discussion (answered question)	__ Quiz (attach copies)
	__ Demonstration of skills/knowledge (e.g. hands-on)	__ Other:

Training Leader Signature: _____

Date Received by Skills & Development Unit: _____ S.A.P. Entry: _____

Forward original within 10 business days of the delivery date to Manager, Skills & Development for input into S.A.P. employee training records.

Template available: DOCS # **82141**

TORONTO

SECTION 01830

FACTORY ACCEPTANCE TESTING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 All major equipment where identified within specific specification sections, shall undergo a complete Factory Acceptance Test (FAT), at the manufacturer's facilities.

.2 The manufacturer shall make allowance for witness testing by the City. The Contractor shall notify the Contract Administrator four (4) weeks prior to the test. The decision to partake in this testing will be at the discretion of the City.

.3 The Contractor shall make allowance within their price, for the participation of a minimum of two (2) persons employed with the City's Engineer. These costs shall include, at a minimum, travel to and from the manufacturer's facility, lodging, meals and all other incurred travel expenses. Note that it is the Contractor's responsibility to determine the number of days required for each of the FAT's. Costs associated with the participation of direct City employees will be at the City's cost.

.4 All equipment shall be subject to inspection and testing by, and at the expense, of the Contractor. All testing, including shop tests, type tests, and field tests, shall be performed in accordance with the latest revision of the applicable standards and in accordance with these specifications.

.5 Testing shall confirm conformance of the equipment to the relevant standards and shall confirm the proper functioning of the equipment.

.6 The equipment shall be functionally tested as far as practicable in the Contractor's plant and, again, in the field to test the operation of all circuits and devices and to optimize performance.

.7 The Contractor shall seek written approval from the Contract Administrator prior to the shipping of the equipment.

1.2 SUBMITTALS

.1 The Contractor shall direct each equipment vendor shall submit a FAT plan 4 weeks prior to the scheduled FAT date. The City will review the plan and submit comments back to the Contractor for inclusion into the testing. The submittal shall be administered in the same manner as shop drawings, as described under Section 01330.

.2 The final FAT report, signed off at the factory by the Engineer and/or City, and the Manufacturer, shall be submitted to the City prior to delivery of the tested equipment.

PART 2 PRODUCT – NOT USED

PART 3 EXECUTION

3.1 FACTORY TESTS

.1 Tests carried out under FAT shall include, but not limited to the following:

.1 A complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.

.2 Standard production tests that are relevant to each specific piece of equipment and performed in accordance with applicable standards.

.3 Functional testing including the simulation of external interlocks and alarms.

.4 Production test on the switchgear assembly in accordance with all applicable standards and regulations.

.5 Production test on the circuit breakers in accordance with all applicable standards and regulations.

.6 Production test on the instrument transformers in accordance with CSA C13.

.7 Basic impulse level (for switchgear and transformers only).

.8 Any other tests identified within the specific equipment specification section.

.2 Upon completion of the FAT, the Contractor shall direct the manufacturer to correct any defects and/or deficiencies identified during the testing. Once all deficiencies have been corrected, a copy identifying as such shall be sent to the City, at which time approval will be given for the equipment to be delivered.

3.2 TEST REPORT

.1 Manufacturer shall prepare a FAT report for each piece of major equipment tested and shall include the following, at a minimum;

.1 Test descriptions.

.2 Test results (data tables, etc.)

.3 Standards referenced.

.4 Deficiency List identifying all items corrected.

.5 Certificate of Compliance (refer to Section 01430 – Manufacturer's Services).

.6 Sign-off approval sheets.

.2 Submit to the City, a copy of the final report (PDF format) within two (2) weeks after the completion of the FAT or once all deficiency items have been corrected.

.3 Include copies of FAT report within Operations and Maintenance Manuals, in accordance with Section 01783 – Operation and Maintenance Manual.

END OF SECTION

TORONTO

DIVISION 2

SITE WORKS

TORONTO

SECTION 02080

HAZARDOUS MATERIALS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 REFERENCES

.1 Definitions:

.1 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.3 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.

.2 Reference Standards:

.1 Canada Green Building Council (CaGBC)

.1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package for New Construction and Major Renovations (including Addendum 2007).

.2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide for Commercial Interiors.

.2 Canadian Environmental Protection Act,1999 (CEPA 1999)

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.3 Department of Justice Canada (Jus)

.1 Transportation of Dangerous Goods Act, 1992 (TDG Act) 1992, (c. 34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).

.4 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.2 GS-36-00, Commercial Adhesives.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 National Research Council Canada Institute for Research in Construction (NRC-IRC)

.1 National Fire Code of Canada-2005.

.3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with applicable sections.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS sheets to Owner’s Representative for each hazardous material required prior to bringing hazardous material on site.

.3 Submit hazardous materials management plan to Owner’s Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with applicable sections and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.1 When exporting hazardous waste to another country, ensure compliance with Export and Import of Hazardous Waste and Hazardous Recyclable Materials Regulations.

.4 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials with Owner’s Representative and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and waste in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.

.1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Owner's Representative.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.

.7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.

.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 When hazardous waste is generated on site:

.1 Co-ordinate transportation and disposal with Owner's Representative.

.2 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.

.3 Use licensed carrier authorized by provincial authorities to accept subject material.

.4 Before shipping material obtain written notice from intended hazardous waste treatment or disposal facility it will accept material and it is licensed to accept this material.

.5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.

.6 Only trained personnel handle, offer for transport, or transport dangerous goods.

.7 Provide photocopy of shipping documents and waste manifests to Owner's Representative.

.8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide photocopy of completed manifest to Owner's Representative.

.9 Report discharge, emission, or escape of hazardous materials immediately to Owner's Representative and appropriate provincial authority. Take reasonable measures to control release.

.12 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

.13 Report spills or accidents immediately to Owner's Representative. Submit a written spill report to Owner's Representative within 24 hours of incident.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Description:

.1 Bring on site only quantities of hazardous material required to perform Work.

.2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

PART 3 EXECUTION

3.1 CLEANING

.1 Progress Cleaning: clean in accordance with applicable Sections.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Lead-acid battery recycling.

.4 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

TORONTO

SECTION 02081

LEAD PAINT AND LEAD PRODUCT REMOVAL

TABLE OF CONTENTS

PART 1 GENERAL

1.1 OUTLINE OF WORK

.1 Comply with the requirements of this Section when performing the following work:

.1 Removing lead-containing products, coatings, sheet metal, packing, babbit or similar material, and soldering from structures in advance of building deconstruction demolition and renovation, only pertaining to locations and circumstances where it's required.

.2 Type 1 Operation:

.1 Work operations that generate an airborne lead concentration less than 0.05 mg/m³.

.2 Using chemical gel or paste.

.3 Using power tools with effective HEPA-filtered dust collection system.

.3 Type 2a Operation:

.1 Work operations that generate an airborne lead concentration from 0.05 to 0.50 mg/m³.

.2 Welding or high temperature cutting of lead-containing coatings or materials outdoors.

.3 Removal of lead-containing coatings or materials by scraping or sanding using non-powered hand tools.

.4 Manual demolition of lead painted plaster walls or building components by striking a wall with a sledgehammer or similar tool.

.4 Type 3a Operation:

.1 Work operations that generate an airborne lead concentration from 1.25 to 2.50 mg/m³.

.2 Welding or high temperature cutting of lead-containing coatings or materials indoors or in a confined space.

.3 Burning of a surface containing lead.

.4 Dry removal of lead-containing mortar using an electric or pneumatic cutting device.

.5 Removal of lead-containing coatings or materials using power tools without an effective, HEPA filtered dust collection system.

.6 Removal or repair of a ventilation system used for controlling lead exposure.

.7 Demolition or cleanup of a facility where lead-containing products were manufactured.

.8 An operation that may expose a worker to lead dust, fume or mist that is not a Type 1, Type 2, or Type 3b operation.

.5 Type 3b Operation:

.1 Work operations that generate an airborne lead concentration in excess of 2.50 mg/m³.

.2 Abrasive blasting of lead-containing coatings or materials.

.3 Removal of lead-containing dust using an air mist extraction system.

.2 Lead paint on structures is to be removed as part of overall building renovation, deconstruction, and/or demolition. Refer to Scope of Work outline. Reference to this specification relates to precautions to be undertaken during building deconstruction, demolition or renovation in removing and handling of lead-contaminated waste, including worker protection, cleanup and disposal procedures.

.3 Comply with the regulation respecting lead made under the Occupational Health and Safety Act, Revised Statutes of Ontario, 1990, Ontario Regulation R.R.O. 1990, 0. Reg. 213/91 as amended by O. Reg. 631/94, O. Reg. 490/09 (Lead), as amended and Ministry of Labour, Occupational Health and Safety Branch, Guideline: Lead on Construction Projects September 2004, www.labour.gov.on.ca/ english/hs/guidelines/lead/index.html.

1.2 DEFINITIONS

.1 Authorized visitor: the Owner's Representative and persons representing regulatory agencies.

.2 Lead Work Areas: where actual removal or welding, burning or high temperature cutting application of lead containing coatings or materials takes place.

.3 Lead dust: consists of solid particles created through processes such as blasting, sanding, grinding and electric or pneumatic cutting.

.4 Lead fumes: fumes produced when lead or lead contaminated materials are heated to temperatures above 500 degrees C, such as welding, high temperature cutting, and during operations.

.5 Lead mist: liquid droplets containing lead suspended in air.

.6 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency, capable of controlling airborne lead concentration levels to below 0.05 mg/m³.

.7 Occupied Area: Any area of the building or work site that is outside the Lead Work Area.

.8 Polyethylene sheeting sealed with tape: Polyethylene sheeting of type and thickness specified sealed with tape along all edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealants, and to prevent escape of lead dust, lead fumes or lead mist through the sheeting into a clean area.

.9 Negative pressure: A system that extracts air directly from work area, filters such extracted air through a High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building. This system shall maintain a minimum pressure differential of 5 Pa relative to adjacent areas outside of work areas, be equipped with an alarm to warn of system breakdown and be equipped with an instrument to continuously monitor and automatically record pressure differences.

.10 Airlock: A system for permitting ingress or egress without permitting air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways at least 2 m apart.

.11 Curtained doorway: An arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows: Place two overlapping sheets of polyethylene over an existing or temporarily framed doorway, secure each along the top of the doorway, secure the vertical edge of one sheet along one vertical side of the doorway, and secure the vertical edge of the other sheet along the opposite vertical side of the doorway. Reinforce free edges of polyethylene with duct tape and weight the bottom edge to ensure proper closing. Each polyethylene sheet shall overlap openings not less than 1.5 m on each side.

1.3 REGULATORY AGENCIES

.1 Comply with Federal, Provincial, and local requirements pertaining to lead, provided that in any case of conflict among these requirements or with these specifications the more stringent requirement shall apply.

1.4 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CSA-S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

.2 National Building Code 2010 (NBC):

.1 NBC 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.

.3 National Fire Code 2010 (NFC):

.1 NFC 2010, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.

.4 Province of Ontario:

.1 Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Ontario 1990, Chapter O.1 as amended, 0. Reg. 213/91 as amended by O. Reg. 631/94, O. Reg. 490/09 (Lead) as amended by O. Reg. 148/12 and O. Reg. 149/12 and Ministry of Labour, Occupational Health and Safety Branch, Guideline: Lead on Construction Projects September 2004, www.labour.gov.on.ca/ english/hs/guidelines/lead/index.html.

.2 Workplace Safety and Insurance Act, 1997.

.3 Municipal statutes and authorities.

.5 United States Department of Labour:

.1 Safety and Health Regulations for Construction, Subpart D Occupational Health and Environmental Controls, Lead Regulation 29 CFR 1926.62, OSHA Occupational Safety and Health Administration. www.osha.gov/pls/oshaweb/ owadisp.show_document?p_table=STANDARDS&p_id= 0 41.

1.5 SUBMITTALS

.1 Before commencing work:

.1 Obtain from the appropriate agency and submit to Owner's Representative all necessary permits for transportation and disposal of lead waste. Ensure that dump operator is fully aware of hazardous nature of material being dumped, and proper methods of disposal. Submit proof satisfactory to Owner's Representative that suitable arrangements have been made to receive and properly dispose of lead waste. Coordinate disposal with applicable spec sections.

.2 Submit proof satisfactory to Owner's Representative that all employees have had instruction on the hazards of lead exposure, respirator use, dress, use of showers, entry and exit from work areas, and all aspects of work procedures and protective measures. Supervisory personnel shall have attended a lead exposure course, of not less than two days duration, approved by the Owner's Representative. Submit proof of attendance in the form of a certificate. Minimum of one Supervisor for every ten workers.

.3 Submit layout of proposed enclosures and decontamination facilities to Owner's Representative for review.

.4 Submit Provincial and/or local requirements for Notice of Project Form.

.5 Submit proof of Contractor's Lead Liability Insurance.

.6 Submit proof satisfactory to the Owner's Representative that all employees have respirator fitting and testing. Workers must be fit-tested (irritant smoke test) with the respirator that is personally issued.

.7 Submit Worker's Safety and Insurance Board status and transcription of insurance.

.8 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets for chemicals or materials used or applied.

1.6 EXISTING CONDITIONS

.1 Reports and information pertaining to material containing lead paint to be handled, removed, or otherwise disturbed during this project are bound into this specification and/or available upon request.

.2 Notify the Owner’s Representative of lead containing material discovered during the work and not apparent from the drawings, specifications, or report, pertaining to the work. Do not disturb such material pending instructions from the Owner’s Representative.

1.7 INSTRUCTION AND TRAINING

.1 Before commencing work, provide to the Owner’s Representative satisfactory proof that every worker has had instruction and training in the hazards of lead exposure, in personal hygiene and work practices, and in the use, cleaning, and disposal, of respirators and protective clothing in accordance with Ministry of Labour, Occupational Health and Safety Branch, Guideline: Lead on Construction Projects.

.2 Instruction and training related to respirators shall include instruction and training related to:

.1 The limitations of the equipment.

.2 The inspection and maintenance of the equipment.

.3 The fitting of the equipment.

.4 The cleaning and disinfecting of the equipment.

1.8 WORKER PROTECTION

.1 Protective equipment and clothing to be worn by workers while in the Lead Work Area in accordance with the Ministry of Labour, Occupational Health and Safety Branch, Guideline: Lead on Construction Projects.

.2 Respirators as per Guideline Lead on Construction Projects, Table 1. Provide workers with personally issued and marked respiratory equipment acceptable to Labour Canada or provincial labour department as suitable for the type of lead exposure. If disposable type dust/fume/mist filters and organic vapour cartridges are used, provide sufficient filters and cartridges so that workers can install new filters and cartridges following disposal of used filters and cartridges before re-entering contaminated areas. No worker or authorized visitor may have facial hair which prevents proper contact between respirator facepiece and skin. Alternatively, a supplied air positive pressure respirator or a supplied air positive pressure hood or helmet may be provided.

.3 Protective clothing and goggles: provide workers with protective clothing made of material designed to reduce dust retention. Such clothing shall feature close-fitting neck and arm openings, which can help to prevent dust penetration.

.4 Eating, drinking, chewing gum, and smoking are not permitted in the work area.

.5 Workers shall wash hands and face when leaving the work area. Facilities for washing are available nearby in Room where indicated on drawings where directed by Owner's Representative.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Drop Sheets: 0.15 mm thick polyethylene.

.1 Polyethylene: 0.15 mm thick.

.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.3 Tape: compatible with drop sheets.

.2 Paint removal paste:

.1 Neutral pH.

.2 Flash point: > 113 C(237 F) none.

.3 Boiling point: > 315 C(600 F).

.4 Specific gravity: 1.0 1.4g/ml.

.5 VOC: g/l<50%.

.6 Weight: 1.4 kg/l (1.6 lbs./gal).

.7 Acceptable material: 'Enviro Klean Safety Peel 1 Enviro Klean Safety Peel 2 Enviro Klean Safety Peel 3' manufactured by Prosoco Inc., 800-255-4255, www.prosoco.com; or 'Super-C-Lead Strip SS Self Sealing Lead Paint Removal Paste' manufactured by Grace Construction Products 866-333-3726 www.graceconstruction.com.

.3 Paint removal gel:

.1 Neutral pH.

.2 Flash point: > 93 C(200 F).

.3 Boiling point: > 315 C(600 F).

.4 Specific gravity: 0.99 g/ml.

.5 VOC:g/l<4.41%.

.6 Acceptable material: 'SoyGreen 6000 Soy Safe Paint Remover & Solvent High Viscosity Paint Stripper/Safety Solvent' manufactured by ECO Safety Products, LLC, 877-366-7547, 602-305-9397 www.ecosafetyproducts.com; 'SoyGreen 6000 Soy Safe Paint Remover & Solvent High Viscosity Paint Stripper/Safety Solvent' manufactured by ECO Safety Products LLC 877-366- 7547, 602-305-9397 www.ecosafetyproducts.com.

.4 Paint removal strip/pad:

.1 Neutral pH.

.2 Flash point: > 113 C(237 F).

.3 Boiling point: > 315 C(600 F).

.4 Specific gravity: 1.0 g/ml.

.5 VOC:g/l<50%.

.6 Acceptable material:

.5 Paint removal liquid:

.1 Neutral pH.

.2 Flash point: > 113 C(237 F).

.3 Boiling point: > 315 C(600 F).

.4 Specific gravity: 1.0 g/ml.

.5 VOC: g/l<50%.

.6 Acceptable material: 'SoyGreen Enviroclear Lead Paint and Coating Remover' manufactured by ECO Safety Products LLC 877-366-7547, 602-305-9397 www.ecosafetyproducts.com.

2.2 EQUIPMENT

.1 Pneumatically operated needle gun with adjustable vacuum enclosure and hardened multiple reciprocating needles completely enclosed within adjustable stainless steel enclosure. Needle gun with standard and custom shrouds to allow cutters to conform to inside corners, outside corners, odd contours and flat surfaces.

.1 Production rate:

.1 Flat surfaces: 1.9-2.8 m²/hr.

.2 Edges and corners: 9-18 m/hr.

.2 Cutting width: 45 mm.

.3 Cutting needles: stainless steel, 3 mm diameter for concrete or steel 2 mm diameter for steel surface preparation to meet Steel Structures Painting Council (SSPC) SSPC-SP 11 - Power Tool Cleaning to Bare Metal.

.4 Vacuum: minimum 1.4 m³/minute vacuum source at 38 mm diameter vacuum hose connection. Interfaceable with self-cleaning, high efficiency HEPA filtered vacuum.

.5 Acceptable material: 'CORNER-CUTTER' manufactured by Piontek Inc., 1026 Fourth Avenue, Coraopolis, Pa, USA 15108, 412-645-2775 www.pentekusa.com, distributed in Canada by Pentek Inc., 905-338-7939.

.2 Mobile, high performance HEPA Vacuum/Drumming System capable of supporting the simultaneous operation of up to three needle guns and the following:

.1 Two-stage positive filtration of hazardous particles.

.1 First stage: Automatic self-cleaning by reverse-flow pulses of high pressure air. Efficiency of 95% at 1 micron.

.2 Second stage: HEPA efficiency of 99.7% at 0.3 microns.

.2 Controlled-seal drum fill system to allow filling, sealing, removal and waste drum replacement under controlled vacuum system.

.3 Size: 1219 mm long x 711 mm wide x 1828 mm or 2134 mm high.

.4 Automatic, full-drum level alarm.

.5 Acceptable material: 'VAC-PAC Models' manufactured by Pentek Inc., 1026 Fourth Avenue, Coraopolis, Pa, USA 15108, 412-645-2775, www.pentekusa.com, distributed in Canada by Pentek Inc., 905-338-7939.

PART 3 EXECUTION

3.1 PROCEDURES

.1 Do work in accordance with:

.1 0. Reg. 213/91 as amended by O. Reg. 631/94, Clause 14, Sections 21, 30, 46 and 59 requirements of the Guideline for details.

.2 O. Reg. 843/90 (Lead) as amended by O. Reg. 519/92 and O. Reg. 389/00 and Ministry of Labour, Occupational Health and Safety Branch, Guideline: Lead on Construction Projects.

.3 United States Department of Labour, Safety and Health Regulations for Construction, Subpart D Occupational Health and Environmental Controls, Lead Regulation 29 CFR 1926.62.

.2 Prevent the spread of dust from the work area using measures appropriate to the work to be done as Type 1, 2a, 2b, 3a, 3b, Operation.

.3 Perform work in a manner to reduce dust creation to lowest levels practicable. All work will be subject to visual inspection. Any contamination of the surrounding areas indicated by visual inspection will require the complete enclosure and clean-up of the affected areas.

.4 Cleanup:

.1 Frequently during the work and immediately after completion of the work clean up dust and waste containing lead using a HEPA vacuum or by damp mopping.

.2 Place dust and waste containing lead in sealed dust-tight waste bags. Drop sheets shall be treated as lead waste and shall be wetted and folded to contain dust and then placed in waste bags.

.3 Immediately before their removal from the work area, and disposal, clean each filled waste bag using damp cloths or HEPA vacuum.

.4 Seal waste bags and remove bags and drums from site. Dispose of in accordance with requirements of Provincial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for lead disposal are followed.

.5 Perform final thorough cleanup of work areas and adjacent areas affected by the work using HEPA vacuum.

.5 Disposal:

.1 Dispose of lead paint and products removal waste in accordance with requirements of Provincial and Federal authority having jurisdiction.

.2 Co-operate with Ministry of Environment inspectors and immediately carry out instructions for remedial work at dump at no extra cost, as required.

.3 Ensure dump operator is fully aware of hazardous nature of material to be dumped.

.4 Provide Owner's Representative with a copy of receipt for disposed lead paint removal waste issued by dump operator.

END OF SECTION

TORONTO

SECTION 02082

MANAGEMENT OF NON-HAZARDOUS WASTE

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section forms part of the contract documents and covers requirements pertaining to the management of non-hazardous waste during abatement and demolition work. Read this section in conjunction with all other sections to comply with the requirements of the Contract's general conditions.

.2 This Section specifies the requirements for waste management including the reduction of materials sent to landfills, maximizing the salvage of materials for reuse and recycling and specifying a systematic waste management program, which at the completion of the project, will have clear documentation of the implemented waste management program.

1.2 MEASUREMENT AND PAYMENT

.1 The work of this Section will not be measured separately for payment. All costs associated with the work outlined in this Section shall be included in the Contract Price.

1.3 RELATED SECTIONS

.1 The management of asbestos waste and hazardous waste is covered in other specifications forming part of this contract. Contractor is to satisfy himself or herself with all requirements throughout the Contract Documents. Each Section of the Specifications is not necessarily complete in itself and all Sections of the Specifications are related. Contractor shall read each Section in conjunction with all of the other Contract Documents. Contractor shall also ensure that all Subcontractors read the relevant documents and comply with their requirements.

1.4 WASTE MANAGEMENT GOALS

.1 Ontario's 3Rs Regulations applying specifically to large scale construction and demolition projects are to be followed on the project.

.2 The Ministry of Environment is primarily responsible for setting standards for the management of non-hazardous waste through legislation and regulations and for enforcing compliance with these legislative requirements.

.3 Public Works and Government Services Canada's (PWGSC) Waste Management Goal is 75 percent of total Project Waste to be diverted from landfill sites.

.4 Provide the City with documentation certifying that waste management, recycling, and reuse of recyclable and reusable materials have been extensively practiced. Accomplish maximum control of solid construction waste.

.5 Preserve environment and prevent pollution and environmental damage.

1.5 LEGISLATION

.1 The following legislation applies to this section and shall be read in conjunction with all Contract Documents:

.1 Environmental Protection Act, Ontario Regulation 102/94, Waste Audits and Waste Reduction Work Plans – March 1994.

.2 Environmental Protection Act, Ontario Regulation 103/94, Industrial, Commercial and Institutional Source Separation Programs – October 2011.

.3 Environmental Protection Act, R.R.O. 1990, Regulation 347, General – Waste Management – November 2012.

1.6 DEFINITIONS

.1 Materials Source Separation Program (MSSP): consists of a series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.2 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.3 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.4 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.5 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modeling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

.6 Salvage: removal of structural and non-structural materials from deconstruction or disassembly projects for purpose of reuse or recycling.

.7 Separate Condition: refers to waste sorted into individual types.

.8 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

.9 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume or weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.

.10 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.7 DOCUMENTS

.1 Maintain at Site, one copy of the following documents:

.1 Waste Audit (Schedule A).

.2 Waste Reduction Workplan (Schedule B).

.3 Material Source Separation Plan.

1.8 SUBMITTALS

.1 Prepare and submit the following:

.1 Two copies of completed Waste Audit: Schedule A.

.2 Two copies of completed Waste Reduction Workplan: Schedule B.

.3 Two copies of Materials Source Separation Program description.

.2 Before final payment: summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.

.1 Failure to submit could result in hold back of final payment.

.2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled or disposed of.

.3 For each material reused, sold or recycled from project, include amount in tonnes and the destination.

.4 For each material landfilled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.9 WASTE AUDIT

.1 Conduct and Prepare WA: Schedule A.

.2 Record on WA - Schedule A extent to which materials or products used consist of recycled or reused materials or products.

1.10 WASTE REDUCTION WORKPLAN

.1 Prepare Waste Reduction Workplan (WRW).

.2 WRW should include, but not be limited to:

.1 Destination of materials listed.

.2 Deconstruction/disassembly techniques and sequencing.

.3 Schedule for deconstruction/disassembly.

.4 Clear labeling of storage areas.

.5 Details on materials handling and removal procedures.

.6 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.

.3 Structure WRW to prioritize actions and follow 3Rs hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials based on information acquired from WA.

.6 Post WRW or summary where workers at Site are able to review content.

.7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

.8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.11 MATERIALS SOURCE SEPARATION PROGRAM

.1 Prepare Materials Source Separation Program (MSSP) and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by the City.

.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated materials in areas which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

.1 Transport to approved and authorized recycling facility.

.8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.

.1 Ship materials to site operating under Certificate of Approval.

.2 Materials must be immediately separated into required categories for reuse or recycling.

1.12 WASTE PROCESSING SITES

.1 Ministry of Environment, 135 St. Clair Avenue West, Toronto, ON, M4V 1P5
Telephone: 416-323-4321, 1-800-565-4923
Fax: 416-323-4682.

.2 Environment Canada
Telephone: 416-734-4494.

1.13 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations acceptable to City.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.4 Protect structural components not removed for demolition from movement or damage.

.5 Support affected structures. If safety of building is endangered, cease operations and immediately notify the Engineer.

.6 Protect surface drainage from damage and blockage.

.7 Separate and store materials produced during dismantling of structures in designated areas.

.8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.9 Practice On-site source separation wherever possible.

.10 Provide waybills for separated materials.

1.14 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste (e.g. volatile materials, mineral spirits, oils, paint thinners, etc.) into waterways, storm, or sanitary sewers.

.3 Keep records of construction waste including:

.1 Number and size of bins.

.2 Waste type of each bin.

.3 Total tonnage generated.

.4 Tonnage reused or recycled.

.5 Reused or recycled waste destination.

.4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.5 Prepare project summary as part of WA to verify destination and quantities on a material-by-material basis.

1.15 USE OF SITE AND FACILITIES

.1 Execute work with the least possible interference or disturbance to normal use of premises.

.2 Establish and maintain security measures throughout the project at the Site.

1.16 SCHEDULING

.1 Co-ordinate Work with other activities at Site to ensure timely and orderly progress of Work.

PART 2 EXECUTION

2.1 APPLICATION

.1 Do Work in compliance with WRW.

.2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

2.2 CLEANING

.1 Remove tools, equipment and waste materials upon completion of Work, and leave Site in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

2.3 DIVERSION OF MATERIALS

.1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by the City, and consistent with applicable fire regulations.

.1 Mark containers or stockpile areas.

.2 Provide instruction on disposal practices.

.2 On-site sale of salvaged, recovered, reusable or recyclable materials is not permitted.

.3 Demolition Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Acoustic Tile	50	
Acoustical Insulation	100	
Carpet	100	
De-mountable Partitions	80	
Doors and Frames	100	
Electrical Equipment	80	
Furnishings	80	
Marble Base	100	
Mechanical Equipment	100	
Metals	100	
Rubble	100	
Wood (uncontaminated)	100	
Other		

.4 Construction Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Cardboard	100	
Plastic Packaging	100	
Rubble	100	
Steel	100	
Wood (uncontaminated)	100	
Other		

Schedule A – Ministry of the Environment Waste Form
Report of a Waste Audit
Large Construction and Demolition Projects
As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste audit must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request. (revised July 2008)

I. GENERAL INFORMATION

Name of Person Undertaking Project and Company Name:				
Name of Contact Person and Company:		**Telephone #:**	**Email address:**	
Project Type (Check One)*	**Construction Project**		**Demolition Project**	
Floor Area (square metres):		**Number of Buildings:**		
Street Address of Project Site (if known):				
Lot and Plan Number:		**Municipality:**		
Estimated Start Date of Project:		**Estimated Completion Date of Project:**		

**** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.***

II. DESCRIPTION OF PROJECT

Provide a brief overview of the construction or demolition project:

III. CATEGORIES OF WASTE AND WASTE ITEMS

List the categories of waste the project will produce and the associated waste items for each category (*see part VI for examples of categories of waste*):

Categories of Waste	Waste Items
Example: Wood	*Lumber cut-offs, Old Window frames*

IV. PRODUCTION OF WASTE

For each category of waste listed in Part III of this form, explain how the waste at the construction or demolition project will be produced. Include references to how management decisions and policies will affect the production of waste:

How Waste Is Produced	Decisions and Policies Affecting Waste Produced
Example: Cut-offs and over-runs of waste shingles are produced during roofing.	*Look at more accurate measurements for estimating amount of roofing shingles required*

V. MANAGEMENT OF WASTE

For each category of waste listed in Part III of this form, indicate which waste items will be disposed or reused/recycled and how each item will be managed at the project:		
Category	**Waste to be Disposed**	**Reused or Recycled Waste**
Example: Lumber cut-offs	*Small pieces into roll off waste bin.*	*Larger pieces saved in piles and later reused as bridging or blocking during construction.*

VI. ESTIMATED QUANTITY OF WASTE PRODUCED

Categories of Waste	Estimated Amount of Waste Produced (tonnes)	Categories of Waste (continued)	Estimated Amount of Waste Produced (tonnes)
Brick and Concrete		Tile Flooring	
Cardboard		Carpet	
Drywall (unpainted)		Glass	
Drywall (painted)		Plaster	
Steel		Blue Box – Newspaper, cans, etc.	
Wood (unpainted or untreated)		Other	
Wood (painted/treated)			
Plastic (pipes, film, etc)			
Polystyrene Foam			
Porcelain Fixtures			
Insulation			
Asphalt			
Aluminum			
Roof Shingles			
TOTAL		**TOTAL**	

Note: When completing this form, write “n/a” in the Estimated Amount of Waste Produced column where the project will not produce any waste for a category of waste.

VII. EXTENT TO WHICH MATERIALS OR PRODUCTS USED BY THE ENTITY CONSIST OF RECYCLED OR REUSED MATERIALS OR PRODUCTS

Please answer the following questions:

1. Do you have a management policy in place that promotes the purchasing and/or use of materials or products that consist of recycled and/or reused materials or products? If yes, please describe.

2. Do you have plans to increase the extent to which materials or products used consist of recycled or reused materials or products? If yes, please describe.

Please attach any additional page(s) as required to answer the above questions.

I hereby certify that the information provided in this Waste Reduction Work Plan is complete and correct.		
Signature of authorized official:	**Title:**	**Date:**

Schedule B – Ministry of the Environment Waste Form
Report of a Waste Reduction Work Plan
Large Construction and Demolition Projects
As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste reduction work plan must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request.

I. GENERAL INFORMATION

Name of Person Undertaking Project and Company Name:					
Name of Contact Person and Company Name:		**Telephone #:**		**Email Address:**	
Project type (check one)*	**Construction Project**		**Demolition Project**		
Floor Area (square metres):		**Number of Buildings:**			
Street Address of Project Site (if known):					
Lot and Plan Number:		**Municipality:**			
Estimated Start Date of Project:		**Estimated Completion Date of Project:**			

**** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.***

II. DESCRIPTION OF PROJECT

Provide a brief overview of the construction and/or demolition project:

III. PLANS TO REDUCE, REUSE AND RECYCLE WASTE

For each category of waste described in Part III of "Report of a Waste Audit" (on which this plan is based), explain what your plans are to reduce, reuse and recycle the waste, including:
1) how the waste will be source separated at the project, and
2) the programs to reduce, reuse and recycle all source separated waste.

Waste Category	Source Separation and 3Rs Program
Example: Wood waste	*Separate reusable pieces into special marked bins; non-reusable pieces into disposal bin. Larger pieces of wood will be reused for bridging or blocking.*

IV. RESPONSIBILITY FOR IMPLEMENTING THE WASTE REDUCTION WORK PLAN

Identify who is responsible for implementing the Waste Reduction Work Plan at the construction or demolition project. If more than one person is responsible for implementation, identify each person who is responsible and indicate the part of the Waste Reduction Work Plan that each person is responsible for implementing.

Name of Person	Responsibility	Telephone #

V. TIMETABLE FOR IMPLEMENTING WASTE REDUCTION WORK PLAN

Provide a timetable indicating when each Source Separation and 3Rs program of the Waste Reduction Work Plan will be implemented.	
Source Separation and 3Rs Program	**Schedule for Completion**
Example: Wood Reuse Program	*Set up before construction. Ongoing during project.*

VI. COMMUNICATION TO WORKERS

Explain how the Waste Reduction Work Plan will be communicated to workers at the site of the construction or demolition project:

VII. ESTIMATED ANNUAL WASTE PRODUCED BY MATERIAL TYPE AND THE PROJECTED ANNUAL AMOUNT TO BE DIVERTED BY THE 3RS

Material Categories (as shown in Part III)	**Estimated Waste Produced/Yr. *** (kgs or tonnes)	**Name of Proposed 3Rs Program** (as stated in Part III)	**Projections to Reduce, Reuse or Recycle Waste/Yr.** (kgs or tonnes)			**Estimated Waste Diversion Rate**** (%)
			Reduce	**Reuse**	**Recycle**	
Example: Wood (unpainted)	*600 kgs*	*Wood Reuse Program*		*~ 360 kg*		*60%*

* Estimated Waste Produced = Waste Diverted (3Rs) + Waste Disposed

** Estimated Waste Diversion Rate = Amount of Waste Diverted (3Rs) ÷ Estimated Waste Produced x 100%

Note: When completing this form, write “n/a” in the Estimated Waste Produced column where the project will not produce any waste from a material category.

I hereby certify that the information provided in this Waste Reduction Work Plan is complete and correct.		
Signature of authorized official:	**Title:**	**Date:**

END OF SECTION

TORONTO

SECTION 02137

BRACING AND SHORING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Protection of existing structures, services, utilities, facilities and other foundations on grade from damage or displacement by providing appropriate ground support.

.2 Designing, supplying, placing, bracing, and removing temporary shoring of sides of excavations.

.3 Excavation shoring systems left in place, where necessary, to prevent movement, settlement and there by ensure safe execution of supporting ground.

.4 Shoring system where indicated on the Contract Drawings.

1.2 RELATED SECTIONS

.1 Division 1, General Requirements

.2 Section 02315, Excavation, Trenching and Backfilling.

.3 Section 03400, Precast Concrete

.4 Section 03300, Cast-in-Place Concrete.

1.3 REFERENCES

.1 CAN/CSA-G40.20-M General Requirements for Rolled or Welded Structural Quality Steel.

.2 CAN/CSA-G40.21-M Structural Quality Steels.

.3 CAN/CSA-S16.1 Limit States Design of Steel Structures.

.4 CSA W47.1 Certification of Companies for Fusion Welding of Steel Structures.

.5 CSA W59-M Welded Steel Construction (Metal Arc Welding).

.6 ASTM A29/A29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirement for.

.7 ASTM A322 Specification for Steel Bars, Alloy, Standard Grades.

.8 Regulations for Construction Projects, Ontario Regulation 213/91, made under the *Occupational Health and Safety Act*, Revised Statutes of Ontario, 1990, Chapter O.1.

1.4 DEFINITIONS

.1 Temporary Structures: Structures of a short-term nature, such as excavation shoring systems, vertical or lateral shoring of existing structures or utilities, and similar systems which will be required in order to execute construction of permanent works.

.2 Excavation Shoring (Support) System: A left in place, or removable temporary structure, such as steel liner plates, steel-sheet piling, soldier piles and lagging, interlocking concrete caisson walls with or without steel piles embedded, concrete slurry walls, steel rib and lagging, or similar system required with necessary lateral support system to retain earth and water in order to facilitate construction of permanent works within specified deflection limits and other conditions imposed.

.3 Cofferdam: A watertight excavation shoring system enclosing an area within which construction of permanent works can be safely carried out.

.4 Lateral Supports: Tie backs anchored in soil and rock (pre-stressed where required), rakers, struts and walers, and internal bracing that will control deflection and movement of excavation shoring system so that performance criteria are met.

.5 Temporary Supports and Bracing: Structural supports that may be needed during construction of the permanent works.

.6 Man Made Obstructions in Ground: Existing man-made underground obstructions include abandoned pipes, concrete pipe cradles on piles, broken pieces of reinforced concrete left from previous construction projects, etc.

1.5 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Excavation systems shown on the Contract Drawings are not designed, and outlines the approximate locations are shown only conceptually. The Vendor is responsible for selection and design of all excavation shoring systems for excavations bases on their proposed means and methods and equipment for completing the Work.

.2 Design based on recognized geotechnical and structural theories for conditions present. Design to allow for the protection and support of existing structures (existing pipes, maintenance holes/chambers, utilities, etc.)

.3 Select shoring systems to suit existing field conditions. When selecting and designing a suitable shoring system, take the following factors into considerations:

a. Proximity of existing underground utilities.

b. The presence of existing pipe lines and abandoned pipelines, conduit, cables, duct banks, known and unknown buried in the area.

c. Suitability of tie-backs locations based on existing utility.

d. Profile of soil and piping coming in future.

e. The geotechnical conditions and the potential use of 'deadmen' tie-backs, etc.

.4 Consider applicable loads and load combinations, including lateral pressures from groundwater, surcharge load due to traffic and equipment, soil, unsymmetrical surcharge loads from construction operations, and frost action on retained soil as applicable.

.5 Limit horizontal deflections of excavation shoring systems to maximum 30 mm so that shoring system retains material and supports foundations at a higher elevation and retained material is not disturbed or weakened.

.6 Bracing to remain fully effective during construction. Pre-stress bracing, if required, to control deflection within limits specified.

.7 Base section properties of steel-sheet piling on complete slippage at interlocks.

.8 Design splices in walers and bracing in accordance with requirements of CAN/CSA-S16.1.

.9 The support system shall be designed to positively ensure that no loading will be placed on the new work prior to the completion of the new work and until design strength has been reached. The Vendor shall be solely and completely responsible for any loss due to premature loading of the new work.

.10 Other Design Requirements for Shoring System:

a. Select a shoring system that can accommodate known, and unknown, obstructions.

b. Pre-excavate/probe to determine location and extent of obstructions prior to finalizing shoring selection and design as necessary to suit.

c. Provide shoring system where indicated on the Drawings and where required by the Work.

.2 Performance Requirements:

.1 Construct substantially watertight excavation shoring systems.

.2 Take all necessary steps to prevent the movement limits from being exceeded by providing proactive support/ground improvement measures without any additional compensation.

.3 Prevent disturbance, destabilization, or failure of sides and bottom of excavation.

.4 Protect new and existing structures, piles, services, utilities, roads, and embankments from disturbance, displacement, settlement, or damage during construction.

.3 Mandatory Locations for Shoring System: As a minimum, shoring systems will be required as indicated on the contract drawings.

1.6 SUBMITTALS:

.1 Shop Drawings:

.1 Submit shop drawings of excavation shoring and bracing systems for record purposes.

.2 Shop drawings to bear seal and signature of a professional engineer licensed in Ontario.

.3 Excavation shoring and bracing systems drawings will not be reviewed for structural adequacy. Engineer will review Vendor's submittal only for compliance with the requirements of this Section, and any comments provided for Vendor's consideration shall not be construed to indicate approval or disapproval of the submitted excavation shoring and bracing system design. Full responsibility for the design, installation, inspection and maintenance of excavation shoring and bracing systems rests with the Contractor.

.4 Coordinate installation and removal of shoring system which matches with sequence of overall construction of structure without affecting any lateral support system of permanent structures.

.5 Indicate:

a. General arrangement of temporary structures showing plans, sections and all necessary details required for construction.

b. Design loadings.

c. Dimensions and elevations of shoring.

d. Installation and deflection tolerances.

e. Material sizes, designations, and grades.

f. Relationship of temporary structures to new and existing structures, services, and utilities.

g. Method and details of installation of temporary structures.

h. Location of temporary struts and walers relative to permanent structure.

i. Schedule for removal of temporary struts and walers

j. If shoring system is to rest on shale, indicate so on the shop drawing.

.6 Two (2) unstamped copies of the shop drawings will be returned with Engineer's comments.

.7 Excavation Shoring System Deflection Records:

a. Where required, and/or directed by the Engineer, monitor deflection of the shoring system.

b. Submit a copy of written records of measured deflections of excavation shoring system to Engineer weekly.

.8 Certificates:

a. Submit two (2) copies of steel producer mill test data and certification.

b. Submit welding certificate in accordance with CSA W47.1.

1.7 QUALITY ASSURANCE

.1 A professional engineer licensed in the province of Ontario and employed or retained by the Vendor shall design, supervise installation, and inspect temporary structures. The Vendor's engineer shall have at least three years of experience with design and construction of similar types of excavation shoring systems and excavations. The Vendor's engineer shall maintain involvement and responsibility from design through installation, performance and abandonment or removal of excavation support systems.

.2 Personnel with demonstrated competence and experience shall install temporary structures.

.3 Quality Control – Monitoring.

.4 Welder: CSA W47.1 certified.

1.8 SITE CONDITIONS

.1 Soils Report and other information:

.1 Refer to Instructions to Bidders.

.2 Identify all existing utilities before commencing any Work.

.3 The Owner accepts no responsibility for any opinions or conclusions given in any factual or interpretative ground investigation reports. The Contractor shall interpret information given in past and present geotechnical reports as relevant to all aspects of his work.

.4 The Contractor shall report immediately to the Engineer any circumstances, which indicates that, in Contractor's opinion, the ground conditions differ from those reported or which could have been inferred from ground investigation reports or test results.

.5 Review site conditions with respect to equipment and bearing capacity of soil at the site. Also review site restrictions with respect to roadway widths, existing facilities and overhead power lines.

1.9 PAYMENT:

.1 The Vendor shall include all costs for all labour, equipment, and materials for all required excavation shoring systems, both temporary and those left in the ground, and shoring system shown on contract drawing, which are required to execute the construction of new work within the appropriate unit price items included within the Schedule of Prices.

.2 No additional payment for any excavation shoring systems required for executing the Work will be allowed.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Structural steel: CAN/CSA-G40.21-M; Grade 300W.

.2 Steel sheet piling: CAN/CSA-G40.20-M; hot rolled, interlocking type with interlock sealing system.

.3 Welding: CSA W59-M.

.4 Tie-backs and Anchor Bars: ASTM A29/A29M and ASTM A322; proof stressed to minimum yield stress; Dywidag bars.

.5 Lumber:

.1 Graded lumber, sound, straight, free from cracks, shakes, and large or loose knots.

.2 Planks for sheeting: Tongued and grooved, or grooved and splined.

.6 Drypack Concrete Fill Behind Lagging:

.1 Type B fill concrete as specified in Section 03300, Cast-in-Place Concrete.

.7 Concrete Around Soldier Piles:

.1 Lean mix concrete. Minimum concrete compressive strength at seven (7) days is 15 MPa.

.8 Grout:

.1 Mix: Sand and Type 10 Cement in a 1:1 weight ratio.

.2 Compressive Strength: 25 MPa minimum at seven (7) days and 35 MPa at twenty-eight (28) days.

PART 3 EXECUTION

3.1 INSTALLATION

.1 General:

.1 Locate all existing underground utilities, pipes, piles and/or underground structures, which may potentially affect the shoring installation, before proceeding with installation.

.2 Coordinate the installation of the mandatory shoring system along the road with the selective demolition work specified in Section 02200, Demolition and Removals.

.3 Install other shoring and bracing systems, which may be required for the general execution of the work under this contract but not specifically called for on the drawings, as required by the soil conditions and Ontario Occupational *Health and Safety Act* and Regulations for Construction Projects. Prevent cave-ins of banks and sides of excavations.

.4 Underpinning is mandatory in areas where the excavation will potentially undermine existing structures, pipes, services, utilities, or roads.

.5 Do not install excavation shoring or bracing systems until permission has been given by the Engineer to proceed.

.6 Where shoring is used as formwork for concrete structure, verify that shoring in its deflected position does not reduce thickness of structural concrete. If excavation shoring system as installed reduces the thickness of structural concrete, alter shoring at no additional cost to Owner until shoring installation meets above requirements.

.7 Do not encase any part of the shoring in permanent concrete structure without written permission from the Engineer.

.8 Install shoring so that there is no loose material or voids between shoring and sound undisturbed soil behind.

.9 Schedule removal of bracing members and walers so that permanent structures, excavation shoring system, or bracing members are not overstressed.

.2 Soldier Piles and Lagging:

.1 Install soldier piles to required dimensions and elevations in pre-drilled holes. Fill void with lean concrete.

.2 As excavation proceeds, wedge lagging tightly against firm undisturbed ground.

.3 Remove loose soil from between lagging and firm undisturbed ground.

.4 Fill voids between lagging and firm undisturbed ground with ‘drypack’ concrete rammed tightly in place.

.5 Do not leave sides of excavation exposed without lagging.

.6 Install walers, struts, and bracings at required elevations as excavation proceeds.

.3 Temporary Support and Bracing:

.1 Design, install and maintain temporary supports and bracing, wherever it may be needed during construction of the permanent works.

.2 Design of such supports and bracing shall be carried out by a professional engineer registered in the province of Ontario.

.3 Temporary supports and bracing to remain in place until permanent supports are constructed.

3.2 FIELD QUALITY CONTROL

.1 Monitor and keep a written record of horizontal deflections of the excavation shoring system and any settlement resulting from Work under this Section.

.2 Log Book: Survey log book with initial horizontal and level readings and dimensions to known reference points. Perform weekly checks and maintain documentation and reporting of any variances to readings. Contractor to notify the Engineer immediately of any reading variances. Contractor to provide a proposal to remedy any reading variances and maintain the integrity of the shoring system.

.3 Keep all shop drawings for excavation shoring system signed and stamped by professional engineer at site all times during construction period.

END OF SECTION

TORONTO

SECTION 02140

DEWATERING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 This Section specifies the requirements for dewatering procedures where necessary to stabilize ground and/or keep excavations dry during the construction of the Works including:

.1 Control of groundwater and surface run-off to facilitate construction of the specified works under dry conditions on a stable sub-grade.

.2 Discharge of drainage water from construction site.

.3 Coordinate dewatering work with requirements of other trades and units of work affected by dewatering operations.

1.2 MEASUREMENT AND PAYMENT

.1 All costs associated with the work of this Section shall be included in the price for Div. 2.

1.3 DEFINITIONS

.1 Subgrade: Surface to which excavations are made for the purpose of construction of the Work in accordance with the Contract Documents. Subgrade as defined does not include additional depths of excavation that may be required or ordered to obtain suitable foundation conditions.

.2 Dewatering: Removal of water, groundwater as well as surface run-off, to facilitate construction of the specified works under dry conditions on a stable sub-grade.

1.4 NEED FOR DEWATERING

.1 It is the Contractor's responsibility to ascertain in advance which sections of the work will require dewatering. It is a requirement that the construction site be dewatered/ depressurized.

1.5 SYSTEM DESCRIPTION

.1 Design and Performance Requirements:

.1 Engage a professional engineer with demonstrated competence to design, and to supervise construction, operation and maintenance of a dewatering system.

.2 Design, construct, operate, and maintain a dewatering system, to control groundwater. Consider also the lateral tracking of groundwater underneath existing structures.

.3 Co-ordinate with design and construction of excavation shoring systems, excavation and backfilling operations.

.4 Prevent surface run-off from entering excavations. Construct ditches, berms, and similar items as required to lead water away from excavation. Do not allow silt laden run-off water to enter watercourses. Direct run-off flows to siltation ponds or catchment areas.

.5 Maintain groundwater level a minimum of 300 mm below subgrade level, or lower as may be required, to permit placing geo-textiles, granular construction working surface, concrete and similar items, on firm dry undisturbed subgrade.

.6 Maintain groundwater at required level until:

a. Structure is completely built where designed self-weight of structure resists the buoyancy forces.

b. Backfilling to final grade is complete.

.7 Prevent destabilization, heaving, or shear failure of the sides and bottom of excavation.

.8 Prevent damage to or displacement of structures from groundwater pressures.

.9 Obtain the Engineer's written consent prior to allowing a rise in groundwater level or prior to shutting down the dewatering operation.

.10 Repair or replace any structure or Works damaged due to dewatering at no expense to the City.

.2 Dewatering Discharge Requirements:

.1 Provide appropriate filter screens so that no soil or foundation material is removed, and solids concentration of less than 5 ppm in the discharge water is achieved. Do not exceed solids concentration of 10 ppm at any time.

.2 Provide a discharge siltation pond of required size to allow sufficient detention time so that the decanted water will meet provincial regulations.

.3 Maintain siltation pond during construction period by removing silt build-up from time to time to keep siltation pond functional.

.4 The City will carry out physical analysis of drainage water to establish conformance with provincial regulations. If directed by the Engineer, treat the drainage water before discharging into existing storm sewer systems or watercourses.

1.6 SYSTEM REQUIREMENTS

.1 In the event of encountering groundwater levels within excavations, install a primary dewatering system to maintain the groundwater level at least 1 m below the invert of the excavation or trench so that the excavation, pipe laying, construction of foundations, placement and compaction of bedding and backfill etc. can be carried out in the dry and in such a way as not to disturb or soften the foundation, native soils or fills already placed and prevent uplift of any structure or piping during and after construction.

.2 Prevent surface run-off from entering excavations. Construct ditches, berms, and similar items as required to lead water away from excavation. Do not allow silt laden run-off water to enter watercourses. Direct run-off flows to siltation ponds or catchment areas.

.3 Maintain dewatering systems of sufficient capacity to keep the bottom of the excavation or trench dry and free of water at all times until the pipes and structures have been completed.

.4 Install a secondary dewatering system consisting of perimeter ditches and/or ground contouring to prevent flow of surface runoff water into the excavation. As part of secondary dewatering system, provide also for pumping from sumps located within excavations to handle any surface run off or subsurface water entering the excavation, in spite of the primary and secondary dewatering systems in place.

.5 Maintain a duplicate system of equal or greater capacity as emergency equipment, in case of breakdown of the dewatering systems in place.

1.7 SUBMITTALS

.1 Shop Drawings:

.1 Submit a general plan of dewatering scheme as applicable which might include:

a. Location of generators and other noise producing equipment and anticipated decibel levels.

b. Relationship between dewatering equipment, new and existing structures, the excavation plan, and excavation shoring systems.

c. Location of dewatering discharge points.

d. Location and dimensions of siltation pond.

e. Details of screens and filter media.

f. Location of groundwater observation wells.

g. Location of monitoring points.

.2 All design and shop drawings shall bear the signature and stamp of a Licensed Professional Engineer registered in the Province of Ontario with a demonstrated competence in this type of work.

.3 These submittals are for record purposes only and will not be reviewed for adequacy.

1.8 PERMITS

.1 Permit to Take Water:

.1 If pumping equipment for dewatering excavations is capable of extracting more than 50,000 L/day, register with the Environmental Activity and Sector Registry

(EASR) from the Regional Office of the Ministry of Environment, Conservation and Parks.

.2 If pumping equipment for dewatering excavations is capable of extracting more than 400,000 L/day, apply and obtain Permit to Take Water from the City Office of the Ministry of Environment, Conservation and Parks..

.2 Dewatering Discharge Approval:

.1 Apply and obtain dewatering discharge approval from the Ministry of Environment, Conservation and Parks. to comply with the Ontario Water Resources Act.

.2 Provide the Consultant with a copy of the approval.

1.9 PROTECTION AND DAMAGES

.1 Prevent damage to pipes, manholes, other structures, ground cover and grades within and in the immediate vicinity of the area of work. Make good any damage.

.2 Rectify any and all damage caused to excavated bases and/or pipe bedding and other adjacent structures and slopes due to improper and/or inadequate dewatering to the satisfaction of the Consultant and at no cost to the Town.

1.10 QUALITY ASSURANCE

.1 Qualifications:

.1 The Contractor is responsible for the quality assurance measures and implementation as per the reviewed submission.

1.11 SITE CONDITIONS

NA

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 Dewatering Equipment:

.1 Pipes, wells, deep wells, well-points, pumps, electrical generators and other equipment.

.2 Standby pumps and generator with effective muffling devices to keep noise levels at or below background noise levels. In any event, do not exceed a noise level of 55 dB at adjacent structures at property lines.

PART 3 EXECUTION

3.1 FIELD PUMP TEST

.1 Perform a field pumping test to ensure the adequacy of the primary dewatering system as proposed and as installed, to establish the rate of pumping to be used during various construction activities, and the rate of recharge when the primary dewatering system is shut off.

3.2 INSTALLATION AND MAINTENANCE

.1 Install and maintain the primary and secondary dewatering systems, and piezometers (observation wells).

.2 Maintain the dewatering systems in operation until a written authorization is given by the Consultant that the dewatering systems could be shut off.

.3 During the entire work, observe and record the elevation of the water levels in all observation wells daily. Submit the water level records to the Consultant each day.

.4 Do not remove any observation well except with the written permission of the Consultant. Within 24 hours, replace observation wells which were damaged or destroyed.

3.3 DISPOSAL OF WATER

.1 Dispose of water removed from the excavation in such a way that it will not be injurious to public health, private property or to any operation of the work completed or under construction under this contract or by others.

.2 Provide appropriate filter screens so that no soil or foundation material is removed, and solids concentration of less than 5 ppm in the discharge water is achieved. Do not exceed solids concentration of 10 ppm at any time.

.3 Provide a discharge siltation pond of required size if needed to allow sufficient detention time so that the decanted water will meet city regulations.

.4 Maintain siltation pond during construction period by removing silt build-up from time to time to keep siltation pond functional.

.5 Note that the Ontario Water Resources Act requires that a Permit to Take Water be obtained for taking water in excess of 400,000 L/day, and registration with the Environmental Activity and Sector Registry (EASR) be completed for taking water in excess of 50,000 L/day from any ground or surface source of water supply. Obtain permit, if required, by applying to the Ministry of Environment, Conservation and Parks. An Discharge water from a dewatering system directly to a water course provided the discharge is of good quality and contains no significant silt or other debris and is at a rate and in a manner not to cause scouring to the stream beds or banks. Discharge water in the direction of the stream flow and unto a splash pad.

3.4 REMOVAL OF PRIMARY DEWATERING SYSTEM

.1 Maintain the primary dewatering system until the excavation has been completely backfilled and compacted. Remove the primary dewatering system only on receipt of written authorization from the Consultant to do so.

.2 Remove the primary dewatering system in stages to allow the groundwater level to rise at a controlled rate.

3.5 FIELD QUALITY CONTROL

.1 Monitoring Groundwater Level:

.1 Take readings of groundwater level twice a day for the duration of the dewatering period. Keep a written record of groundwater levels.

END OF SECTION

TORONTO

SECTION 02200

DEMOLITIONS AND REMOVALS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements. Pay special attention to the need for a preconstruction survey before starting any work and a post construction survey after the completion of the Work.

1.2 DESCRIPTION

.1 Supply all material, labour and equipment necessary for demolishing the existing workshop structures, including the disposal of all resultant debris, and to dismantle, modify, relocate or dispose of all piping, equipment, machinery, ductwork, etc. as specified herein and outlined in the Contract Drawings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 02080 – Handling of Asbestos Containing Materials.

.2 Section 02081 – Handling of Designated Substances and Hazardous Materials.

.3 Section 02082 – Management of Non-Hazardous Waste

.4 Section 02315 – Excavation and Backfilling.

1.4 WORK INCLUDED

.1 Without in any way limiting the scope of the foregoing, the Work consists of the following:

.1 Removal of existing monorail and related equipment as shown in the Contract Drawings.

.2 Removal of all existing Electrical equipment, wiring, related equipment, and as outlined in the Contract Drawings.

.3 Removal of all plumbing fixtures, valves, and associated piping as outlined in the Contract Drawings.

.4 Removal of existing handrail as outlined in the Contract Drawings.

.5 Complete demolition and removal of the existing structural concrete structures as outlined in the Contract drawings and where it interferes with new installations.

.6 Coring and cutting concrete for any wall and ceiling penetrations.

1.5 REFERENCES

.1 Comply with Division 1 – General Requirements, Division 15 – Mechanical and Division 16 – Electrical and all documents referred to therein.

.2 Comply with the requirements of CSA S350 - M Code of Practice for Safety in Demolition of Structures, NFPA 241 Safeguarding Construction Alteration and Demolition Operations and all applicable Municipal Regulations and Requirements.

.3 Comply with the Ontario Building Code.

.4 Comply with the National Building Code of Canada Part 8, Safety Measures at Construction and Demolition Sites.

.5 Comply with Ontario Regulation 213/91 as amended, under the Occupational Health and Safety Act and Regulations for Construction Projects – latest revisions.

.6 Sorting of demolished materials is to be in conformance with Ontario Regulations 102/94, 103/94, 105/94 (waste reduction, source separation and recycling programs) and Bill 208 “Designated Substances”.

1.6 SUBMITTALS

.1 Submit a cleaning operation schedule.

.2 Submit a proposed method of substrate preparation.

.3 Submit the demolition methods and procedures sealed and signed by a structural engineer licensed in Ontario for each area of the Work.

.4 Submit bracing and shoring drawings signed and stamped by a structural engineer licensed in Ontario.

1.7 PREPARATION

.1 Disconnect electrical and mechanical systems in areas of demolition according to the rules and regulations of the authorities having jurisdiction.

.2 Relocate systems that need to be retained clear of demolition and to suit future arrangement.

.3 Post warning signs on equipment that will remain in operation in areas of selective demolition.

.4 Disconnect and cap mechanical services in accordance with the requirements of the local authority having jurisdiction or pay for having this Work done by local authorities.

.5 Inspect the Site and verify with the Contract Administrator and City, items designated for removal and items to be preserved.

.6 Protect existing items designated to remain and materials designated for salvage. In the event of damage, immediately replace such items or make repairs to the approval of the Contract Administrator and at no additional cost.

.7 Take precautions to support structures and, if the safety of the area being demolished or adjacent structures or services appear to be endangered, cease operations and notify the Contract Administrator.

.8 Inform the Contract Administrator and record any defects in the existing building and structures, which become apparent during construction and demolition. The Contractor may be held responsible for this damage if not recorded.

.9 The work of the Section shall be executed in strict accordance with the latest edition of the Occupational Health and Safety Act and Ontario Building Code. The Contractor shall be responsible for ensuring that its forces and its Subcontractors abide by the rules and requirements set forth under these Acts.

1.8 DEMOLITION MANAGEMENT

.1 Perform demolition work under the direction and control of a professional engineer.

.2 Submit demolition methods and procedures signed and sealed by an engineer licensed in Ontario for each area of the Work.

.3 Undertake demolition and selective demolition under the schedule specified and agreed upon. This schedule must be maintained, as the existing facility must remain in operation for the duration of the contract.

.4 Maintain access for plant operations personnel to each location where equipment remains in operation or as directed by the Consultant.

.5 Prior to commencing the Work, identify and record existing structural or architectural defects in structures adjacent to areas of demolition and notify the Consultant.

.6 Where interior partitions, non-loading bearing walls and finishes are being removed, erect dust proof partitions in logical locations to protect other areas. Partitions may not obstruct exits or normal movements of facility operation staff. Confirm locations with the Consultant and operations staff. Remove partitions upon completion of the demolition work.

.7 Engineer design bracing and shoring as required. Submit approval by a structural engineer licensed in Ontario for demolition methods and procedures.

.8 If asbestos containing materials are encountered or suspected, inform the Consultant and stop all work in that area until further notice. All asbestos removal and disposal work must conform to all regulatory requirements.

.9 Some interior demolition work may need to be completed at night or on weekends to minimize interference with facility operations. Coordinate this work with the City and complete this work during night or weekend at no additional cost to the City.

.10 Some interior demolition work will be staged. If partial removal is required, cut neatly to limits defined on Site by the Consultant and clean the area to allow immediate use of space. This will apply principally to ceilings and drywall partitions.

1.9 DISPOSAL OF MATERIAL

.1 Comply with the requirements of Division 1 and Division 2.

.2 Remove all unwanted material, such as demolition debris spoil or excess material from the Site.

.3 Do not use waste as fill unless otherwise specified.

.4 Remove waste from the Site daily. Do not store on the Site.

1.10 MEASUREMENT AND PAYMENT

.1 All costs associated with the work of this Section shall be included in the Bid Form.

PART 2 PRODUCTS

2.1 GENERAL

.1 Provide all necessary labour and equipment to complete the demolition work.

.2 Provide all necessary labour and equipment and all other associated costs for disposal of waste material.

PART 3 EXECUTION

3.1 PREPARATION

.1 Post warning signs on equipment which will remain in operation in areas of selective demolition.

.2 Post warning signs on electrical lines and equipment which must remain energized to serve remaining equipment.

.3 Do not disrupt active or energized utilities in areas of selective demolition.

.4 Disconnect and cap mechanical systems in areas of selective demolition in accordance with the rules and regulations of authorities having jurisdiction.

.5 Protect sewer and water lines to buildings being demolished. Remove, cap and dispose of other existing underground services. Retain services required to sustain the operation of existing facilities, and provide temporary services or facilities if necessary.

.6 Protect debris from collecting and blocking mechanical, drainage and electrical system which will remain in operation.

.7 Where existing buildings or portions of buildings are being completely demolished, remove and dispose of all materials including foundations, footings and underfloor services as well as all materials above grade.

.8 Where a portion of a building is being removed or demolished, carefully cut roof, walls, floors and other items at the limit of removals. Ensure all services are shut off and capped or disconnected. Refer to the drawings for special conditions or considerations.

.9 Prevent movement, settlement, or damage of existing structure and adjacent structures, walks, paving and parts of building to remain in service.

.10 Where existing exterior walls or roofs are being cut or windows removed, do not cut openings until new windows, doors, louvers or panels are on the Site. Do not leave openings unprotected. Fill openings with windows, doors, louvers or panels within forty-eight (48) hours of cutting. For roof openings or penetrations provide temporary waterproof enclosures with plywood and single-ply membrane as required to suit schedule and weather conditions.

.11 Where selective demolition is occurring around existing equipment which is to remain in operation, erect an enclosure of 38 mm x 89 mm lumber framing a 13 mm plywood top or cover and wrap the whole construction in a 10 mil polyethylene sheet. Do not remove enclosure until instructed to do so by the Consultant. Provide additional protection around meters, valves, seals and other items at the direction of the Consultant.

.12 Where interior finishes only are to be removed conform to the following:

.1 Install dust barriers.

.2 Confirm materials are asbestos free.

.3 Remove ceiling (tile or plaster) including all grids, suspension framing and accessories and dispose of all materials. Suspension rods or wires may be left in place.

.4 Remove all existing floor finishes including adhesives.

.13 Repair all existing surfaces disturbed or otherwise damaged by alterations. Match material and finishes unless otherwise specified.

3.2 DEMOLITION

.1 Remove existing equipment, services and obstacles where required for refinishing or making good of existing surfaces and replace same as Work progresses.

.2 At end of each day's work, leave the Work in safe condition so that no part is in danger of collapse or falling. Protect interiors of parts not to be demolished from exterior elements at all times.

.3 Demolish in a manner to minimize dusting. Keep dusty materials wetted.

.4 Demolish masonry walls in small sections.

.5 Do not sell or burn materials on Site. Demolition materials shall be disposed of in accordance with authorities having jurisdiction. The Contractor shall meet the requirements of local by-laws and environmental regulations.

.6 Where new work connects to the existing and where existing work is altered, cut, patch and make good to match existing work Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly. Provide adequate supports to assure structural integrity of surroundings, devices and methods to protect other portions of the project site from danger. Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools are not allowed without prior approval from the Consultant.

3.3 CLEANING

.1 In operating areas immediately adjacent to demolition work, be responsible for maintaining the area free of waste material, debris and dust. Maintain demolition area clean after completing works each day. If the demolition work has impacted the adjacent operating areas, be responsible for cleaning these adjacent areas including the vacuuming of control panels, MCC etc. as directed by the Consultant at no additional cost.

.2 After demolition, clean existing substrates to a sound, clean surface free of extraneous matter.

.3 Broom clean all areas each Day after demolition work.

3.4 DISPOSAL OF WASTE

.1 Dispose waste off Site at location acceptable to authorities having jurisdiction.

.2 Remove waste from Site daily. Do not store on Site.

.3 Do not use waste as fill.

3.5 RESTORATION

.1 Upon completion of work, remove debris, trim surfaces and leave work site clean.

.2 Reinstate areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.

.3 Restore work with new products in accordance with requirements of the Contract Documents.

.4 Refinish surfaces to match adjacent finishes.

.5 Restore damaged or temporarily removed hangers, insulation and pipes immediately after installing the new works.

END OF SECTION

TORONTO

SECTION 02201

SITE PREPARATION

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements.

.2 Work of this Section includes:

.1 Installation of erosion and sedimentation control measures.

.2 Removing trees, topsoil and other materials as required to prepare the work areas for construction.

1.2 RELATED SECTIONS

.1 Section 02315 – Excavation and Backfilling.

1.3 DEFINITIONS

.1 Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

.2 Clearing: Removal of trees and interfering or objectionable material lying on or protruding above ground surface.

.3 Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 50mm caliper to a depth of 150mm below subgrade.

.4 Scalping: Removal of sod without removing more than upper 75mm of topsoil.

.5 Stripping: Removal of topsoil remaining after applicable scalping is completed.

.6 Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.4 SUBMITTALS

.1 Shop Drawings: Drawings clearly showing clearing, grubbing, and stripping limits.

1.5 QUALITY ASSURANCE

.1 Obtain Engineer's approval of staked clearing, grubbing, and stripping limits, and prior to commencing clearing, grubbing, and stripping.

1.6 SCHEDULING AND SEQUENCING

.1 Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 GENERAL

.1 Design and install Construction fencing and erosion control facilities.

.2 Clear and strip areas actually needed for waste disposal, borrow, or site improvements within limits shown or specified.

.3 Do not injure or deface vegetation that is not designated for removal.

3.2 LIMITS

.1 As required for construction of the works and protection of trees but not beyond projects limits.

.2 Remove rubbish, trash, and junk from entire area within Project limits.

3.3 CLEARING

.1 Clear areas within limits shown or specified.

3.4 SCALPING

.1 Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

.2 Scalp areas within limits shown or specified.

3.5 STRIPPING

.1 Do not remove topsoil until after scalping is completed.

.2 Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.

.3 Stockpile stripping topsoil, separately from other excavated material.

3.6 DISPOSAL

.1 Clearing and Grubbing Debris:

.1 Dispose of debris offsite.

.2 Burning of debris onsite will not be allowed.

.2 Scalpings: As specified for clearing and grubbing debris.

.3 Strippings: Remove immediately from site unless utilized within 24 hours of striping operations.

END OF SECTION

TORONTO

SECTION 02315

EXCAVATION AND BACKFILLING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INTENT OF SECTION

.1 Section includes, but not limited to the following:

.1 Excavation, backfilling, trench backfilling and compaction for the safe installation of the intake air duct and exhaust duct from the generator room to the filter building, refer to drawings.

.2 Removal and Reinstallation of Geofoam and drainage channels

.3 Replace any damaged Geofoam as needed.

.4 Imported material is not expected.

.5 Subgrade preparation.

.6 Supply and placement of engineered fill.

.7 Protection of foundation and structures.

.8 Testing of excavated material

.9 Disposal of surplus excavated material if needed

.10 Site grading and restoration of existing grades.

.11 Dust control.

1.2 CONFORMANCE

.1 Conform to Division 1 - General Requirements.

1.3 REFERENCES

.1 ASTM International (ASTM):

.1 ASTM C117-[90], Test Method for Material Finer Than: 0.075mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C136-[84a], Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422 – Standard Test Method for Particle-Size Analysis of Soil

.4 ASTM D698-(1990), Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 2.49 kg rammer and 304.8mm drop.

.5 ASTM D1557-(1990), Test Methods for Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 4.54 kg Rammer and 457mm Drop.

.6 D6938 –Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

.2 Ontario Provincial Standard Specifications (OPSS):

.1 OPSS 501 – Construction Specification for Compacting.

.2 OPSS 504 – Construction Specification for Preservation, Protection and Reconstruction of Existing Facilities.

.3 OPSS 506 – Construction Specification for Dust Suppressants.

.4 OPSS 514 – Construction Specification for Trenching, Backfill and Compaction.

.5 OPSS 517 – Construction Specification for Dewatering.

.6 OPSS 518 - Construction Specification for Control of Water.

.7 OPSS 577 – Construction Specification for Temporary Erosion and Sediment Control Measures.

.8 OPSS 1010 – Material Specification for Aggregates – Granular A,B,M and Select Subgrade Materials.

.9 OPSS 1860 – Material Specification for Geotextiles.

1.4 DEFINITIONS

.1 Backfilling means the operation of filling the trench with bedding, cover and backfill material, or embedment and backfill material.

.2 Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.

.3 Backfill Material: Means fill material used above the embedment or cover material.

.4 Embedment Material: Means material as it related to flexible pipe, from the bottom of the bedding to the bottom of backfill (top of cover material).

.5 Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.

.6 Imported Material: Material obtained by Contractor from source(s) offsite.

.7 Lift: Loose (uncompacted) layer of material of specified maximum thickness.

.8 Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank (to top of cover material).

.9 Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

.10 Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D698. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by the Engineer.

.11 Relative Density: As defined by ASTM D4253 and ASTM D4254.

.12 Standard Proctor Maximum Dry Density: The greatest dry unit weight obtained by ASTM D698.

.13 Selected Backfill Material: Material available onsite that the Engineer determines to be suitable for a specific use.

.14 Cover Material: Means the material placed from the top of the bedding to the bottom of the backfill.

.15 Controlled Low Strength Material/Unshrinkable Fill: Means a controlled density cement treated aggregate material.

.16 Common Excavation is defined as material, of whatsoever nature, excavated to complete works as specified and indicated and includes but not necessarily limited to: earth, trees, tree stumps, deadheads, pipes, tanks, masonry, asphalt pavement, concrete sidewalks, concrete pavements, concrete curbs and gutters, timber, hard pan, shall fractured shale, logs, quicksand, fill, cinders, snow, ice, frost, any combination of these with normal or abnormal earth conditions, or any other obstacles encountered in the excavation, all of which must be removed.

.17 Selected excavated material is defined as excavated material that is free from cinders, ashes, refuse, vegetable or organic matter, boulders, rocks or stones with nominal dimensions greater than 100mm, paving material, timbers, unbroken or frozen masses of earth, and other material which in the opinion of the Engineer is unsuitable. Selected excavated material to have properties to meet specified compaction requirements.

.18 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.19 Waste material: excavated material unsuitable for use in work or surplus to requirements.

1.5 SITE CONDITIONS

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.2 Contours and spot elevations indicated on the Drawings give approximate site grades at time of tendering.

.3 Actual grades may vary slightly.

.4 Notify the Engineer of any significant discrepancy in the existing grades before disturbing the site conditions.

.5 Maintain existing utilities which must remain in service in the area of the excavation.

.6 Record locations of underground utility lines.

.7 Repair damage to existing utility lines and services resulting from work under this Section at no cost to the City.

.8 Notify utilities prior to excavating.

.9 Obtain written permission from Engineer before starting excavation in frozen ground.

.10 Carry out additional environmental soil chemical testing of the excavated material if required by the owner of the approved disposal site

1.6 PROTECTION

.1 Ten (10) Working days prior to any excavation, notify the Engineer and indicate the location and extent of the planned excavation through the use of spray paint. Establish the location and extent of all underground structures, services and utility lines in areas of excavation and notify in writing, Engineer and City of findings. Submit copies of all notifications to Engineer. This allows City staff to impart any local knowledge of subsurface utilities that may not be on the record drawings, and also to implement contingency plans when needed.

.2 Notify Engineer if uncharted utility lines, services or structures are encountered in the area of excavation

.3 Protect exposed utilities from frost and freezing.

.4 Protect existing buildings and surface features which may be affected by work from damage while work is in progress. In event of damage, immediately make repair to approval of Engineer.

.5 Where excavation necessitates root or branch cutting, do cutting as approved by the Engineer.

.6 Protect bottom of excavations from freezing, both during and after construction. Do not disturb or weaken subgrade in any way.

.7 Adequately protect benchmarks, layout markers, survey markers and geodetic monuments.

.8 Protect to ensure no damage occurs to existing facilities and equipment situated on site.

.9 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.10 Direct surface runoff away from open excavations.

1.7 SUBMITTALS

.1 Copies of sampling records of excavated materials

.2 As Constructed Drawings

.1 Record locations and elevations of all new utilities installed and existing utilities encountered.

.2 Record contours of the final grade.

.3 Ten (10) days before commencement of excavation provide a submittal for excavation and soil management plan is required inclusive of a hazard assessment prior to any excavation including obtaining private/public locates

.4 At least two (2) weeks prior to commencing work, submit grading curves and source information for all imported granular material, performed by an independent testing agency in accordance with ASTM D422.

.5 At least two (2) weeks prior to commencing work, submit Maximum Dry Density Analysis for all imported granular material, performed by an independent testing agency in accordance with ASTM D698.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Marking Tape:

.1 Nondetectable:

a. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.

b. Thickness: Minimum 4 mils.

c. Width: 300mm.

d. Identifying Lettering: Minimum 25mm high, permanent black lettering imprinted continuously over entire length.

e. Manufacturers and Products:

(a) Reef Industries; Terra Tape or equal approved.

(b) Allen; Markline or equal approved.

.2 Granular "A" material conforming to OPSS 1010.

.1 Dry sand, accepted by Engineer, may be provided for trenches above maximum groundwater level.

.2 Reclaimed asphaltic material is not acceptable.

.3 Crushed limestone is not acceptable.

.3 Granular "B" material conforming to OPSS 1010.

.1 Dry sand, accepted by Engineer, may be provided for trenches above maximum groundwater level.

.2 Reclaimed asphaltic material is not acceptable.

.3 Crushed limestone is not acceptable.

.4 20mm Clear Crushed Stone: OPSS 1004 - Crushed Rock composed of hard, uncoated angular fragments produced from rock formations or boulders of uniform quality.

.5 75mm Granular Fill Material:

.1 Washed gravel, free from foreign materials. Gradation as follows:

Sieve Size	**Percent passing by weight**
75 mm	100
53 mm	95-100
37.5 mm	55-75
19 mm	10-50
4.75 mm	0-10
0.075 mm	0-2

.6 Imported Fill Material: Non-organic or non-clay, clean fill compactable to specified density and free from frozen lumps, rubble, debris and rocks or boulders with nominal size larger than 100mm.

.7 Native site material:

.1 Excavated material approved by the Engineer.

.2 Material free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150mm in any dimensions or other deleterious materials.

.8 Unshrinkable Backfill:

.1 Unshrinkable backfill to OPSS 1359.

.2 Admixtures shall conform to OPSS 1303 and the latest MTO designated sources list. Calcium chloride or pozzolanic mineral admixtures shall not be used. Air entraining admixtures may be added if desired by the Contractor.

.9 Pea Gravel: Roughly spheroidal in shape, nominal size 5mm to 10mm diameter.

.10 Natural Sand: CAN/CSA-A23.1-M.

.11 Non-Woven Geotextile.

.1 Non-woven needle punched staple fibre polymer geotextile: OPSS 1860. Equivalent opening size of 140 microns. 270R by Terrafix Geosynthetics Inc. Mirafi P-150 by Dominion Textile Inc.

.2 Non-woven needle punch polypropylene geotextile: OPSS 1860. Equivalent opening size of 145 microns. TS800 by Terrafix Geosynthetics Inc.

.12 Woven Geotextiles.

.1 Woven geotextile comprised of two or more sets of filaments interlaced at right angles: OPSS 1860.

.2 Ball burst strength of 200 Newton and equivalent opening size of 500 microns. Terratrack 200W by Terrafix Geosynthetics Inc. Mirafi 600X by Dominion Textile Inc.

.13 Erosion Control Mat 100mm high density polyethylene cellular confinement system complete with galvanized rebar stakes as supplied by Geoweb.

PART 3 EXECUTION

3.1 TRENCH PERPETRATION

.1 Water Control:

.1 Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, chambers, appurtenances, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water.

.2 Remove water in a manner that minimizes soil erosion from trench sides and bottom.

.3 Provide continuous water control until trench backfill is complete.

.2 Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.2 TRENCH BOTTOM

.1 Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

.2 Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of over excavation, if any required.

3.3 GRANULAR BEDDING

.1 Furnish imported Granular A bedding material.

.2 Place over the full width of the prepared trench bottom in two equal lifts when the required depth exceeds 200mm.

.3 Hand grade and compact each lift to achieve a minimum 98 percent of the Standard Proctor Maximum Dry Density (SPMDD), i.e. relative compaction, which will provide a firm, unyielding surface.

.4 Minimum Thickness: As follows:

.1 Pipe, 450mm to 900mm: 150mm.

.5 Check grade and correct irregularities in bedding material. Loosen top 25 to 50mm of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

.6 Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

.7 Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.4 BACKFILL PIPE ZONE

.1 Upper limit of pipe zone shall not be less than following:

.1 Pipe: 300mm, unless shown otherwise.

.2 Restrain pipe as necessary to prevent their movement during backfill operations.

.3 Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

.1 Maximum 150mm lifts.

.4 Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.

.5 After the full depth of the pipe zone material has been placed as specified, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls.

.6 Do not use power-driven impact compactors to compact pipe zone material.

3.5 BACKFILL ABOVE PIPE ZONE

.1 In landscaped areas process excavated material to meet specified gradation requirements.

.2 Adjust moisture content as necessary to obtain specified compaction.

.3 Place and compact backfill in lifts of 300mm compacted to 95 percent of SPMDD.

.4 Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 600mm of backfill has been provided over the top of pipe.

.5 Do not use power driven impact type compactors for compaction until at least 1200mm of backfill is placed over top of pipe.

.6 Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.

.7 Backfill around structures with same class backfill as specified for adjacent trench unless otherwise shown or specified.

.8 Under roadways and paved areas backfill trenches with Granular B in lifts of 150 mm compacted to 98 percent of SPMDD to underside of road sub-grade.

3.6 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.7 STRIPPING OF TOPSOIL

.1 Commence topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.

.2 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.

.3 Stockpile in designated areas.

3.8 STOCKPILING

.1 Stockpile fill materials in areas designated.

.2 Stockpile granular materials in manner to prevent segregation.

.3 Protect fill materials from contamination.

.4 Do not stockpile material in a manner or location that will interfere with site operation or drainage.

.5 Apply water, sodding or other means as required to provide continuous control of dust from drifting or blowing.

.6 Crown, shape and tarp stockpiles as required to promote runoff and minimize increase in moisture content.

3.9 EXCAVATION

.1 Locate existing buried pipes, conduits, duct banks and utilities prior to commencement of excavated operation.

.2 Excavate to lines, levels and dimensions required.

.3 Protect under ground structures underneath excavation locations.

.4 Excavate to provide adequate space for structure and connections to structures, for formwork, braces and supports, for excavation shoring systems and dewatering.

.5 Prevent disturbance and destabilization of final subgrade.

.6 Make excavation in the dry. Provide levelled dense subgrade. Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavation by groundwater lowering, sheet pile cut-offs or other means. Verify lowered groundwater level in piezometers prior to excavating.

.7 Protect open excavations against flooding and damage due to surface run-off.

.8 Provide side slopes of excavation in open cuts suitable to the conditions encountered and in accordance with requirements of OHSA. Stability of side slopes is time dependent. Slopes generally become increasingly unstable with time. Remove all slides and cave-ins, without extra compensation, at whatever time and circumstances they may occur.

.9 Provide shoring and bracing necessary to safely support soil to prevent movement, loss of soil, or other activity that would cause damage to existing structures and to protect construction activities, personnel and equipment.

.10 Where rock is encountered, use conventional excavation methods to remove. Use of explosives is prohibited.

.11 Excavate with care adjacent to existing structures around existing utilities and pipelines. Provide temporary supports as required. Prevent damage.

.12 Unauthorized Excavation: Remedy unauthorized excavation made to elevation below the founding level at no cost to the City. Submit remediation proposal to Engineer for approval.

3.10 SUBGRADE PREPARATION

.1 Remedy subgrade weakened or destabilized at no cost to the City.

.2 Bottom of excavations to be trimmed, dry, undisturbed soil, free from loose or soft material.

.3 Prior to placing fill under slabs on grade, proof roll existing subgrade to obtain same compaction specified for fill. Remove any hard or soft spots and unsuitable subgrade, fill with approved material and re-compact.

3.11 BACKFILLING TO STRUCTURES

.1 Backfill under structures with granular fill unless shown otherwise. Place fill in 150mm lifts and compact to 98% SPMDD (Standard Proctor Maximum Dry Density) at a placement moisture content within 2% of optimum.

.2 Backfill against new walls only after the concrete of the wall and bracing slabs have reached adequate strength as determined by Engineer.

.3 Backfill around structures evenly in 300mm lifts compacted to 98% SPMDD (Standard Proctor Maximum Dry Density) at a placement moisture content within 2% of optimum. Place a 600mm minimum wide layer of Granular "B" against all exterior concrete walls. Backfill the remainder with selected excavated material.

.4 Make up any shortfall of selected excavation material with imported fill material.

.5 Do not backfill to elevations higher than the finish grades.

.6 Use equipment for backfilling and compaction that would not impose loads greater than those indicated or will damage the surface finishes.

.7 Fill in low spots after settlement and regrade as necessary until settlement ceases.

.8 Remove all debris and surplus materials from site on completion of work.

.9 Below roads and paved areas, backfill with Granular "B" from top of undisturbed soil to underside of paving subgrade. Place Granular "B" in lifts of 150mm and compact to 98% SPMDD at a placement moisture content within 2% of optimum.

3.12 BACKFILLING TO PAVED AREAS

.1 Backfill with Granular "B" material from top of prepared subgrade to underside of paving subgrade. Place Granular "B" in lifts of 150mm and compact to 98% SPMDD at placement moisture content within 2% of optimum.

.2 Apply water as necessary during compaction to obtain specified density.

.3 Proof roll with equipment sized to suit the paved area.

.4 Where proof rolling reveals areas of defective subgrade, remove sub-base and subgrade material to depth and extent as directed by the Engineer.

.5 Backfill excavated subgrade with approved common material and compact in accordance with this section.

3.13 SETTLEMENT OF BACKFILL

.1 Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

3.14 SITE GRADING

.1 Use selected excavated material to rough grade the site. Make up any shortfall in selected excavated material with imported fill material. Place fill in lifts of 300mm compacted to 95% SPMDD at a placement moisture content within 2% of optimum.

.2 Provide well drained grades throughout the course of grading work.

.3 Handle excavated material so that selected topsoil material is placed on the top surface.

.4 Raising or lowered of the grade to avoid haulage is not permitted.

.5 Remove stones or rock fragments larger than 100mm nominal diameter from the top of finished grade.

.6 Make adjustments in lines or grades as necessary in order to obtain satisfactory construction.

3.15 DUST CONTROL

.1 Throughout construction period, provide adequate dust control on the site by watering or use of other accepted dust control materials.

.2 Apply water or other material as often as necessary to provide continuous control of dust from drifting or blowing.

.3 Eliminate dust and dirt in areas where electrical equipment, metering instruments and similar equipment requiring interior cleanliness are being installed or assembled by providing temporary enclosures, covers for openings, or other means of protection.

3.16 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

.1 .1 for on-site soil management including a soil management plan, stock piling guidelines refer to O. Reg. 406/19: ON-SITE AND EXCESS SOIL MANAGEMENT (ontario.ca)

.2 Haul off site and dispose of at an approved site, surplus excavated material not required or suitable for backfill.

.3 Haul surplus excavated material from site in tight bodied trucks or other means. Clean truck tires prior to exiting site. Prevent hauled material from spilling on roads. Promptly clean up if such spill occurs and maintain roads free of any tracked soil.

.4 Provide the City with a copy of the valid operating license and permits for each proposed disposal facility, 3 days prior to shipping material off site.

.5 Provide the City with a copy of the valid operating license and permits for each transporter, 3 days prior to shipping material off site.

.6 Carry out additional environmental soil chemical testing of the surplus excavated material as may be required by the disposal facility. Cost to be borne by Contractor.

3.17 FIELD QUALITY CONTROL

.1 Inspection:

.1 Notify the City sufficiently in advance of operations, to provide field inspection.

.2 On reaching specified excavation level, request an inspection of subgrade by the Contractor Geotechnical Engineer.

.3 Provide all facilities to enable proper inspection.

.4 Do not excavate below the specified level or place concrete or other materials on subgrade until the inspection has been undertaken and permission granted to proceed in writing by the Engineer.

.5 Notify the Engineer if bottom of excavation appears to be unsuitable for foundation. Excavate unsuitable material and backfill as directed by the Engineer.

.2 Site Material Testing:

.1 Perform tests in the field and in laboratories on samples of the fill in order to determine whether they meet the specification.

.2 Carry out one Dry Density, one Optimum Moisture Density and one Particle Size Analysis test per 1000m^3 of material placed.

.3 If tests indicate the material specifications have not been achieved or cannot be obtained with the equipment or procedures in use, the Contractor shall remove and replace the work. Additional testing required by the Engineer will be at the Contractor's expense.

.3 Soil Compaction Densities:

.1 Where specified, compaction densities are percentages of SPMDD in accordance with ASTM D698.

.4 Field tests of soil compaction densities will be carried out in accordance with ASTM D2922 and ASTM D3017 by the City.

END OF SECTION

TORONTO

SECTION 02911

SOIL PREPARATION

TABLE FO CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 02201 – Site Preparation.

.2 Section 02920 – Lawns and Grasses.

1.2 REFERENCES

.1 The following is a list of standards which may be referenced in this section:

.1 ASTM International (ASTM):

a. C33, Standard Specification for Concrete Aggregates.

b. C602, Standard Specification for Agricultural Liming Materials.

.2 U.S. Bureau of Reclamation (USBR):

a. 514.4.4, Reclamation Instructions, Series 510—Land Classification Techniques and Standards, Part 514—Laboratory Procedures, Chapter 4—Particle-Size Analyses.

b. 514.8.7, Reclamation Instructions, Series 510—Land Classification Techniques and Standards, Part 514—Laboratory Procedures, Chapter 8—Soil Chemical Tests.

1.3 SUBMITTALS

.1 Action Submittals:

.1 Shop Drawings: Product labels/data sheets.

.2 Samples:

a. Representative of stockpiled or imported topsoil.

.2 Informational Submittals:

.1 Certified Topsoil Analysis Reports:

a. Indicate quantities of materials necessary to bring topsoil into compliance with textural/gradation requirements.

b. Indicate quantity of lime, and quantity and analysis of fertilizer.

1.4 SEQUENCING AND SCHEDULING

.1 Perform Work specified in Section 02201 – Site Preparation, prior to performing Work specified under this section.

PART 2 PRODUCTS

2.1 TOPSOIL

.1 General: Natural, friable, sandy loam, obtained from well-drained areas, free from objects larger than 37mm maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.

.2 Composition: As determined in accordance with USBR 514.4.4:

.1 Gravel-Sized Fraction: Maximum 50 per cent by weight retained on a No. 10 sieve.

.2 Sand-Sized Fraction: Maximum 65 per cent passing No. 10 sieve and retained on No. 270 sieve.

.3 Silt-Sized Fraction: Maximum 50 per cent passing No. 270 sieve and larger than 0.002 millimeter.

.4 Clay-Sized Fraction: Maximum 25 per cent smaller than 0.002 millimeter.

.3 Organic Matter: Minimum 1.5 per cent by dry weight as determined in accordance with USBR 514.8.7.

.4 pH: Range 6.0 to 7.2.

.5 Textural Amendments: Amend as necessary to conform to required composition by incorporating sand, peat, manure, or sawdust.

.6 Source: Stockpile material onsite, in accordance with Section 02201 – Site Preparation. Import topsoil if onsite material fails to meet specified requirements or is insufficient in quantity.

2.2 LIME

.1 Composition: Ground limestone with not less than 85 percent total carbonates, ASTM C602.

.2 Gradation:

.1 Minimum 50 percent passing No. 100 sieve.

.2 Minimum 90 percent passing No. 20 sieve.

.3 Coarser material acceptable provided rates of application are increased proportionately on basis of quantities passing No. 100 sieve.

2.3 SAWDUST OR GROUND BARK

.1 Nontoxic, of uniform texture, and subject to slow decomposition when mixed with soil. Nitrogen-treated, or if untreated mix with minimum 2 kg of ammonium nitrate or 3.25 kg of ammonium sulfate per cubic meter of loose material.

2.4 PEAT

.1 Composition: Natural residue formed by decomposition of reeds, sedges, or mosses in a freshwater environment, free from lumps, roots, and stones.

.1 Organic Matter: Not less than 90 per cent on a dry weight basis as determined by USBR 514.8.7.

.2 Moisture Content: Maximum 65 per cent by weight at time of delivery.

2.5 FERTILIZER

.1 Manure:

.1 Well-rotted, stable or cattle manure, free from weed seed and refuse.

.2 Maximum 50 per cent sawdust or shavings by volume.

.3 Age: Minimum 4 months; maximum two years.

.2 Fertilizers: Commercial, complete, of neutral character; in granular, packet, or pellet or pellet form, 75 per cent of nitrogen will be slow release form, 50 per cent of the elements of which will be derived from organic sources.

.3 The following fertilizer requirements are for tendering purposes only:

.1 Tree planting pits: 10-6-4 at 1 kg per 25mm of tree caliper or as outlined in planting soil analysis fertilizer recommendations.

.2 Planting beds: 12-6-4 at 1 kg per cubic meter of planting soil or as outlined in planting soil analysis fertilizer recommendations.

.4 Slow-release and natural fertilizers will be incorporated into planting soil. Quick-release fertilizers will be broadcast after planting and then watered in. Do not mix quick-release forms with the planting soil used to backfill the planting pit.

.5 Incorporate fertilizer into planting soil mixture in quantities sufficient to overcome chemical deficiencies of soil identified by planting soil analysis report.

2.6 SAND

.1 Fine Aggregate: Clean, coarse, well-graded, ASTM C33.

2.7 SOIL STERILANT

.1 Granular Calcium Cyanamide: Herbicide, manufactured by American Cyanamide Co.

2.8 SOURCE QUALITY CONTROL

.1 Topsoil Analysis/Testing: Performed by approved certified testing laboratory.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

.1 If required, apply lime at the rate of 24.4kg per 100m^2 to subgrade before tilling.

.2 Scarify subgrade to minimum depth of 150mm where topsoil is to be placed.

.3 Remove stones over 60mm in any dimension, sticks, roots, rubbish, and other extraneous material.

.4 Limit preparation to areas which will receive topsoil within two days after preparation.

3.2 TOPSOIL PLACEMENT

.1 Do not place topsoil when subsoil or topsoil is frozen, excessively wet, or otherwise detrimental to the Work.

.2 Mix soil amendments, lime, and fertilizer with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding. Delay mixing of fertilizer if planting or seeding will not occur within three days.

.3 Place 1/2 of total depth of topsoil and work into top 100mm of subgrade soil to create a transition layer. Place remainder of topsoil to depth as shown after compacting to 75 per cent where seeding and planting are scheduled.

.4 Uniformly distribute to within 12mm of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.

.5 Remove stones exceeding 30mm, roots, sticks, debris, and foreign matter during and after topsoil placement.

.6 Remove surplus subsoil and topsoil from Site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

END OF SECTION

TORONTO

SECTION 02920

TREE, LAWNS AND GRASSES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 This section covers the supply, delivery and placing sodding as indicated on the Contract Drawings.

1.2 RELATED SECTIONS

.1 Section 02911 – Soil Preparation.

1.3 DEFINITIONS

.1 Maintenance Period: Begin maintenance immediately after each area is planted (sod) and continue for a period of eight (8) weeks after all planting under this section is completed.

.2 Satisfactory Stand:

.1 No bare spots larger than 0.27m^2.

.2 Not more than 10 percent of total area with bare spots larger than 0.1m^2.

.3 Not more than 15 percent of total area with bare spots larger than 40cm m^2.

1.4 SUBMITTALS

.1 Action Submittals: Product labels/data sheets.

.2 Informational Submittals:

.1 Seed: Certification of seed analysis, germination rate, and inoculation:

a. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing, within 6 months of date of delivery. Include with certification:

(a) Name and address of laboratory.

(b) Date of test.

(c) Lot number for each seed specified.

(d) Test Results: (i) name, (ii) percentages of purity and of germination, and (iii) weed content for each kind of seed furnished.

.2 Mixtures: Proportions of each kind of seed.

a. Seed Inoculant Certification: Bacteria prepared specifically for legume species to be inoculated.

b. Certification of sod; include source and harvest date of sod, and sod seed mix.

c. Description of required maintenance activities and activity frequency.

1.5 DELIVERY, STORAGE, AND PROTECTION

.1 Sod:

.1 Do not harvest if sod is excessively dry or wet to the extent survival may be adversely affected.

.2 Harvest and deliver sod only after laying bed is prepared for sodding.

.3 Roll or stack to prevent yellowing.

.4 Deliver and lay within 24 hours of harvesting.

.5 Keep moist and covered to protect from drying from time of harvesting until laid.

.2 Plant material deemed unacceptable will immediately be removed from the Contract site by the Contractor.

1.6 WEATHER RESTRICTIONS

.1 Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.7 SEQUENCING AND SCHEDULING

.1 Complete Work specified in as specified in Section 02911 – Soil Preparation, before starting Work of this section.

.2 Complete Work under this section within ten (10) days following completion of soil preparation.

.3 Notify the Engineer at least three (3) days in advance of:

.1 Each material delivery.

.2 Start of planting activity.

.4 Planting Season: Those times of year that are normal for such Work as determined by accepted local practice.

1.8 MAINTENANCE SERVICE

.1 Contractor: Perform maintenance operations during maintenance period to include:

.1 Watering: Keep surface moist.

.2 Washouts: Repair by filling with topsoil, liming, fertilizing, seeding, and mulching.

.3 Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3-1/2 inches.

.4 Fences: Repair and maintain until satisfactory stand of grass is established.

.5 Reseed unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced.

.6 Reseed/replant during next planting season if scheduled end of maintenance period falls after September 15.

.7 Reseed/replant entire area if satisfactory stand does not develop by July 1 of the following year.

1.9 WARRANTY

.1 The Contractor hereby warrants that plant material as shown on the drawings will remain free of defects for two full growth years.

.2 Middle of warranty and end-of-warranty inspection will be conducted.

.3 Engineer reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

.4 During warranty period, remove from site any plant material that has died or failed to grow satisfactorily as determined by the Engineer. Replacement of this plant material is to take place in the next planting season.

.5 Extend warranty on replacement plant material for a period equal to the original warranty period or in accordance with the Owner’s requirements.

.6 Continue such replacement and warranty until plant material has successfully developed during the warranty period and accepted by the Engineer.

PART 2 PRODUCTS

2.1 FERTILIZER

.1 Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.

.2 Application Rates: Determined by soil analysis results.

.3 Top Dress Type: As recommended by local authority.

2.2 SOD

.1 Certified, containing grass mix identical to the grass seed mix.

.2 Strongly rooted pads, capable of supporting own weight and retaining size and shape when suspended vertically from a firm grasp on upper 10 percent of pad.

.1 Grass Height: 40 to 60mm.

.2 Strip Size: minimum dimensions 400mm wide by 910mm long.

.3 Soil Thickness: Uniform; 25mm plus or minus 6mm at time of cutting.

.4 Age: Not less than 10 months or more than 30 months.

.5 Condition: Healthy, green, moist; free of diseases, nematodes and insects, and of undesirable grassy and broadleaf weeds. Yellow sod, or broken pads, or torn or uneven ends will not be accepted.

2.3 WATER

.1 Water will be potable and free of impurities and chlorine that would inhibit germination and growth.

2.4 WOODEN SURVEY STAKE

.1 Steel survey stake (500mm long) with colored flag will be used to identify seeding area limits.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Make available topsoil test results and soil amendments recommendations for review by the Engineer.

.2 Ensure that all rough grading and backfilling has been completed in accordance to Grading Plan. Check subgrade condition for conformity with elevations shown on Contract Drawings. Notify the Engineer of any irregularities before proceeding.

.3 Ensure that topsoil has been placed on all seeding areas as specified. All structures, hard surfaces such as walks, curbs, and trees and shrubs will be in place prior to commencing seeding Work.

.4 Identify and mark with steel survey stake the boundary of the seed areas and sod areas. Mark each boundary with marker spaced every 20m along the boundary line. Distinguish between boundaries by using different colour survey stake. No planting will take place until these boundaries have been marked in the field.

.5 Ensure that all barrier fencing is in place to protect existing vegetation to be retained prior to commencing cultivation of seeding areas.

.6 Notify the Consultant of unsatisfactory conditions. Do not start subsequent stage without approval of the Consultant.

3.2 PREPARATION

.1 Grade areas to smooth, even surface with loose, uniformly fine texture.

3.3 SODDING

.1 Do not plant dormant sod, or when ground is frozen.

.2 Lay sod to form solid mass with tightly fitted joints; butt ends and sides, do not overlap.

.1 Stagger strips to offset joints in adjacent courses.

.2 Work from boards to avoid damage to subgrade or sod.

.3 Tamp or roll lightly to ensure contact with subgrade; work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass.

.4 Complete sod surface true to finished grade, even, and firm.

.3 Fasten sod on slopes to prevent slippage with wooden pins 150mm long driven through sod into subgrade, until flush with top of sod. Install at sufficiently close intervals to securely hold sod.

.4 Water sod with fine spray immediately after planting. During first week, water daily or more frequently to maintain moist soil to depth of 100mm. Water sodded area regularly after the first week to maintain sod in healthy, vigorous growing condition. Keep a record of the dates on which watering occurred. Water after six weeks if prolonged periods of drought occur (more than three days without rainfall). Always water in early morning. Ensure that watering activities do not cause sod and soil to be displaced.

3.4 FIELD QUALITY CONTROL

.1 Two weeks after sodding is complete and on written notice from Contractor, the Consultant will, within ten (10) days of receipt, determine if a satisfactory stand has been established.

.2 If a satisfactory stand has not been established, Consultant will make another determination after written notice from Contractor following the next growing season.

3.5 PROTECTION

.1 Protect from pedestrian traffic by erecting temporary fence around each newly sodded area.

3.6 PROTECTION OF INSTALLED WORK

.1 Protect sodded areas and planted tree against damage for duration of maintenance period.

3.7 ADJUSTMENT OR REPLACEMENT OF SODDED AREAS

.1 Perform adjustment and replacement Work with materials of the same variety and quality as outlined in Contract Drawings. Replacement work will have a warranty of the same length with the same conditions as outlined in this Specification. Date renewed warranty from time of approval of replacement work.

END OF SECTION

DIVISION 3

CONCRETE

TORONTO

SECTION 03100

CONCRETE FORMWORK AND ACCESSORIES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1, General Requirements.

.2 This Section forms part of Section 03300, Cast-in-Place Concrete.

1.2 REFERENCES

.1 Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

.1 Canadian Standards Association (CSA):

a. A23.1, Concrete Materials and Methods of Concrete Construction.

b. S269.1, Falsework for Construction Purposes.

c. S269.2-M, Access Scaffolding for Construction Purposes.

d. S269.3-M, Concrete Formwork

.2 American Concrete Institute (ACI):

a. 347, Guide to Formwork for Concrete.

.3 National Lumber Grades Authority (NLGA):

a. Standard Grading Rules for Canadian Lumber.

1.3 DESIGN REQUIREMENTS

.1 Design formwork in accordance with CSA S269.1, S269.2-M, and S269.3-M and CSA A 23.1-09 Clause 6.5 Formwork to provide specified finishes.

.2 Design formwork and falsework to carry dead loads and construction live loads.

.3 When high range water reducer (superplasticizer) is used in concrete mix, design forms for full hydrostatic pressure.

.4 Make joints in forms watertight.

.5 Design formwork to meet variations from a reference system specified in CSA A23.1-09 Clause 6.4 Construction Tolerances for Cast-in-Place Concrete.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Submit formwork and falsework drawings bearing seal and signature of a Professional Engineer licensed in the Province of Ontario for record purpose.

.2 Formwork and falsework Shop Drawings will not be reviewed for structural adequacy.

.3 Be fully responsible for the design, construction, and maintenance of formwork and falsework.

a. Show design criteria as specified in CSA A23.1-09 Clause 6.5.2.1.

.4 Indicate:

a. For suspended slabs

(a) Shoring left in place until concrete has reached specified strength.

(b) Re-shoring below slabs or beams supporting shoring above.

b. Lateral bracing system.

c. For walls and columns on top of slabs and beams

(a) Shoring left in place until concrete in walls and columns above has reached specified strength.

(b) Lateral bracing system.

.5 Layout of panel joints, form liners, and tie hole pattern. Method of sealing form tie hole. Coordinate with details where shown.

.6 Double Wall Construction: Show details of double wall forming and premolded joint filler attachment.

.7 Two unstamped copies of the Shop Drawings will be returned with Contract Administrator's comments.

.2 Product Data Sheets:

.1 Submit Manufacturer's product data sheets including materials, allowable loading, installation, application, and maintenance instructions for:

a. Proprietary scaffolding.

b. Shoring beams.

c. Lumber for formwork and falsework.

d. Plywood for formwork and falsework.

e. Formwork for curved surfaces.

f. Tubular column forms.

g. Void forms (tubes).

h. Void forms (bio-degradable).

i. Form release agent.

j. Form ties.

k. Controlled permeability form liner.

.3 Samples: One each as follows:

.1 Form ties.

.2 Form liners.

.4 Informational Submittals:

.1 Statement of qualification for formwork designer.

.2 Contractor's Certificate of Proper Installation.

1.5 QUALIFICATIONS

.1 Formwork, Falsework, and Shoring Designer: An engineer licensed in the Province of Ontario.

1.6 QUALITY ASSURANCE

.1 Mockup Panels:

.1 Show architectural details, joints, form ties, form liners, and reinforcing bar spacers to produce finished surface required.

.2 Test form release agent on one mockup panel to ensure no adverse effects are caused on form or form liner materials.

.3 Cast panels from minimum of 3–cubic metre truck mixer load.

.4 Approved panels establish standard of quality by which concrete work will be judged.

.5 Replace panels if not representative of Work as specified.

.6 Panels may be incorporated into Work if approved by Contract Administrator

.7 Construct additional 2400 mm by 2400 mm panel or use Contract Administrator-selected portion of as-cast wall surface hidden from view to develop and test patching techniques and mixes.

.2 Construct additional panels and use to demonstrate repair material and application procedures and obtain approval prior to using material to repair project structures.

PART 2 PRODUCTS

2.1 FORM MATERIALS

.1 General:

.1 Materials:

a. Lumber for Formwork and Falsework: Grade-marked sawn lumber graded in accordance with NLGA.

b. Plywood for Formwork: High density overlay (plastic overlay) grade plywood. Plywood may be of lower finish grade when use in conjunction with form liner.

c. Fibreglass or steel forms in undamaged condition, of sufficient strength and surface smoothness to produce specified finish.

.2 Circular Structures:

a. Conform forms to circular shape of structure.

b. Straight panels may be substituted for circular forms provided panels do not exceed 600 mm in horizontal width and angular deflection is no greater than 3-1/2 degrees per joint.

.3 Void Forms:

a. Bio-degradable: Suitable to support construction load with a controlled built-in strength loss.

b. Manufacturer: Void Form International Ltd.

.2 Form Liners:

.1 Controlled Permeability Form Liner:

a. Controlled pore size, maximum 0.08 mm to permit drainage of excess water; water permeability at 200 mm water head of 20 L per square metre per second.

b. Liner must be noncompressible under wet concrete pressure.

c. Manufacturer and Product:

(a) Dupont; Zemdrain MD (re-use up to 2 times).

(b) Fibertex; Formtex (do not re-use).

.3 Painted Surface Forms: High density overlay plywood surfaces.

.4 Form Release Agent:

.1 Use form release agent on all cast in place concrete except where form liners is used.

.2 Material: Release agent that does not bond with, leave residue on, stain, or adversely affect concrete surfaces, and does not impair subsequent treatments of concrete surfaces when applied to forms

.3 Freezing point: Minus 15 degrees C or lower.

.4 Manufacturers and Products:

a. BASF; MasterFinish RL 211.

b. Cresset Chemical Company; Crete-Lease 20-VOC.

c. W.R. Meadows of Canada Ltd.; Sealtight Duogard.

d. Euclid Admixture Canada, Inc.; Eucoslip VOX.

.5 Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides preventing loss of paste or water between the two surfaces.

.6 Form Ties:

.1 Material: Steel.

.2 Spreader Inserts:

a. Conical or spherical type.

b. Design to maintain positive contact with forming material.

c. Furnish units that will leave no metal closer than 25 mm to concrete surface when forms, inserts, and tie ends are removed.

.3 Wire ties not permitted.

.4 Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 25 mm depth and sufficient dimensions to permit patching of tie hole.

.5 Water Stop Ties: For water-holding structures, below grade structures, pipe galleries, and accessible spaces below finish grade, furnish one of the following:

a. Integral steel water stop 2.6 mm thick and 16 mm in diameter tightly and continuously welded to tie.

b. Neoprene water stop 5 mm thick and 24 mm diameter whose center hole is 1/2-diameter of tie, or molded plastic water stop of comparable size.

c. Orient water stop perpendicular to tie and symmetrical about center of tie.

d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

e. Through bolt ties are not permitted for water-holding structures.

.6 Through-Bolts: Tapered minimum 25 mm diameter at smallest end.

a. Not permitted for water-holding structures, below grade structures, pipe galleries, and accessible spaces below finish grade.

.7 Elastic Vinyl Plug:

a. Use in conjunction with through-bolt type form ties.

b. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length, and diameter upon removal forming watertight seal.

c. Manufacturer and Product: Dayton/Richmond Co., A58 Sure Plug.

.7 Stay-Form: Form at joints with waterstop as manufactured by AMICO Type No. 66-26 GA minimum.

PART 3 EXECUTION

3.1 FORM SURFACE PREPARATION

.1 Remove water, snow, ice, laitance, curing compound, loose soil, and other debris and thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants prior to coating surface.

.2 Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by the Manufacturer.

.3 Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

.4 Form Liners: Provide liners with full sheets and place seams at horizontal and vertical grooves. Prepare as recommended by Manufacturer.

.1 Use anchorage systems recommended by Manufacturer to anchor liner to formwork.

.2 Do not use form release agent on formwork.

3.2 ERECTION

.1 General:

.1 Unless specified otherwise, follow applicable recommendations of CSA S269.1, S269.2- M and S269.3-M.

.2 Align form joints and make watertight. Keep number of joints to a minimum.

.3 Laterally brace formwork and falsework and prevent displacement during concrete placement.

.4 Form chases, openings, projections, recesses, expansion joints and construction joints.

.5 Form around pipes, mechanical, and electrical equipment which penetrate the concrete structure.

.6 Incorporate frames, castings, pipes, sleeves, and similar items into formwork.

.7 Do not re-use damaged formwork which may not provide a uniform consistent finish.

.8 Do not re-use controlled permeability form liner when water drainage from the liner has reduced to 75 percent of its first use drainage performance.

.2 Beveled Edges (Chamfer):

.1 Form 20 mm bevels at concrete edges, unless otherwise shown.

.2 Where beveled edges on existing adjacent structures are other than 20 mm, obtain Contract Administrator's approval of size prior to placement of beveled edge.

.3 Wall Forms:

.1 Locate form ties and joints in an uninterrupted uniform pattern.

.2 Inspect form surfaces prior to installation to assure conformance with specified tolerances.

.3 Do not use through-the-wall removable form ties for walls of liquid holding structures and exterior walls below grade.

.4 Where excavation shoring system is used as formwork, fasten form tie to shoring in a suitable manner to withstand applied loads.

.5 Double Wall Construction:

a. Joint Filler Attachment:

(a) Use attachments to secure premolded joint filler to one wall only.

(b) Secure premolded joint filler without gaps and separations keeping concrete from second wall pour from penetrating thickness and space occupied by premolded joint filler. Seal all premolded joint filler joints by tapping.

b. Do not use form ties or other devices permanently penetrating premolded joint filler between walls or produce a rigid connection between walls.

c. Ensure first cast wall has attained the greater of the wall design concrete strength or the construction strength required, as determine by form design engineer, prior to casting second wall. Determine strength based on field cast and cured test cylinders.

.4 Formwork with Form Liners:

.1 Construct forms to structurally withstand deflection, movement, leakage, high hydraulic pressures resulting from rapid filling and heavy-high frequency vibration.

.2 Lay out form joints and ties in uniform pattern, unless otherwise shown.

.3 Use plywood forms when using form liners. Plywood may be of lower finish grade when used in conjunction with form liners.

.4 Controlled permeability form liner applications:

a. For liquid holding structures provide liner on both faces except at tunnels and galleries apply liner on wet side only. Provide liners in full sheets. Place seams at regular horizontal and vertical pattern. Prepare as recommended by the Manufacturer.

b. Use anchorage systems recommended by the Manufacturer to anchor liner to formwork. Close anchorage of liner is recommended to prevent wrinkling of the liner.

c. Do not use form release agent on formwork.

.5 Form Tolerances: Comply to tolerances of CSA A23.1.

.6 Fasteners: Use only galvanized nails and fasteners when such fasteners will be left in place in the permanent structure.

.7 Void Forms: Brace void forms to prevent distortion and floatation.

.8 Shoring under walls or columns:

.1 When constructing concrete walls or columns on top of slabs or beams, provide shoring under these slabs or beams to carry the total construction load.

.2 Leave shoring in place until the compressive strength of the concrete in the wall above has reached 75 percent of its specified 28-day compressive strength.

.9 Lateral Supports: Where required, brace walls until permanent lateral supports are in place.

.10 Formwork at Construction and Expansion Joints: Provide formwork incorporating water stop in joint. Use “Stay-Form” for joints with waterstop. Install Stay-Form as per Manufacturer’s installation instructions and as shown on Drawing details.

3.3 FORM REMOVAL

.1 Remove wall and column formwork as soon as possible after concrete has attained adequate strength to support its own weight and superimposed loads, without cracking or deflecting excessively in order to facilitate effective finishing, but not earlier than 30 hours after concrete placement if:

.1 Concrete is sufficiently hard so as not to sustain damage by form removal operations, and

.2 Curing and protection operations are maintained.

.2 Elevated Structural Slabs, and Beams: Remove formwork after concrete has reached 75 percent of its specified 28-day compressive strength as determined by field cure test cylinders.

.3 Remove nails, fasteners, tie wire and similar items at the surface.

3.4 MANUFACTURER’S SERVICES

.1 Form liner Manufacturer’s Representative to provide installation assistance at Site, and inspection. Contractor to provide inspection report certifying acceptable liner installation in accordance with the Manufacturers’ Specifications.

END OF SECTION

TORONTO

SECTION 03210

REINFORCING STEEL

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 This section specifies requirements for supplying and installing all reinforcing steel and all associated accessories as indicated on the Contract Drawings, as specified herein and as required to complete the work.

1.2 REFERENCES

.1 The following is a list of standards which may be referenced in this section:

.1 Canadian Standards Association (CSA):

a. CAN/CSA-A23.1/A23.2 – Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

b. CSA-A23.3 – Design of Concrete Structures.

c. ASTM-A185/A185M – Welded Steel Wire Fabric for Concrete Reinforcement.

d. ASTM-A497/A497M – Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

e. CAN/CSA-G30.18-M92 (R2002) – Billet-Steel Bars for Concrete Reinforcement.

f. G40.20-04/G40.21-04 (R2009) – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

g. CSA W186-M1990 (R2007) – Welding of Reinforcing Bars in Reinforced Concrete Construction.

.2 American Society for Testing and Materials (ASTM):

a. ASTM A775/A775M – Specification for Epoxy-Coated Reinforcing Steel Bars.

.3 Reinforcing Steel Institute of Canada: Reinforcement Steel Manual of Standard Practice.

.4 International Conference of Building Officials (ICBO): ICBO Research Report.

.5 ACI Standard 315R “Manual of Engineering and Placing Drawing for Reinforced Structures”.

1.3 SUBMITTALS

.1 Samples and Product Data Sheets

.1 Submit three samples and three copies of manufacturer's product data sheets including installation and maintenance instructions for:

a. Chairs, bolsters, bar supports, and side form spacers.

b. Mechanical splices, mechanical threaded connectors.

.2 Shop Drawings

.1 Reinforcing Bars:

a. Submit reinforcing bar placement drawings prepared in accordance with Reinforcement Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada and as specified below.

b. Indicate reinforcing bars that form part of an individual concrete placement and reinforcing bars that extends into adjacent placements.

c. For each reinforcing bar placement shop drawing, submit a separate bar list and bending schedule showing size, shape, dimensions, and numbers of bars required for each bar type.

d. Identify reinforcing bars in the bar list and bending schedule with a separate bar mark that corresponds to bar marks shown on reinforcing bar placement drawings.

e. If bar list and bending schedule contain details of bars of more than one reinforcing bar placement drawing, then arrange bar marks in separate groups for each placement drawing. Clearly indicate for each bar mark the corresponding reinforcing bar placement drawing number.

f. For slabs, show a separate plan indicating concrete thickness, reinforcing bars, and dowels for walls and columns cast in slab.

g. For walls, show separate elevations indicating concrete thickness, reinforcing bars, and dowels for slabs and adjacent walls cast in wall.

h. Do not add new information on previously reviewed shop drawings.

i. Reinforcing bar placement shop drawings will be reviewed for bar sizes, locations, and spacing, and will be stamped and signed. Reviewed bar list and bending schedule will be dated only.

.2 Submit shop drawings of dowel bar splicers detailing locations, size, and type.

.3 Quality Control Submittals

.1 Submit certified mill test reports of steel reinforcing bars: Determine physical and chemical properties of steel reinforcing in accordance with requirements of CAN/CSA-G30.18-M.

.2 Dowel Bar Splicers (mechanical threaded connections):

a. Current International Conference of Building Officials (ICBO) Research Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.

b. Verification that device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.

.3 Submit welding certificate in accordance with CSA W47.1 and CSA W186-M.

1.4 QUALITY ASSURANCE

.1 Welder Qualifications: CSA W47.1 and CSA W186-M certified.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Ship bundles of reinforcing bars identified by tags containing bar marks along with bar list.

.2 Store materials in a manner, which will prevent deterioration or contamination. Deteriorated or contaminated materials will be rejected and must be removed from site.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Reinforcing Bars

.1 Deformed steel bars: CAN/CSA-G30.18-M; Grade 400R. Do not substitute with epoxy-coated bars. Use only 1 source for reinforcement bar supply.

.2 Mechanical Splices

.1 Mechanical Threaded Connections: Furnish metal coupling sleeve with internal threads engaging threaded ends of bars, capable of developing in tension or compression 125% of yield strength of bar.

a. Manufacturers and Products:

(a) DB-SAE by NCA

(b) Lenton Form Saver by Erico Canada Inc.

(c) D150 DBR Coupler and DBR Setting-Splice Bar, with size equivalent to DB-SAE, by Dayton Superior Canada Limited.

.3 Dowel-in bar: Suitable for existing dowel bar splicer with rolled UNC or tapered threads as required.

.1 DI by NCA/Acrow-Richmond Ltd.

.2 Splice bar by Erico Canada Inc.

.3 D-51, D-52, or D-53, with size equivalent to DI, by Dayton Superior Canada Limited.

.4 Welded Wire Fabric

.1 CSA G30.5-M; electrically welded steel wire fabric.

.2 Furnish flat sheets only, rolled sheets not permitted.

2.2 ACCESSORIES

.1 Tie Wire

.1 Black, soft-annealed 1.6 mm diameter wire.

.2 Nylon-, epoxy-, or plastic-coated wire.

.2 Bar Supports and Spacers

.1 Adequate for accurate placing and as required for construction loads. Provide non-conductive bar supports in contact with exposed surfaces that prevents moisture movement from the surface to the reinforcement.

.2 In Beams, Columns, Walls, and Slabs Exposed to View After Form Removal: Small rectangular concrete blocks made up of same color and strength as concrete being placed around them or all-plastic bar supports and side form spacers.

.3 Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports are not high enough.

.4 Precast concrete supports of same strength as concrete for reinforcing in concrete placed on grade. Clay brick or concrete masonry block as reinforcement chairs are not acceptable.

2.3 FABRICATION

.1 Reinforcing Bars

.1 Comply with CSA A23.1 and CSA A23.3.

.2 Tolerances:

a. Length: ±25 mm.

b. Height of truss bar: +0 to -10 mm.

c. Outside dimensions of stirrups, ties, and spirals: ±10 mm.

d. Other bends: ±25 mm.

.3 Use longest bar possible. Keep number of splices to a minimum.

.4 Do not weld chairs, bolsters, bar supports, or spacers to reinforcing bars.

.2 Reinforcing Splices

.1 Lap Splices:

a. Splice by lapping reinforcing bars, all lap splices shall be Class B unless specified otherwise.

.2 Welded Splices (where permitted by the Engineer):

a. Full-penetration direct butt-splice welds in accordance with CSA W186-M and as specified.

.3 Splices in Wire Fabric:

a. Comply with CSA A23.3.

PART 3 EXECUTION

3.1 PREPARATION

.1 Notify Engineer when reinforcing is ready for inspection and allow 48 hours in advance for inspection prior to placing concrete.

.2 Clean reinforcing bars of loose rust, mill scale, dried cement or concrete paste from previous pours, mud, oil, or other coatings that will affect adhesion in accordance with CSA A23.1, Clause 6.1.5 - Surface Conditions of Reinforcement, prior to placing concrete.

.3 Coat wire projecting from bar supports with dielectric material, epoxy, or plastic.

3.2 REINFORCING BAR INSTALLATION

.1 Place reinforcement within tolerances specified in clause 6.6.8 -CSA A23.1[-09].

.2 Splicing

.1 Use lap splices, unless otherwise shown or permitted in writing by Engineer.

.2 Welded Splices: Accomplish by full penetration groove welds and develop a minimum of 125%t of yield strength of bar in tension and compression.

.3 Stagger splices in adjacent bars where indicated.

.3 Dowel Bar Splicers

.1 Use only in areas specifically approved in writing by Engineer.

.2 Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICBO Research Report.

.3 Install dowel bar splicers with plastic setting plugs.

.4 Lightly grease internal threads in accordance with manufacturers printed instructions.

.5 Maintain minimum edge distance and concrete cover.

.4 Tying Reinforcing Bars

.1 Bend tie wire away from concrete surface to ensure a cover as shown or specified for tie wires, form tie bolts etc. Do not let reinforcing tie wire touch formwork or be exposed in the finished concrete structure.

.5 Reinforcement Around Openings: As a minimum, on each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut or disrupted for opening. Extend steel reinforcing a standard lap length beyond opening at each end, unless shown otherwise on design drawings.

.6 Welding Reinforcement

.1 Only Type W bars may be welded.

.2 Do not perform welding until welder qualifications are approved.

.7 Dowels Threaded Into Dowel Bar Splicers in Existing Structures

.1 Expose existing dowel bar splicers.

.2 Remove plastic setting plugs and clean threads.

.3 Thread dowel-in bars into the dowel bar splicers and tighten securely to develop required strength in tension and compression.

.8 Straightening and Rebending: Field bending of reinforcing steel bars is not permitted.

.9 Unless permitted by Engineer, do not cut reinforcing bars in field.

3.3 WELDED WIRE FABRIC INSTALLATION

.1 Use only where specifically shown.

.2 Extend fabric to within 50 mm of edges of slab, and lap splices at least 1-1/2 courses of fabric or minimum 200 mm.

.3 Tie laps and splices securely at ends and at least every 600 mm with tie wire.

.4 Install 15M reinforcing bars at 2000 mm maximum spacing in each direction, supported on chairs, to securely support welded steel wire fabric during concrete placement.

.5 Do not use fabric that has been rolled. Install flat sheets only.

3.4 TESTS AND INSPECTION

.1 The Engineer will inspect the reinforcing steel once it has been placed and will check for conformity with shop drawings and bar lists.

.2 Advise the Engineer at least 48 hours in advance for the inspection.

.3 The concrete pour will only be authorized after the placed steel is reviewed by the Engineer.

.4 The Engineer's review does not relive the Contractor of his responsibility of correctly placing and adequately supporting the reinforcing steel.

END OF SECTION

TORONTO

SECTION 03300

CAST IN PLACE CONCRETE

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 Provide all labour, materials and equipment and incidentals necessary to complete cast-in-place concrete work as specified and as indicated on the Contract Drawings.

.2 This Section includes but is not limited to the following:

.1 Normal-density concrete.

.2 Fill concrete.

.3 Bonded concrete toppings.

.4 Repair of cracks that develop in concrete.

1.2 DEFINITIONS

.1 Exposed Concrete: Concrete surfaces that can be seen inside or outside of structures regardless whether concrete is above water, dry at all times, or can be seen when structure is drained.

.2 Defective Areas:

.1 Surface defects that include honeycomb, rock pockets, indentations greater than 5 mm, spalls, chips, air bubbles greater than 20 mm in diameter, pinholes, bug holes, embedded debris, lift lines, sand lines, bleed lines, fins and other projections, form pop outs, texture irregularities, and stains and other color variations that cannot be removed by cleaning.

.2 Cracks 0.1 mm wide and larger in water retaining structures as well as any crack that leaks in below grade spaces.

.3 Cracks 0.25 mm wide and larger in non liquid holding structures.

.4 Leakage through construction and expansion joints.

.3 New Concrete: Less than 60 days old.

1.3 REFERENCES

.1 CSA A23.1 Concrete Materials and Methods of Concrete Construction.

.2 CSA A23.2 Methods of Test for Concrete.

.3 CSA A3000 Cementitious Materials for Use in Concrete

.4 ACI 304.2R Placing Concrete by Pumping Methods.

.5 ASTM C260 Specifications for Air-Entraining Admixtures for Concrete.

.6 ASTM C494 Specification for Chemical Admixtures for Concrete.

.7 ASTM C900 Test Method for Pullout Strength of Hardened Concrete.

.8 ASTM C1017 Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.9 ASTM C1074 Practice for Estimating Concrete Strength by the Maturity Method.

1.4 PERFORMANCE REQUIREMENTS

.1 28-day Concrete Compressive Strengths

.1 Normal-density concrete:

a. Type A: 30 MPa Exposure Class S-2

b. Type B: 15 MPa

.2 Density

.1 Normal density 2350 $\pm$ 50 kg/m^3.

.3 Construction Tolerances

.1 Comply with Clause 6 – CSA A23.1 unless noted otherwise.

1.5 SUBMITTALS

.1 Product Data Sheets

.1 Submit three copies of manufacturer's product data sheets including installation, application, and maintenance instructions for:

a. Chemical admixtures.

b. Air-entraining admixtures.

c. Superplasticizing admixtures.

d. Bonding agent.

e. Crack injection material.

f. Repair materials.

.2 Drying shrinkage Test

.1 Drying Shrinkage Tests:

a. Specimens: Fabricate, cure, dry and measure as specified in ASTM C157 modified as follows:

(a) Remove specimens from molds aged 23 hours, ± one hour after trial batching.

(b) Place immediately in water at 22.8°C ±2°C for at least 30 minutes.

(c) Measure within 30 minutes thereafter to determine original length and then submerge in saturated limewater at 22.8°C, ±2°C.

(d) Measure specimens at age seven days to determine expansion expressed as percentage of original length. Length at age seven days shall be base length for drying shrinkage calculations (0 days drying age).

(e) Store specimens immediately in humidity control room maintained at 22.8°C, ±2°C and 50 percent, ±4 percent relative humidity of remainder of test.

(f) Measure to determine shrinkage expressed as percentage of base length and report separately for 7, 14, 21, and 2

b. Concrete Shrinkage at 28-Day Drying Age: 0.040% maximum for laboratory trial mixes of proposed concrete for construction. If shrinkage specimen tests for concrete exceed shrinkage limits modify concrete mix to reduce shrinkage.

.3 Concrete Mix Design

.1 Submit proposed performance mix, and supplier's applicable standard deviations.

.2 Tabulate concrete mixes. Indicate range of cementing materials content, type of cements, size of coarse aggregate, water/cementing material ratio, admixtures used, air content, slump, and locations of use for each mix.

.3 For high-slump flowing concrete submit a mix that will not result in segregation.

.4 Submit detailed plan for cold weather curing and protection of concrete placed and cured in weather below 0°C.

.5 Submit detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 25°C.

.6 Concrete mix designs will be reviewed for conformance with requirements of the Specifications and will be returned with Engineer's comments.

.4 Source Quality Control Submittals

.1 Chemical admixtures, used in the production of concrete shall be certified as safe product from recognized approving authorities.

.2 Submit certification that the cement and supplementary cementing materials do not contain regulated metals and no hazardous waste derived fuels were used in the production of the cement(s).

.5 Quality Control Submittals

.1 Submit Concrete quality control plan for the project. Provide the following:

a. Certification from concrete producer that the mix has been designed based on the requirements of the Specification and that concrete mix will meet the performance requirements.

b. Identify the Company and contact names of subcontractors, material suppliers and testing companies involved with concrete manufacture and placement.

c. Identify all tests that will be used for material acceptance and indicate minimum specification requirements for each test.

d. Identify the frequency of testing for each test.

e. Identify the course of action to be taken if the testing program indicates that specification requirements have not been met.

f. Concrete quality control plan shall not take precedence over any other Contract documents.

g. Submit concrete delivery records.

h. Submit a correlation curve of pullout strength test to standard cylinder strength test. Submit a correlation curve of strength of concrete at given time in hours to 28-day strength.

.6 Concrete Placing Schedule

.1 Submit a detailed concrete placing schedule, including mix by type and location of proposed pour.

.2 Provide notice of intent to pour a minimum of 2 days prior to the pour.

.3 Provide a completed Concrete Pour Release Form (appended) prior to each pour.

.4 Do not order concrete until the Concrete Pour Release Form has been signed by the Engineer.

.7 Certificates

.1 Submit certificate of Ready Mixed Concrete Production Facilities.

.2 Submit certification that aggregates will not, nor have the potential to, react with cement to result in deleterious expansion in the concrete.

.3 Submit certification that deleterious substances in aggregate are within limits specified in CSA A23.1, Table 12 - Limits for Deleterious Substances and Physical Properties of Aggregates.

.4 Submit certification that proposed performance mix will produce concrete meeting the requirements of Specifications.

.5 Submit certification that proposed mix design strengths have been selected allowing for the supplier's standard deviations as indicated in CSA A23.1 Clause 4.4.6 - Compressive Strength.

.6 Submit certification that bonding agent, if used, will meet the requirements of Specifications.

.7 Submit certification that crack injection materials are suitable for continuous submersion.

1.6 QUALITY ASSURANCE

.1 Ready Mixed Concrete Producer: Certified member in good standing of the local Ready Mixed Concrete Association.

.2 Concrete Testing

.1 Testing of concrete for materials and compression will be done by the Contractor Third party for QC. Owner will carry our quality assurance spot checks through a third party.

.2 Pay for additional testing required because of changes in material or the mix proportions, as well as any extra testing of concrete or materials occasioned by their failure to meet the specification requirements.

.3 The use of testing services does not relieve the Contractor of his responsibility of quality control testing to provide materials and construction in compliance with the Drawings and Specifications.

.4 The use of 3rd party QA does not relieve the Contractor of his responsibility of his own quality control testing to provide materials and construction in compliance with the Drawings and Specifications.

.3 Pre-placement Meeting

.1 Hold a meeting at least four weeks prior to the initial placement of concrete to review the detailed requirements for preparing the concrete design mixes, finishes, and procedures for concrete placement for the structures.

.2 Arrange for the attendance at the meeting of the Engineer, City, and of concrete subcontractors, manufacturers, and suppliers including, but not limited, to the following:

a. Contractor's superintendent.

b. Ready-mix concrete producer.

c. Admixture manufacturer(s).

d. Concrete pumping and conveying equipment supplier.

e. Concrete formwork and finishing subcontractors.

.3 Notify the Engineer at least 10 working days prior to the scheduled date of the meeting.

.4 The Engineer will set an agenda for the meeting at least five working days prior to the scheduled date of the meeting.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Comply with manufacturers' recommendations for delivery, storage, and handling.

.2 Store materials in a manner that will prevent deterioration or contamination. Deteriorated or contaminated materials will be rejected and must be removed from site.

1.8 SITE CONDITIONS

.1 Cold Weather Requirements

.1 The following requirements are in addition to CSA A23.1, Clause 7.4.1.5 - Cold-Weather Protection.

.2 Provide temperature-controlled enclosures for areas where concrete is placed whenever ambient air temperature is 0°C or lower.

.3 Protect concrete from the adverse effects of space-heated enclosures including local overheating and combustion products.

.4 Heat mix-water and, if necessary, aggregates to achieve a wet concrete temperature of +15°C minimum at the site prior to pouring the concrete.

.5 Maintain temperature of reinforcing bars and forms above +5°C prior to placing concrete.

.6 Maintain temperature of concrete when deposited in forms not less than 15°C or higher than 25°C

.7 Cover slabs and horizontal surfaces with insulated tarpaulins for a minimum of 7 days and monitor the temperature of the surface. Maintain temperature of concrete at surfaces at least 10°C for a minimum period of seven days after placing concrete. Concrete temperature may then be lowered to ambient air temperature at a rate of 1/2°C per hour or 10°C per day. Site cured compression cylinder must be placed under the insulated tarpaulin if required for determining the strength of the concrete for form removal and re-shoring.

.8 Cover forms on vertical formed structures as required for 7 days and monitor temperatures as specified before removing forms.

.9 The temperature difference for the concrete being placed and the concrete being poured against, is of primary importance during winter concreting. Therefore, the temperature of the surface of the previously poured concrete must be within 5°C of the concrete being placed but must not be lower than 7°C.

.2 High-temperature Control Requirements

.1 The following requirements are in addition to CSA A23.1, Clause 7.4.1.4 – Hot-Weather Protection.

.2 Limit peak temperature during the curing period to 40°C maximum. Placing temperature that will satisfy this requirement depends on ambient temperature, humidity at the time of placing, thickness of the concrete, and curing methods employed.

.3 Consider use of retarders, low-heat cement, slag replacement, ice in mixing water, pre-cooling of aggregates, cooling of concrete through continuous wet curing, and similar methods in order to prevent concrete temperatures from exceeding 40°C at any time.

.4 Monitor concrete temperatures for walls and slabs 500 mm or more in thickness. After concrete temperature has peaked, control rate of cooling to ambient air temperature at a rate of ½°C per hour to prevent cracking.

.5 Notwithstanding requirements of subparagraphs .1 and .2 above, do not place concrete with temperature higher than 25°C. Concrete with temperature in excess of 25°C on arrival at the site will be rejected. Remove rejected concrete form the site.

.3 Protection

.1 Protect freshly placed concrete from damage due to construction operations and from cold, heat, rain, snow, running water, drying winds, and any other circumstances which would likely cause deterioration of concrete quality.

.2 Use waterproof insulated covers or other suitable materials to enclose freshly placed concrete under these conditions.

.4 Frost Protection for Slabs on Grade

.1 Provide continuous protection for slabs on grade to prevent subgrade below from freezing during cold weather. Provide heated enclosures and insulation as required.

.2 Subgrade below completed tanks may be protected against frost by filling with water to a minimum depth of 2000 mm. Place log booms, 200 mm diameter, at maximum spacing of 5000 mm in each direction to abate ice pressures on tank walls. Break ice on formation.

.5 Influence of Ambient Concrete Temperature on Concrete Crack Control

.1 To minimize the formation of thermal cracks during placement and curing, maintain previously cured concrete and concrete that will be placed against it at the same temperature.

.2 Do not place concrete against any surface, which is less than 7°C in temperature.

.3 The Engineer may direct the Contractor to employ any of the means for crack control during hot weather outlined in ACI Report “Hot Weather Concreting”, at no additional cost to the Contract.

.4 Failure to minimize temperature differential between adjacent pours will result in temperature induced cracking. Repair such cracks as specified in this Section.

.6 Backfilling and Service Loads Restrictions

.1 Verify that backfill is not higher than the finished grades indicated.

.2 Verify that loads during construction will not impose loads greater than those indicated.

.3 Verify that concrete in walls, and slabs, struts, and cross walls, which frame into the walls providing lateral stability, has been placed and has attained specified compressive strength before backfilling against walls or subjecting walls to service loads.

.4 Verify that concrete in slabs, including slabs on grade, and support components have reached specified compressive strengths before backfilling or subjecting slabs to service loads.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Cements

.1 Type MS “Moderate Sulphate-resistant” conforming to CSA A23.1.

.2 Supplementary Cementing Material

.1 Cementitious hydraulic slag: CSA A363-M “Cementitious Hydraulic Slag” and comply to the following conditions and requirements:

a. For fill concrete slag is not acceptable.

.3 Aggregates

.1 Normal-density Concrete

a. Coarse aggregate: CSA A23.1; rough and angular gravel or crushed stone.

b. Fine aggregate: CSA A23.1; natural sand.

.4 Admixtures

.1 Compatible with each other and with other concrete materials.

.2 Calcium chloride, thio-cyanates, or admixtures containing more than 0.05% chloride ions are not permitted.

.3 Corrosion inhibitor admixture shall be used at the pumping station structure.

.4 Air-entraining admixture: ASTM C260; non-detergent type.

.5 Water-reducing admixtures: ASTM C494; Type A.

.6 Set-retarding admixture: ASTM C494; Type B.

.7 Superplasticizing admixture: ASTM C494; Type F 1 or G 2 [ASTM C1017, Type 1 or 2.]

.8 Corrosion inhibitor: ASTM C494; Type C; DCI by:

a. W.R. Grace Co. of Canada Ltd.

b. Rheocrete CNI by Master Builders Technologies, Ltd.

.9 Corrosion inhibitor dosage: 10 L/m^3

.5 Water: CSA A23.1; clear and free from oil, acid, alkali, organic matter, or other deleterious substances.

.6 Bonding agent: Suitable for conditions of service and performance requirements of this Section.

.7 Epoxy Grout: Hydrocote 3061-I by BASF or approved equivalent.

.8 Repair all dry cracks with epoxy grout injection unless otherwise specified by the Engineer.

.9 Polyurethane injection resin for sealing cracks, single-component Diphenylmethane Diisocyanate (MDI) based, water-activated, hydrophobic type resin:

.1 Flexible Resin by Multiurethanes Limited

.2 Hydro Active Flex LV by DeNeef Construction Chemicals (U.S.) Inc.

2.2 CONCRETE MIXES

.1 General

.1 Establish proportions of cementing materials, aggregates, water, and admixtures required to produce consistent workable concrete that is watertight, durable concrete with strength and other properties specified. Comply with clause 4.3.6-CSA A23.1 Volume Stability Considerations.

.2 Use same type and brand of cement throughout.

.3 Comply with and allow for the supplier's Standard Deviation as specified in CSA A23.1 Clause 4.4.6 - Compressive Strength Requirements. If the concrete supplier has no established Standard Deviations for concrete of the specified strengths, use a value of 4 MPa minimum.

.2 Types of Normal-density Concrete

.1 Type A: Concrete for structures containing reinforcing bars, unless specified otherwise.

a. Use superplasticizing admixture for slabs, walls, beams and columns.

b. The concrete for all slabs, walls, beams and columns shall be 'low-shrinkage concrete as defined in Clause 8.8 of CSA A23.1.

c. Concrete for topping shall be the low shrinkage concrete except that it must contain a shrinkage compensating admixture.

.2 Type B: Fill concrete, mass concrete, mud slab and concrete benching, grouting in concrete masonry units, unless specified otherwise.

.3 Mixes for Normal-density Concrete

.1 Cementing Materials Content:

a. Use Portland cement or blended Portland as specified.

.2 Coarse Aggregates: CSA A23.1; rough and angular gravel or crushed stone

a. All mixes for concrete elements with thicknesses of 125mm or less use 10mm aggregate.

b. Use 20mm aggregate in the remainder of the mixes, unless approved in writing or otherwise specified by the Engineer.

c. Nominal size 10 mm, for Type A concrete used for Hollow core concrete topping.

.3 Water/Cementing Materials Ratio (W/C):

a. 0.42 maximum.

b. Type B concrete: As required for strength and workability.

.4 Workability:

a. Responsibility of the Contractor to provide concrete that has suitability workability for application.

b. Contractor shall ensure that the concrete mix design provided is suitability for the selected method of conveyance of the concrete from the concrete truck to the point of deposition.

.5 Air Content:

a. Comply with CSA A23.1, Table 4 - Requirements for the Air Content Categories.

b. Provide air content category 1, unless noted otherwise.

c. Provide air content category 2 for Type B concrete.

.6 Admixtures:

a. Use a superplasticizing admixture in all Type ‘A’ concrete.

b. Use superplasticizing admixture with a retarder when requirements of CSA A23.1, Clause 7.4.2.4.1 – Hot-Weather Curing are applicable.

.4 Mix for Filling Openings and Box Outs

.1 Use custom blended material with the following proportions:

a. In-Pakt Standard Grout: 500 kg/m³.

b. Fine aggregate: 700 kg/m³.

c. Coarse aggregate: 700 kg/m³.

d. Water: 250 kg/m³.

.2 Alternatively, use preblended non-shrink non-ferrous hydraulic cement grout complying with manufacturer's printed instructions.

.5 Mix for Wall and Column Grout

.1 Should be similar to Type A concrete with reduced aggregate content

.2 Minimum content of cementing materials: 600 kg/m³.

.3 Coarse aggregate: None.

.4 Fine aggregate: CSA A23.1; natural sand.

.5 Water/cementing materials ratio (W/C): 0.42 maximum.

.6 Slump: Matching Type A concrete.

.7 Air content: Matching Type A concrete.

.8 Admixtures: Use water-reducing admixture.

2.3 SOURCE QUALITY CONTROL

.1 Conduct testing in compliance with CSA A23.1 and CSA A23.2 standards under the following conditions:

.1 When test results conducted within the last year are not available.

.2 Testing must include:

a. Chemical composition and physical properties of the aggregates.

b. Presence and quantity of deleterious substances in the aggregates.

PART 3 EXECUTION

3.1 PREPARATION

.1 General

.1 Determine requirements of other trades, inform concerned trades, and assume responsibility for location, installation, and quality of items, which affect the work of this Section.

.2 Preparation of Surfaces

.1 Remove water, snow, ice, loose soil, laitance, curing compound, wood, and other debris from surfaces on or against which new concrete will be placed.

.2 Roughen and clean surfaces of previously placed concrete against which subsequent concrete will be placed.

3.2 PLACING CONCRETE

.1 General

.1 Do not commence concrete placing until sufficient manpower and equipment is available to complete the placement expeditiously preventing the formation of cold joints, and to produce specified surface finish.

.2 Provide standby equipment for critical items in case of equipment failure.

.3 Verify that cast-in-place accessories, inserts, and reinforcement are set correctly and are not disturbed during concrete placement.

.4 Place concrete on dry and clean substrate.

.5 Place concrete between expansion or construction joints in one continuous operation.

.2 Depositing

.1 Limit free drop of concrete to 1500 mm maximum in accordance with requirements of CSA A23.1, Clause 7.2.4 - Depositing.

.3 Time Limitations on Concrete Placement

.1 Do not use concrete after a period of one and half hours (1.5 hr) has passed since first mixing of ingredients unless otherwise approved by the Engineer.

.4 Adverse Weather Conditions

.1 Make suitable arrangements to prevent damage to fresh concrete, under adverse weather conditions.

.2 Do not allow rain, sleet, or snow to damage surface finish.

.3 Plan rate of placement to eliminate cold joints and other visual defects.

.4 Provide windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.

.5 Do not place concrete when ambient temperature is below -5°C or approaching -5°C and falling, without special protection.

.6 Do not place concrete against frozen earth or ice, or against forms and reinforcement with frost or ice present.

.7 Provide heated enclosures when air temperatures are below 5°C.

.8 Install temperature probes approximately 150mm below the surface of the concrete to allow monitoring of concrete surface temperatures.

.9 External Heating Units:

a. Vent heating units to atmosphere and do not locally heat or dry concrete. Where water cure is specified, maintain wet condition.

b. Do not exhaust heater flue gases, directly into enclosed area.

.5 Wall and Column Grout

.1 Deposit 100 mm of wall and column grout evenly along horizontal construction joints in bottom of form through an elephant trunk immediately before placing wall or column concrete.

.6 Consolidation

.1 Consolidate the concrete during and immediately after depositing, thoroughly and uniformly by means of tamping, hand tools, finishing machines, and vibrators in order to obtain dense, watertight, homogeneous concrete well bonded to reinforcing bars.

.2 Carefully vibrate concrete around the conduits, waterstops, and gas-stops to make sure thorough contact.

.3 Bend edge of horizontal waterstops or gas-stops, slightly upward allowing concrete to flow under and completely fill space below the waterstop or gas-stop. Verify no air is trapped below waterstop or gas-stop and concrete is in contact with waterstop or gas-stop over its entire surface area.

.4 Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.

.5 Vibration consolidation not to exceed distance of 1 m from point of placement. Vibrators are not to be used to move the concrete within the forms. Concrete must be placed evenly.

.7 Maximum Size of Concrete Placements:

.1 Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.

.2 Should placement sequence result in cold joint located below finished water surface, install water stop in joint.

3.3 REPAIR OF TEMPERATURE AND SHRINKAGE INDUCED CRACKS

.1 Repair cracks in the completed structures employing a grout injection technique to make such cracks completely watertight after repair.

.2 Remove surface injection materials following completion of work and finish affected areas to match surrounding concrete.

3.4 CONCRETE BONDING

.1 Horizontal Construction Joints in Reinforced Concrete Walls:

.1 Thoroughly clean and saturate surface of joint with water.

.2 Limit wall and column grout placement to 50 mm maximum thickness, 25 mm minimum thickness.

.3 Do not deposit grout from pump hoses or large concrete buckets, unless specified placement thickness can be maintained and verified through inspection windows close to joint.

.4 Limit concrete placed immediately on top of slurry concrete to 300 mm thick. Thoroughly vibrate to mix concrete and grout together.

3.5 FIELD QUALITY CONTROL

.1 General

.1 Tests will be made throughout progress of the work. Tests will be in accordance with CSA A23.1 and CSA A23.2. Provide labour, concrete, and other facilities for making the test specimens.

.2 Provide and maintain facilities for storing and initial curing of test cylinders, and provide suitable crates for shipping test cylinders in accordance with CSA A23.2[-09], Test Method A23.2-3C - Making and Curing Concrete Compression and Flexural Test Specimens.

.3 The testing laboratory shall provide the test results to the City, Engineer, Contractor and material supplier within 5 days of availability. For test that fails to meet the Specification inform Engineer, Contractor and material supplier immediately.

.2 Standard Strength Tests

.1 Provide concrete for one standard strength test consisting of 3 cylinders for each 100 m^3 of concrete of each type placed in any day. If the amount placed, for each type of concrete is less than 100 m^3 in a day, provide concrete for one standard strength test. One cylinder will be tested at 7 days and two at 28 days.

.3 Linear Shrinkage Tests

.1 Provide linear shrinkage tests for every 1000 m^3 of concrete used on the project to ensure conformity to approved mix designs.

.2 Provide linear shrinkage tests for any pour greater than 150 m^3.

.4 Concrete Temperature Monitoring

.1 Provide and keep in working order sufficient Taylor Instrument pocket biotherm thermometers model 6097-1 to monitor concrete temperatures in each pour.

.2 Install 12 mm diameter by 150 mm deep copper tubes crimped at bottom end into concrete at each monitoring location. Fill tube with water.

.3 Monitor concrete temperature at corners and in the centre of each concrete placement.

.5 Air Content Tests

.1 Contractor testing agency will carry out air content tests in accordance with CSA A23.1 and CSA A23.2.

.6 Failure to Meet Strength, Air Content, or Workability Requirements

.1 When measured workability or air content falls outside of required limits, carry out a check test immediately on another portion of the same sample. In the event of a second failure, the concrete will be considered to have failed to meet the requirements. Remove the whole batch, from which the samples were taken, off the site.

.2 When the strength requirement provisions are not met, carry out one or more of the alternatives of CSA A23.1, Clause 4.4.6.7 - Failure of Standard Cured Cylinder Test Results to Meet Requirements.

.3 When, after carrying out these requirements, there is still doubt about of the adequacy of the concrete, strengthen or replace, as directed, portions of the Work which failed to develop the required strength.

.7 Uniformity of Mixed Concrete

.1 If the results of workability, air content or density for any mix design do not comply with CSA A23.1, Table 13 - Determination of Within-Batch Uniformity, alter mixing operations and equipment until tests indicate that the requirements are satisfied.

.8 Concrete Delivery Records

.1 Submit with each batch of concrete before unloading, a typed delivery ticket prepared at the ready mix plant containing following information:

a. Name of ready-mix batch plant.

b. Serial number of ticket.

c. Date and truck number.

d. Name of the Contractor.

e. Name of Job.

f. Specified 28-day strength of concrete with identifying mix number.

g. Time loaded or of first mixing of cement and aggregates.

h. Temperature of Fresh Concrete

.9 Keep records of the time when each load arrives at the site and when discharge is completed.

CONCRETE POUR RELEASE FORM	Submission No.

PROJECT NAME -

OWNER'S PROJECT NO. –

LOCATION OF POUR .....

DATE OF POUR ..... TIME OF POUR .....

* NOTE: Consulting Engineer is to be given 24 hours notice before time of pour

1. All items of work have been completed for this pour and the following foremen have approved their work ready for inspection:

REBAR STEEL: ..... DATE :..... TIME :

MECHANICAL SLEEVE INSERTS AND PIPING: ..... DATE :..... TIME:

ELECTRICAL SLEEVES INSERTS AND PIPING: ..... DATE :..... TIME :

ANCHOR BOLTS AND STRUCTURAL INSERTS:..... DATE :..... TIME :

LINE AND LEVELS: ..... DATE :..... TIME:

2. The formwork has been inspected by the formwork design engineer or his authorized designate for conformance to the formwork design.

Formwork Design Engineer DATE TIME

3. I have checked all items for this pour and request your inspection before pouring.

Contract Superintendent DATE TIME

4. The items of work have been inspected:

The pour may proceed subject to the Contractor being responsible for the work in accordance with the Contract. ☐ (Check)

or

Corrections are required as noted below ☐ (Check)

.....

Resident Supervisor DATE TIME

NECESSARY CORRECTIONS AND REMARKS:

.....

.....

END OF SECTION

TORONTO

SECTION 03400

PRECAST CONCRETE

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 Precast Structural Concrete.

1.2 REFERENCES

.1 The following is a list of standards which may be referenced in this section:

.1 National Building Code of Canada (2014)

.2 Canadian Standards Association (CSA):

a. A23.4, Precast Concrete – Materials and Construction.

.3 ASTM International (ASTM):

a. A167, Standard Specification for Stainless and Heat-Resisting Chromium – Nickel Steel Plate, Sheet, and Strip.

b. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

c. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.

.4 Precast/Prestressed Concrete Institute (PCI):

a. MNL-120, PCI Design Handbook, 7th Edition.

1.3 SUBMITTALS

.1 Action Submittals:

.1 Sealer for Exterior Surfaces: Product data with mixing/application instructions.

.2 Form Liners: Manufacturer's literature and product data.

.3 Calculations and Technical Data: Proposed details and design calculations for stresses in all critical sections of precast members for all loading conditions, including transportation, handling, and erection.

a. Shop Drawings and design calculations stamped and sealed by a structural engineer registered in the Province of Ontario.

.2 Informational Submittals:

.1 For Precasting Manufacturers Not Listed in Article Quality Assurance:

a. Experience record on production of precast concrete as shown, with information on precasting plant, that will indicate capability to satisfactorily perform the Work.

b. Evidence of current PCI plant certification.

.2 Certificate of Compliance: Certify admixtures and concrete do not contain calcium chloride.

.3 Test Reports:

a. For precast Manufacturer's concrete test cylinders.

b. Inspection of installed members.

1.4 QUALITY ASSURANCE

.1 Qualifications of Precasting Manufacturers:

.1 Manufacturer: Certified to Canadian Precast / Prestressed Concrete Institute (CPCI) Certification Program.

.2 Precast Concrete and Precast Prestressed Concrete: Product of Manufacturer with 3 years' experience producing precast concrete products of quality specified.

.3 Precast Plant: PCI certified plant with current certification.

.4 Calculations stamped and signed by an engineer registered in the Province of Ontario.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Formwork:

.1 One-piece, full-length, and without seams.

.2 As specified in Section 03100, Concrete Forming and Accessories.

.2 Reinforcing Steel: As specified in Section 03210, Reinforcing Steel.

.3 Cement: As specified in Section 03300, Cast-in-Place Concrete.

.4 Pretensioning Strands: Seven-wire, uncoated, stress relieved, ASTM A416, Grade 270.

.5 Aggregates: As specified in Section 03300, Cast-in-Place Concrete, for 20 mm maximum size. Furnish of consistent quality, and gradation.

.6 Admixtures: As specified in Section 03300, Cast-in-Place Concrete.

.7 Embedded Items:

.1 ASTM A167 with minimum yield stress of 227 MPa.

.2 Anchor Studs: Headed anchor studs (HAS), deformed bar anchors (DBA), or threaded studs as manufactured by Nelson Stud Welding Co.

.3 Furnish inserts for lifting, bolting stiffeners, attaching braces, and as otherwise required.

.4 Embedded items must be stainless steel, Type 316L.

.8 Grout: Nonshrink, nonmetallic Type II grout.

.9 Sealer for Exterior Surfaces:

.1 Silane Sealer: One-component penetrating sealer, hydrophilic (isopropyl alcohol as a carrier) with 40 percent active ingredients.

.2 Manufacturers:

a. BASF.

b. Euclid Chemical Co.

2.2 CONCRETE MIX

.1 Precast members: Type A, a specified in Section 03300, Cast-in-Place Concrete, except as noted below.

.1 Design Strength: 35 MPa at 28 days.

.2 Water/Cement Ratio: 0.38 maximum.

2.3 DESIGN REQUIREMENTS

.1 Precast items include:

.1 Precast channels to cover the underground duct.

.2 General:

.1 Design for post-disaster requirements.

.2 Design connections between precast members, and between precast members and other structural components.

.3 Meet applicable sections of PCI MNL-120.

.4 Calculated tension at full service loads shall not exceed six times the square root of design strength except that in wet or corrosive service conditions the calculated tension due to live load and dead load shall not exceed zero.

.5 Limit long-term camber growth to span length divided by 360.

.3 Precast Channels:

.1 Where precast members are required to be cut for openings, provide steel support below cut openings and transfer loads to adjacent members. Adjacent members shall be designed to support additional loads due to load transfer.

.2 Design vertical precast member for lateral soil pressure as indicated on the drawings.

.3 Design horizontal precast member for 3m overburden soil pressure as indicated on the drawings.

.4 Design both element types for a surcharge of 4.8 kPa at ground level.

2.4 FABRICATION

.1 General:

.1 Reinforcing Steel and Pretensioning Strands:

a. Place in position before concrete is cast.

b. Keep clean and free from form oil or other substances harmful to bond.

.2 Pretensioning Force, if Used: Determine by elongation and by gauge pressure.

a. Method: Meet requirements of Prestressed Concrete Institute.

.3 Forms: Produce smooth surfaces.

.4 Concrete: Deposit, vibrate, finish, and cure in accordance with recommended practices of CSA A23.4. Steam curing is permitted.

.5 Release Strength for Pretensioning Method: Minimum 28 MPa, unless otherwise approved.

.6 Coordinate dimensions, determine type, quantity, size, and location of, and furnish necessary embedded items in precast concrete. Coordinate location of embedded items in cast-in-place concrete necessary to connect precast items.

.2 Surface Finish for Precast Structural Units: Furnish concrete finish, as specified in Section 03 30 00, Cast-in-Place Concrete, to additional concrete field placed on precast units.

.1 Other Surfaces: Smooth screeded finishes, unless otherwise shown.

.2 Top surface of the precast roof slab is to be raked (roughened) for bonding of composite topping.

.3 Sealer:

.1 Apply to surfaces as noted in Room Schedule in accordance with Manufacturer's instructions.

.2 Protect surface until installed in the Work.

.3 Repair damage as approved by Manufacturer.

.4 Embedded Stainless Steel:

.1 Provide embedded stainless steels to be casted into precast members for the support of other trades.

.2 Embedded stainless steels to anchor precast members shall have sufficient strength and shall design to allow movements.

.3 Anchor locations for precast members must be reviewed and approved by Contract Administrator before fabrication and construction.

.4 Stainless steel cast into concrete frames or weld to frames for the purpose of anchoring precast members shall be supplied and installed by this Section.

2.5 SOURCE QUALITY CONTROL

.1 Prepare minimum three standard concrete test cylinders for each 50 cubic yards or fraction thereof of concrete placed in the precastce with ASTM C31.

.2 Test and record concrete strengths.

PART 3 EXECUTION

3.1 ERECTION

.1 Verify that anchorage inserts are in correct locations.

.2 Handle and erect precast concrete with care as recommended by Manufacturer.

.3 Erect precast units plumb, straight, level, square, and in proper alignment.

.4 Fasten units securely in place and brace to maintain position, stability, and alignment until permanently connected and structure is complete and stable.

.5 Field Cutting: Not allowed without prior approval of precast concrete Manufacturer and Contract Administrator.

.6 Where insufficient bearing area is provided along edges of walls, beams, columns or support elements, provide bearing area using stainless steel channels, angles, beams, etc. and drill in anchors with sufficient strength to support the precast loads.

3.2 PATCHING

.1 Mix and place patching mixture to match color and texture of surrounding concrete and to minimize shrinkage.

.2 Demonstrate patching method and obtain acceptance and approval.

3.3 CLEANING

.1 After installation, clean soiled precast concrete surfaces with detergent and water, using fiber brush and sponge.

.2 Use acid solution only to clean particularly stubborn stains after more conservative methods have been tried unsuccessfully.

.3 Use extreme care to prevent damage to precast concrete surfaces and to adjacent materials.

.4 Rinse thoroughly with clean water immediately after using cleaner.

3.4 FIELD QUALITY CONTROL

.1 Inspection:

.1 With Contract Administrator, inspect precast for chips, cracks, and other damage.

.2 Record location and condition of damaged or nonmatching members.

.2 Resolution:

.1 Repair damage to satisfaction of Contract Administrator and the City, at no cost to the City.

.2 Remove members with damage or repairs not acceptable to Contract Administrator.

.3 Install new acceptable members in place of those removed.

.4 Perform reinspection and obtain acceptance by Contract Administrator.

3.5 PROTECTION

.1 Protect precast units from chipping, spalling, cracking, or other damage to the units after delivery to Site.

.2 After erection, protect units from damage.

END OF SECTION

TORONTO

SECTION 03730

RESTORATION OF EXISTING CONCRETE

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements.

.2 Section Includes:

.1 Crack repair by polyurethane grout injection.

.2 Patching spalled and unsound areas by polymer modified mortar patching.

.3 Measurement and Payment

.1 All costs associated with the work of this Section shall be included in the prices for Item Nos. P3 and P4 in the Form of Tender.

.2 Include for mobilization, scaffolding, heating, ventilation, testing, and tools required to carry out work as specified, and demobilization.

1.2 REFERENCE

.1 Concrete restoration work scope will be defined during construction, when the condition of the existing concrete structures is visible.

1.3 SUBMITTALS

.1 Submit a detailed description of the equipment, grouting, and patching operations. Also include, but not limited to:

.1 A summary list of similar projects carried out by the firm.

.2 Physical properties of proposed products.

.3 Surface preparation of work areas.

.4 Protection and curing procedures.

.5 Quality control during installation including heating, mixing methods and control of variable pressures.

.2 Submit certification that the polyurethane materials are suitable for use in continuous submergence.

1.4 QUALITY ASSURANCE

.1 Engage technical representatives from material Manufacturer for inspection service.

.1 Before application, to examine suitability of the substrate.

.2 During and after application, to verify that specified products are properly applied and cured.

.2 Employ only applicators authorized by material Manufacturer and who specializes in this type of repair work.

1.5 PERFORMANCE REQUIREMENTS

.1 The injected polyurethane injection resins shall fill the cracks and joints and in no case shall the depth of penetration of the injection material be less than ninety percent 90 percent of:

.1 The full thickness of the concrete section for cracks.

.2 The cured injected polyurethane injection resin shall form a dense rubber-like flexible foam compression gasket-type seal.

.3 Any repair mortar used shall be deemed compatible with applied coating or toppings by manufacturers of both products, if specified. Preparation of concrete and application of mortar shall be done in accordance with ACI, ICRI and Manufacturer's recommendations.

1.6 PRE-REPAIR MEETING

.1 Pre-repair meeting for interior works

.1 Required Meeting Attendees:

a. Contractor.

b. Repair subcontractor responsible for concrete repair and preparation of interior of tanks.

c. Technical representative for repair material manufacturer.

d. Engineer.

.2 Schedule and conduct prior to incorporation of respective products into Project. Notify the Engineer of location and time.

.3 Agenda shall include:

a. Review of field conditions. Conduct field observations of Work to be performed.

b. Based on above observations, repair material Manufacturer's technical representative shall make material selection and repair method written recommendations.

c. Technical representative for repair material Manufacturer shall review proposed surface preparation, material application, consolidation,

finishing, curing, and protection of repair material from weather conditions.

d. Other specified requirements requiring coordination.

.2 Pre-repair meeting for exterior works

.1 Required Meeting Attendees:

a. Contractor.

b. Engineer

c. Repair subcontractor responsible for concrete repair and preparation of wearing slab on top of digester.

d. Technical representative for repair material manufacturer.

.2 Schedule and conduct prior to incorporation of respective products into Project. Notify the Engineer of location and time.

.3 Agenda shall include:

a. Review of field conditions. Conduct field observations of Work to be performed.

b. Based on above observations, repair material manufacturer's technical representative shall make material selection and repair method written recommendations.

c. Technical representative for repair material manufacturer shall review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.

d. Other specified requirements requiring coordination.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing and Shipping: Package polyurethane resins material in new sealed containers and label with following information:

.1 Manufacturer's name.

.2 Product name and lot number.

.3 Mix ratio by volume instructions.

.2 Storage and Protection: Store materials containers in accordance with manufacturer's printed instructions or in the absence of such information at ambient temperatures above 20 degrees C and below 49 degrees C.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Polyurethane injection grout:

.1 Specton Construction Products Ltd., Acton, ON.

.2 DeNeef Construction Chemicals (U.S.) Inc.

.3 Multiurethanes Limited, Mississauga, ON.

.2 Injection ports: Ports to suit injection equipment.

.3 Reinforcing Steel

.1 Reinforcing steel: CAN/CSA-G30.18-M; Grade 400R.

.4 Epoxy bonding adhesive

.1 Sikadur 32, Hi Mod by Sika Canada Inc.

.2 Or approved equal.

.5 Repair mortar: Thermally compatible with substrate concrete, produces acceptable finish, and compatible with required coatings or toppings (gasproofing, waterproofing, or traffic topping)

.1 Sikatop 123 Plus Polymer Modified, Cementitious, Non Sag Mortar by Sika Canada Inc.

.2 SikaTop 122 Plus Polymer Modified Cementitious trowel grade Mortar by Sika Canada Inc

.3 Meadowcrete OV Glass Fibre Reinforced Overhead and Vertical Patching Compound by W.R. Meadows.

.4 Series 217 MortarCrete cementitious repair mortar by Tnemec.

.6 Anti corrosion coating and bonding agent: Thermally compatible with substrate concrete and compatible with repair mortar.

.1 SikaTop Armatec 110 Epocem Anti Corrosion Coating and Bonding Agent by Sika Canada Inc.

.2 Or approved equal.

PART 3 EXECUTION

3.1 GENERAL

.1 Various materials used for the repair work may emit toxic fumes during the application and curing stage. Handle with care and adequately ventilate work area.

.2 Provide suitable protective clothing, gloves, breathing apparatus for persons working with restoration materials.

.3 During installation and curing of restoration materials, if the ambient temperature is expected to go below the recommended minimum temperature provide enclosures and heat as required.

.4 Use restoration materials in accordance with manufacturer's printed instructions, and as specified.

.5 Provide access platforms as required.

.6 Continuously check materials and applications for correct use.

.7 Follow all manufacturer's recommendations, including surface preparation, application and curing.

3.2 PREPARATION OF CRACKS FOR POLYURETHANE GROUT INJECTION

.1 Free cracks from loose matter, dirt, laitance, oil, grease, salt, and other contaminants.

.2 Clean cracks in accordance with polyurethane manufacturer's instructions.

.3 Clean surfaces adjacent to cracks from dirt, dust, grease, oil, efflorescence, and other foreign matter to expose the full extent of cracks.

.4 Do not use acids and corrosives for cleaning, unless neutralized prior to injecting.

3.3 INJECTION OF CRACKS – POLYURETHANE GROUT

.1 Entry Ports:

.1 Establish openings for polyurethane entry along crack.

.2 Determine space between entry ports equal to thickness of concrete member to allow polyurethane to penetrate to the full thickness of the member.

.3 Drill injection holes at 45-degree angle to the surface and on alternate sides of a crack, where possible, to intercept cracks. Space holes as close as required. Maximum spacing is 300 millimeters on center.

.4 Provide a means to prevent concrete dusts and fines from contaminating the crack or ports when drilling.

.5 Install injectors into drilled holes

.6 Apply surface sealer along crack surface as required.

.7 Flush cracks with clean water.

.2 Polyurethane Injection:

.1 Inject polyurethane grout into cracks in accordance with manufacturer's written instructions.

.2 Start injection into each crack at lowest injector on a vertical face and at one end on a horizontal surface.

.3 Continue injection until pure uncontaminated material flows out from adjacent injectors.

.4 Cap injectors and proceed to adjacent injectors until all injectors have been filled.

.3 Finishing:

.1 Upon completion, remove injectors, surface seal material and injection polyurethane runs and spills from concrete surfaces.

.2 Thoroughly clean the concrete surfaces of excess grout material.

.3 Prepare concrete for application of gasproofing, waterproofing, or traffic topping, where required. Finish surface to match surrounding concrete.

.4 Patch injection holes.

3.4 EQUIPMENT FOR POLYURETHANE GROUT INJECTION

.1 Portable, positive displacement type pumps with in-line metering to meter and mix two adhesive components and inject mixture into crack.

.2 Pumps:

.1 Electric or air powered with interlocks providing positive ratio control of proportions for the two components at nozzle.

.2 Primary injection pumps for each material of different mix ratio, including a standby backup pump of similar ratio.

.3 Capable of immediate compensation for changes in resins.

.4 Do not use batch mix pumps.

.3 Discharge Pressure: Automatic pressure controls capable of discharging mixed components at pressures up to 200 psi, plus or minus 5 percent, and able to maintain pressure.

.4 Automatic Shutoff Control: Provide sensors on both Component A and B reservoirs for stopping machine automatically when only one component is being pumped to mixing head.

.5 Proportioning Ratio Tolerance: Maintain polyurethane manufacturer's prescribed mix ratio within a tolerance of plus or minus 5 percent by volume at discharge pressure up to 160 psi.

.6 Ratio/Pressure Check Device:

.1 Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing valve to restrict material flow.

.2 Pressure gauge capable of sensing pressure behind each valve.

3.5 PATCHING OF AREAS OF UNSOUND CONCRETE

.1 Thoroughly clean up the concrete surfaces. Remove all existing repair material on the surfaces, if any, and loose concrete from the concrete walls and slabs.

.2 Prime exposed reinforcing bars and exposed steel beams with anti corrosion coating and bonding agent in accordance with manufacturer's printed instructions.

.3 Provide supplementary reinforcing bars where required.

.4 Use mix of various consistencies of repair mortar for application to horizontal, vertical, and overhead applications in accordance with manufacturer's printed instructions.

.5 Use aggregates in repair mortar consisting of clean, washed uniformly graded silica sand and pea gravel where required in accordance with manufacturer's printed instructions.

.6 Patch deteriorated areas.

.7 Fill voids on concrete surfaces.

.8 Where required, apply repair mortar in suitable self-supporting layers permitting adequate heat dissipation. Build layers up gradually to thickness matching original concrete surface. For gasproofed areas, provide leveling coat.

.9 Cure patches in accordance with manufacturer's printed instructions.

.10 Finish patches to match surrounding adjacent concrete surface.

3.6 FIELD QUALITY CONTROL

.1 Take samples of injection material at regular interval of material on plywood boards. Record time and date for each sample.

.2 Engage polyurethane materials manufacturer's representative for inspection service:

.1 Before application, to examine suitability of the substrate.

.2 During and after application, to ensure that specified products are properly applied and cured.

.3 Carry out sample testing of the polyurethane at the beginning and at regular intervals to verify correct mixing proportion, consistency and setting time.

.4 Crack injection will only be accepted if the polyurethane grout achieves a minimum of 90 percent penetration of the crack depth. Notwithstanding the foregoing, injected cracks or joints found to exhibit leakage shall be deemed as deficient work irrespective of the depth of penetration. Carry out re-injection of deficient work as required to meet the performance requirements at no cost to the Town.

.5 Obtain approval on surface preparation from the product manufacturer before application.

END OF SECTION

DIVISION 4

MASONRY

TORONTO

SECTION 04200

CONCRETE UNIT MASONRY

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 RELATED WORK

.1 Sealing of existing expansion and control joints in masonry elements: as noted on drawings.

.2 Read other Sections of Specifications for extent of sealing specified in those Sections. Do all other sealing indicated, specified or required.

1.3 REFERENCES

.1 Conform to the latest edition of the following:

.1	CAN/ULC-S102	-	Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
.2	CSA A82.1-M	-	Burned Clay Brick
.3	CSA A165 Series	-	CSA Standards on Concrete Masonry Units
.4	CSA A179	-	Mortar and Grout for Unit Masonry
.5	CSA A370	-	Connectors for Masonry
.6	CSA S304.1	-	Design of Masonry Structures
.7	CSA A371	-	Masonry Construction for Buildings
.8	CSA W47.1	-	Certification of Companies for Fusion Welding of Steel Structures
.9	CSA W48.1-M	-	Carbon Steel Covered Electrodes for Shielded Metal Arc Welding
.10	CSA W59-M	-	Welded Steel Construction (Metal Arc Welding)
.11	CSA W117.2	-	Safety in Welding, Cutting, and Allied Processes

1.4 SUBMITTALS

.1 Submit the following in accordance with Section 01330:

.1 Product data: Submit as Shop Drawings, manufacturer's specifications and other data for masonry.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Check materials for damage and carefully unload. Remove unsatisfactory materials from the Site and replace with new materials to satisfaction of Engineer at no increase in Contract Price.

.2 Store materials on Site in a manner to prevent damage thereto. Stockpile for easy heating if required. Protect from the weather. Do not concentrate storage on any part of the structure so as not to set up any strain beyond the designed load of any portion thereof.

.3 Take particular care so as not to overload unsupported portions of the structure which have not attained their full strength.

.4 Comply with CSA A371.

.5 Protect the following:

.1 Masonry materials during storage and construction from wetting by rain, snow or ground water, or inter-mixture with earth or other materials.

.2 Metal reinforcing or ties against corrosion or contamination, including ice, which will reduce or destroy bond.

.3 Other Work from damage resulting from this Work.

.4 Sills, ledges and projections from droppings of mortar.

.6 Cover tops of masonry walls not enclosed or sheltered during rain, at the end of each day's construction and at times when Work is not in progress, with waterproof covers temporarily secured against displacement, until flashings are completed. Drape cover over wall and extend 600 mm down both sides. Anchor securely in position. Protect exposed corners against droppings or damage from other trades, by boarding or other means.

.7 Prevent grout or mortar from staining the face of masonry to be left exposed or painted. Immediately remove grout or mortar in contact with such masonry.

.8 Cold weather protection: Do not lay masonry at air temperatures below 5°C (41°F) without prior review by Engineer of proposed protective measures. Comply with CSA A371.

.9 Repair or replace damaged Work to satisfaction of Engineer at no increase in Contract Price.

1.6 WELDING

.1 Retain a firm certified in accordance with CSA W47.1 Division 1 or 2.1 to perform welding of anchor clips.

.2 Employ welding operators licensed per CSA W47.1 for types of welding required by the Work.

1.7 TEMPORARY BRACING

.1 Temporarily brace masonry Work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Source (each type of) masonry unit from one manufacturer. Units to be of uniform texture and colour for each kind required.

.2 Concrete blocks: Normal weight, metric modular, moisture-controlled units conforming to CSA A165.1, Type H/15/A/M (and Type S/15/A/M).

.1 Exposed surfaces: Free of cracks, chips or other blemishes, and broken corners. Use sash blocks at control joints, solid block around openings for rolling steel doors or shutters and where noted, and concrete block lintels over openings in concrete block walls unless steel lintels are shown.

.2 Units on external corners of exposed interior block and block at door jambs: Bullnosed type.

.3 Special shapes: Manufacture to shape shown; do not field cut stretcher units to make special shapes.

.3 Concrete blocks: Lightweight, metric modular moisture-controlled units conforming to CSA A165.1, Type H/15/C/M and Type S/15/C/M. Do not use for walls in contact with earth or where exposed to the weather. For the purpose of fire-resistance rating, conform to the requirements of $L_2$20S as specified in the National Building Code.

.1 Exposed surfaces: Free of cracks, chips or other blemishes and broken corners. Include required sash blocks for control joints, solid block around openings for rolling steel doors or shutters where noted, and concrete block lintels over openings in concrete block walls unless steel lintels are shown.

.2 Units on external corners of exposed interior block and block at door jambs: Bullnosed type.

.3 Special shapes: Manufacture to shape shown; do not field cut stretcher units to make special shapes.

.4 Cure concrete blocks using carbon capturing technology with a minimum sequestration rate of 225 grams per 190 x 190 x 390 mm concrete block. Adjust this rate on a volumetric basis for other block sizes.

.4 Mortar: Conforming to CSA A179-M, Type "S".

.5 Mortar (rendering, patching or leveling): Quick-setting, polymer-modified, fiber-reinforced cementitious rendering mortar for interior and exterior concrete wall and floors. Minimum 3 mm thickness and requiring water to be added in the mixer per mortar manufacturer's directions. “Planitop 330 Fast” by Mapei or approved equal.

.6 Horizontal masonry reinforcement (for single wythe masonry block walls): Welded wire, galvanized units in heavy duty truss or ladder two-side rod design by Dur-O-Wal, Blok-Lok, or Hohmann and Barnard, prefabricated in straight lengths of not less than 3 m with matching corner "L" and intersection "T" units. Overall width shall be such that side rods are positioned at the centreline of both face shells of the concrete block. Reinforcing gauge and finish to meet requirements of the Ontario Building Code and referenced CSA Standards.

.7 Masonry anchors: 6 mm thick steel plate anchors and clips to laterally support masonry walls from other walls or structural elements. For interior or dry locations, clean to SSPC-SP3 and prime with CISC/CPMA solvent reducible primer. For exterior or humid conditions, hot-dip galvanize to CSA G164. For non-structural anchorage, Blok-Lok "Flex-O-Lok" may be used.

.8 Masonry-to-precast concrete (concrete) anchors: 1.5 mm (16 gauge) galvanized steel dovetail anchors. Supply filled 0.9 mm (20 gauge) galvanized steel dovetail slots for building-in in concrete (precast concrete).

.9 Vertical reinforcement: Conforming to CAN/CSA G30.18-M, Grade 400

.10 Concrete block cell insulation: "Zonolite" granular vermiculite by W.R. Grace.

.11 Compressible filler atop non-fire rated masonry walls: Where ceiling is used as a return air plenum use:

.1 "Zero Draft Z2-600" by Can-Am Building Envelope Systems, a foamed-in-place material with a flame spread rating of 25 or less in accordance with CAN/ULC-S102, or

.2 Fibreglass or mineral wool sealed with a firestop spray meeting the maximum flame spread and smoke ratings as above, as manufactured by 3M, Tremco or Johns Manville.

.12 Compressible filler atop non-fire-rated masonry walls: Where ceiling space is not used as a return air plenum, use soft grade closed cell foam joint filler strips by CPD.

.13 Premoulded control joint gasket: Dur-O-Wal "Rapid Control Joint" in "Wide-Flange" design of type to suit wall thickness. (Use "Regular" design for control joints at pilasters or columns.) For fire-rated control joint gaskets, use fire-rated closed cell neoprene conforming to ASTM D1056 or ASTM D2056.

.14 Brick Control Joints Material:

.1 Neoprene Sponge by Blok-Lok Limited.

.2 NS - Closed Cell Neoprene Sponge by Hohmann & Barnard Company

PART 3 EXECUTION

3.1 MORTAR MIXING

.1 Mix mortar with the maximum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar. Use a mechanical mixer. No hand mixing permitted.

.2 Do not use mortar which has begun to set or if more than 2½ hours has elapsed since initial mixing. Retemper mortar during the 2½ hour period only as required to restore workability

3.2 GENERAL MASONRY CONSTRUCTION

.1 Carefully and neatly lay masonry, truly vertical and horizontal, with joints of uniform size as required to suit requirements for design coursing and bonding.

.2 Tooth intersections of walls with alternating units, except as otherwise shown or where control joints and expansion joints occur.

.3 Lay blocks in running bond except where shown otherwise. Lay in full mortar beds with face shell vertical joints filled. Align block webs vertically and with thicker ends of face shells up.

.4 When thumbprint hard, tool exposed joints shallow concave with non-staining round jointer. Tool joints flush where shown and where gypsum wallboard, ceramic tile and resilient base are to be applied as finish.

.5 Lay prefaced block in running bond, in full mortar beds and with vertical joints filled with mortar. Neatly tool joints shallow concave with non-staining tools.

.6 Match coursing, bonding (colour and texture) of new masonry work with existing Work where indicated.

.7 Build control joints in masonry walls at 9000 mm unless shown otherwise. Provide joints using sash block units. Fill chase and joint with premoulded gasket full height of control joints. Leave a depth of 12 mm for caulking. Locate control joints in modular dimensions.

.8 Coordinate building-in of anchors as required for the proper installation of the Work of other trades.

.9 Provide solid block or Provide metal lath under block and fill block cells solid for lintel bearing and as required to secure built-in anchor bolts and/or anchors.

.10 Build-in door frames, borrowed light and glazed screen frames, anchors, inserts, loose lintels, shelf angles, conduits and other items required to be built into masonry. Set anchors between frames and masonry and fill voids between metal frames and masonry walls with mortar.

.11 Build recesses to receive items recessed in masonry.

.12 Build-in anchor bolts for wood copings on tops of masonry walls and other locations. Install anchor bolts in a staggered arrangement to prevent wood blocking from "cupping".

3.3 REINFORCING, TIES AND ANCHORS

.1 Build-in continuous masonry reinforcement in horizontal courses terminating at vertical terminations such as control and expansion joints, full height of walls and partitions, at every second block course. Install reinforcing in first and second courses over door and window openings.

.2 Where shown, install vertical steel reinforcing and fill block cells with grout. At lintels, install reinforcing per schedule and fill with grout. Allow 200 mm minimum bearing on each lintel end up to 1200 mm4 span; 400 mm minimum bearing on each end for spans exceeding 1200 mm. Temporarily support lintels until concrete has cured.

3.4 REPAIR, POINTING AND CLEANING

.1 Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout; point to eliminate evidence of replacement.

.2 Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar.

.3 Point-up joints including corners, openings and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.

.4 Rake out to 12 mm depth, joints between sills and between ends of sills and masonry. Point to full 12 mm depth with pointing material specified. Tool pointing to a slightly concave smooth condition.

3.5 CLEANING

.1 After mortar is thoroughly set and cured, clean one-half of sample wall panel. Obtain Engineer’s acceptance of sample wall panel cleaning before proceeding to clean building masonry Work.

.1 Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if required.

.2 Scrub down wall with stiff fibre brush.

.2 Acid cleaning of masonry is not permitted.

END OF SECTION

DIVISION 05

METALS

TORONTO

SECTION 05050

WELDING QUALITY CONTROL

TABLE OF CONTENTS

PART 1 GENERAL

1.1 REFERENCES

.1 Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

.1 Canadian Standard Association CSA:

a. W47.1, Certification of Companies for Fusion Welding of Steel.

b. W47.2, Certification of Companies for Fusion Welding of Aluminum.

c. W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum

d. W59, Welded Steel Construction (Metal Arc Welding).

e. W59.2, Welded Aluminum Construction.

f. W178.2, Certification of Welding Inspectors.

g. W186, Welding of Reinforcing Bar in Reinforced Concrete Construction.

.2 American Welding Society (AWS):

a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.

b. A3.0, Standard Welding Terms and Definitions Including Terms for AdhesiveBonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying.

c. D1.1, Structural Welding Code – Steel.

d. D1.6, Structural Welding Code – Stainless Steel.

e. QC1, Specification for AWS Certification of Welding Inspectors.

.3 American Society of Mechanical Engineers (ASME):

a. BPVC SECTION IX, Qualification Standard for Welding and Brazing Procedures,Welders, Brazers, and Welding and Brazing Operators Welding and Brazing Qualifications.

1.2 DEFINITIONS

.1 Class W47.1 welding positions flat (F) horizontal (H); vertical (V) overhead (O).

.2 CJP: Complete Joint Penetration.

.3 CWB: Canadian Welding Bureau.

.4 CWI: Certified Welding Inspector.

.5 GTSM: Gauge to Sound Metal.

.6 MT: Magnetic Particle Testing.

.7 NDE: Nondestructive Examination.

.8 PJP: Partial Joint Penetration.

.9 PQR: Procedure Qualification Record.

.10 PT: Liquid Penetrant Testing.

.11 RT: Radiographic Testing.

.12 UT: Ultrasonic Testing.

.13 VT: Visual Testing.

.14 WPQ: Welding Personnel Performance Qualification.

.15 WPS: Welding Procedure Specification.

.16 WPDS: Welding Procedure Data Sheets.

.17 WQR: Welder Qualification Record.

.18 Contractor's inspection.

.19 Verification Inspection.

1.3 SUBMITTALS

.1 Shop and Field Drawings:

.1 Welding Data (Shop and Field):

a. Show on a weld map complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out forWPS and NDE numbers in tail of welding symbol.

b. Distinguish between shop and field welds.

c. Indicate, by welding symbols or sketches, details of welded joints and preparation ofbase metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.

d. Fillet weld symbols shall show fillet size and length.

e. Groove weld symbols shall indicate CJP or PJP or GTSM in the tail of the symbol,as applicable.

f. For pipe fittings, provide a joint weld beveling diagram.

g. Welding and NDE symbols shall be in accordance with AWS A2.4.

h. Welding terms and definitions shall be in accordance with AWS A3.0.

i. Submit welding data together with Shop Drawings as a complete package.

.2 Informational Submittals:

.1 When CAN/CSA applies, WPS's and related WPDS's shall be submitted for all jointsprequalified in accordance with W59. Similar documentation is required for non prequalified joints accompanied by PQR's for the non-prequalified joints. All such documentation shall be affixed with the CWB acceptance stamp.

.2 When AWS applies, WPS's standard formats shall be submitted for all prequalified and non prequalified joints. In addition, PQR's shall be submitted for non-prequalified joints.

.3 When the BPVC applies, WPS's and PQR's shall be submitted in accordance withASME SECT. IX approved by the authority having jurisdiction.

.4 When CAN/CSA W55.3 applies, documentation of resistance welded joint qualificationaccepted by the CWB shall be submitted.

1.4 QUALIFICATIONS

.1 Structural fabricators and erectors shall be certified in accordance with CAN/CSA W47.1-03and/or W47.2.

.2 BPVC fabricators shall be qualified in accordance with ASME Section IX.

.3 Welding personnel shall be qualified in accordance with the appropriate codes – CAN/CSAW47.1 or W47.2; AWS D1.1; D1.2; D1.6; ASME Section IX.

.4 CWI shall be qualified in accordance with CAN/CSA W178.2 or AWS QC1 and shall have prior experience with the welding codes specified.

.5 Non-destructive inspection personnel shall be qualified in accordance with the appropriate CAN/CGSB requirements or NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.5 SEQUENCING AND SCHEDULING

.1 Unless otherwise specified, all Submittals required in this Section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 GENERAL

.1 Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.2 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

.1 Contractor's Inspection Criteria:

.1 Selection of Welds to be Tested: Unless 100 percent NDT is specified herein, as agreedupon between Contract Administrator and Contractor.

.2 Unless otherwise specified, perform NDT of welds at a frequency as shown in the attached NDT table in accordance with the referenced welding codes. Perform UT onCJP groove welds that cannot be readily radiographed. In case there is a conflict the higher frequency level of NDT shall apply.

.2 Weld Acceptance criteria for Contractor's inspection shall be based on the acceptance criteriaas per the governing welding codes listed in the NDT table.

3.3 SOURCE AND FIELD QUALITY CONTROL

.1 Contractor Inspection:

.1 The W178.2 (or QC1-96) CWI, employed by the Contractor, shall be present whenevershop or field welding is to be performed. The CWI shall perform inspection prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in referenced welding codes and as follows:

a. Verifying conformance of specified job material and proper storage.

b. Monitoring conformance with approved WPS.

c. Monitoring conformance of WPQ.

d. Inspecting weld joint fit-up and in-process inspection.

e. Providing 100 percent visual inspection of all welds.

f. Supervising nondestructive testing personnel and evaluating test results.

g. Maintaining records and preparing report confirming results of inspection andtesting comply with the Work.

.2 Verification Inspection:

.1 An independent testing agency will be retained by the City to perform verification inspection and testing of welds.

.3 Third-party testing does not relieve the contractor of their responsibility to perform and maintain their own quality control procedures for materials and production in accordance with project requirements.

3.4 WELD DEFECT REPAIR

.1 Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

.2 Repair and retest rejected weld defects to meet the design, plans and specifications.

.3 Retesting shall be performed with the same NDT method used for initial tests and to the samefrequency of testing.

3.5 SUPPLEMENTS

.1 The supplements listed below, following “End of Section,” are a part of this Specification.

.1 Welding and Nondestructive Testing Table.

Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Required	Submit Written NOT Procedure Specifications	NDT Requirements
05502 Structural Steel	CAN/CSA W59, Welded Steel Construction (Metal Arc Welding)	Yes	Yes	Yes	Yes	10% UT or RT of all groove-and- butt joint welds; 10% MT of all fillet welds; see Section 05120

Specification Section	Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Required	Submit Written NOT Procedure Specifications	NDT Requirements
05500 Metal Fabrications (Basic)	CAN/CSA W59, Welded Steel Construction (Metal Arc Welding) or CAN/CSA W59.2, Welded Aluminum Construction	Yes	Yes	Yes	Yes	100% VT; see Section 05500

END OF SECTION

TORONTO

SECTION 05500

METAL FABRICATIONS BASIC

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1, General Requirements.

.2 Metal Fabrications (Structural): Refer to Section 05502, Metal Fabrications (Structural).

.3 Welding (Quality Assurance) Refer to Section 05050, Welding-Quality Assurance.

1.2 REFERENCES

.1 Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

.1 CAN/CSA-S16 Design of Steel Structures.

.2 CAN/CSA G40.20/G40.21 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.3 CSA S157/S157.1 Strength Design in Aluminum/Commentary on CSA S157-05, StrengthDesign in Aluminum.

.4 CSA W47.1 Certification of Companies for Fusion Welding of Steel.

.5 CSA W47.2-M Certification of Companies for Fusion Welding of Aluminum.

.6 CSA W55.3 Certification of Companies for Resistance Welding of Steel and Aluminum.

.7 CSA W59 Welded Steel Construction (Metal Arc Welding).

.8 CSA W59.2-M Welded Aluminum Construction.

.9 ASTM A36 Standard Specification for Carbon Structural Steel.

.10 ASTM A48 Standard Specification for Gray Iron Castings.

.11 ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated,Welded and Seamless.

.12 ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

.13 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron andSteel Products.

.14 ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.15 ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High-Temperature or High Pressure Service and Other Special Purpose Applications.

.16 ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.

.17 ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless SteelPlate, Sheet, and Strip for Pressure Vessels and for General Applications.

.18 ASTM A276 Standard Specification for Stainless Steel Bars and Shapes.

.19 ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod60000 psi Tensile Strength.

.20 ASTM A312 Standard Specification for Seamless, Welded and Heavily Cold WorkedAustenitic Stainless Steel Pipes.

.21 ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksiMinimum Tensile Strength.

.22 ASTM A511 Standard Specification for Seamless Stainless Steel Mechanical Tubing.

.23 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.

.24 ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.25 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic StainlessSteel Sheet, Strip, Plate, and Flat Bar.

.26 ASTM A743 Standard Specification for Castings, Iron-Chromium, Iron-Chromium -Nickel, Corrosion-Resistant, for General Application.

.27 ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-DipGalvanized Coatings.

.28 ASTM A786 Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-StrengthLow-Alloy, and Alloy Steel Floor Plates.

.29 ASTM A793 Standard Specification for Rolled Floor Plate, Stainless Steel.

.30 ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural,High-Strength Low Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

.31 ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon,Structural, High Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

.32 ASTM B26 Standard Specification for Aluminum-Alloy Sand Castings.

.33 ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.34 ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire,Profiles, and Tubes.

.35 ASTM B241 Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipeand Seamless Extruded Tube.

.36 ASTM B308 Standard Specification for Aluminum-Alloy 6061-T6 Standard StructuralProfiles.

.37 ASTM B316 Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods.

.38 ASTM B468 Standard Specification for Welded UNS N08020 Alloy Tubes.

.39 ASTM B632 Standard Specification for Aluminum-Alloy Rolled Tread Plate.

.40 ASTM B766 Standard Specification for Electrodeposited Coatings of Cadmium.

.41 ASTM F436 Standard Specification for Hardened Steel Washers.

.42 ASTM F467 Standard Specification for Nonferrous Nuts for General Use.

.43 ASTM F468 Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket HeadCap Screws, and Studs for General Use.

.44 ASTM F1136 Standard Specification for Zinc/Aluminum Corrosion Protective Coatingsfor Fasteners.

.45 ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi YieldStrength.

.46 ANSI B36.10 Pipe, Steel.

.47 ANSI/NAAMM MBG 531-88/NAAMM Metal Bar Grating Material.

.48 CISC/CPMA 2-75a A Quick-Drying Primer for use on Structural Steel.

.49 National Building Code 2014 with 2012 OBC

.50 SSPC SP1 Solvent Cleaning.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements

.1 Design miscellaneous metal items in accordance with applicable standards.

.2 Design work of this Section, which will support other items or will be required to supportstructural loads of any nature, by a Professional Structural Engineer licensed in the Province of Ontario. Affix professional seal and signature to Shop Drawings for such items.

.3 Design connections and splices using high-strength bolts or welds. Use bearing-type bolts for bolted connections.

.4 Design structural steel connections for moments, shears and axial loads in accordance with CAN/CSA S16 requirements for Simple Construction. Design connection for greaterthan half the shear capacity of the member unless indicated otherwise.

.5 Design splices for the full strength of the member in bending, shear and axial load.

.6 Design end connections and/or splices in bracing members for the full axial strength ofthe member.

.7 Where overlapping or contacting surfaces cannot be avoided, completely seal weld thesesurfaces. Where there is any evidence of rusting or deterioration of finish in such areas, carry out remedial seal welding and refinishing.

.8 Design aluminum work to CSA S157/S157.1 and CSA W59.2-M.

.9 Design equipment, anchorage, and support systems for vertical and lateral loading inaccordance with NBC.

1.4 SUBMITTALS

.1 Shop Drawings: Submit Shop Drawings before fabrication commences of each metal fabrication item, showing in large scale fabrication details, thickness, anchors, location, dimensions, erection details, connections and jointing details, and finishes.

.2 Submit welding procedure specification for each type of material.

.3 Submit sample of aluminum railing including a welded joint to the Contract Administrator foracceptance. Commence fabrication only after acceptance has been obtained.

.4 Samples: Submit two samples of each finish.

.5 Submit written certification from Professional Engineer licensed in the Province of Ontario stating that support systems, anchorage, and equipment have been designed according to requirements of the NBC for post-disaster structures.

1.5 QUALITY ASSURANCE

.1 Ensure workmanship of the highest quality throughout by employing only metal workers that have demonstrated the highest skills in this type of work and qualified welders certified to weld the materials used in fabrication of the miscellaneous metals. Comply with Section 05050, Welding-Quality Assurance.

.2 Welding Procedure for Steel, Aluminum and Stainless Steel:

.1 Comply with Section 05050, Welding-Quality Assurance.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Provide protective coating on stainless steel and aluminum items.

.2 Coordinate deliveries with construction schedule and arrange ahead for off-the-ground, covered storage locations.

.3 Handle and store metal materials at job Site to prevent damage to other materials, existingbuildings, structure, finishes or property.

.4 Handle components with care, and provide protection for surfaces against marring or other damage. Ship and store members with cardboard or other resilient spacers between surfaces.

.5 Use removable coatings or wrappings to protect exposed surfaces of prefinished metal workwhich does not receive Site finishing. Use materials recommended by finishers or Manufacturers to ensure that method is sufficiently protective, easily removed, and harmlessto the finish.

.6 Prevent the formation of wet storage stain on galvanized members with the following measures:

.1 Stack members or bundle to allow air between the galvanized surfaces during transportfrom supplier. Load materials in position that continuous drainage could occur.

.2 Raise members from the ground and separate with strip spacers to provide free access of air to most parts of the surface. Incline in a manner which will allow continuous drainage.Do not lay galvanized steel on cinders, clinkers, wet soil or decaying vegetation.

.3 Handle galvanized members in such a manner as to avoid any mechanical damage and toprevent distortion.

1.7 COORDINATION

.1 Supply to concrete, masonry and/or other Sections, materials requiring setting and/or building- in in concrete, masonry or other trades. This includes inserts, anchors, frames, sleeves, etc. Verify locations of these materials on Site before fabrication and erection.

1.8 WARRANTY

.1 Submit a 5-year warranty for prefinished aluminum work against defects in materials and workmanship including but not limited to fading or non-uniformity of color, cracking, peelingor other corrosion.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Where anchors, lifting hooks, screws, bolts, nuts, washers, hangers and other fasteners are not specifically shown or specified, provide such items with at least the strength and corrosion resistance properties of the metal fabrication for which they are required.

.2 Structural Steel:

.1 W and H-Shapes:

a. CAN/CSA-G40.20/G40.21 Grade 350W.

.2 Shapes Except W and H-Shapes, Rolled plates and Bars:

a. CAN/CSA-G40.20/G40.21 Grade 300W.

.3 Steel Pipe: ASTM A53, Type E or S, Grade B.

.4 Hollow Structural Sections (HSS): CAN/CSA-G40.20/G40.21 Grade 350W Class C.

.5 Cold Formed Sections:

a. ASTM A653 Grade 340 (Grade 50), Fy = 345 MPa for coated sections.

b. ASTM A1011 Grade 340 (Grade 50), Fy = 345 MPa for uncoated sections.

.3 Welding Electrode: Comply with requirements of applicable welding codes. Refer to Section 05050, Welding-Quality Control for applicable codes.

.4 Structural Steel Connections:

.1 High strength Bolts:

a. For structural connections at platforms, support frames and similar items; use ASTM A325 carbon steel high strength bolts with nuts and washers.

b. Where such structural connections will be normally exposed to atmospheric conditions use ASTM A325 carbon steel bolts hot-dip galvanized to ASTM A153.

.2 Nuts: ASTM A563 and the recommended nut grade and style listed in Appendix X1, Table X1 thereof. Where connections will be normally exposed to atmospheric conditions use Grade C3 or DH3.

.3 Washers: Bolted connections - hardened steel washers conforming to ASTM F436. Hot-dip galvanized washers with galvanized bolts.

.5 Cast In Place Anchor Bolts and Anchor Bolt Sleeves:

.1 Cast-In-Place Anchor Bolts:

a. Carbon Steel: ASTM F1554, Grade 55 with weldability supplement S1.

b. Stainless Steel: ASTM F593, AISI Type 316, Condition CW.

c. Headed type, unless otherwise shown on Drawings.

d. Material type and protective coating as shown in Fastener Schedule at end of this Section.

.2 Anchor Bolt Sleeves:

a. Plastic:

.1 Single unit construction with corrugated sleeve.

.2 Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.

.3 Material: High density polyethylene.

b. Fabricated Steel: ASTM A36/A36M.

.6 Concrete and Masonry Drilled Anchors:

.1 General:

a. Material and Protective coating as shown in Fastener Schedule at end of this section.

.2 Wedge Anchors:

a. Hilti Kwik-Bolt-3 (KB-3) Anchor.

b. ITW Construction Products; Ramset/Red Head; Trubolt Wedge Anchor.

.3 Drop in Expansion Anchors:

a. Hilti HDI Drop-In Anchor.

b. ITW Construction Products; Ramset/Red Head; Multi-Set II Drop-In and Self DrillAnchor.

.4 Undercut Anchors:

a. Hilti HDA Undercut Anchor.

b. USP Structural Connectors; DUC Undercut Anchor.

.5 Heavy Duty Sleeve Anchors:

a. Hilti HSL-3 Heavy Duty Sleeve Anchor.

b. ITW Construction Products; Ramset/Red Head; Dynabolt Hex Nut Sleeve Anchor.

.6 Adhesive Anchors:

a. Threaded Rod:

(a) ASTM F593 stainless steel threaded rod, diameter as shown on Drawings.

(b) Length as required, to provide minimum depth of embedment.

(c) Clean and free of grease, oil, or other deleterious material.

(d) For hollow-unit masonry, provide galvanized or stainless steel wire cloth screentube to fit threaded rod.

b. Adhesive:

(a) Two-component, designed to be used in adverse freeze/thaw environments,with gray color after mixing.

(b) Cure Temperature, Pot Life, and Workability: Compatible for intended use andenvironmental conditions.

(c) Non sag, with selected viscosity base on installation temperature and overheadapplication where applicable.

(d) Manufacturers and Products:

(i) Hilti HIT HY 200 Adhesive Anchor System, (use HIT HY 20 for hollowmasonry).

(ii) ITW Construction Products; Ramset/Red Head; C6 Adhesive AnchorSystem or A7 Adhesive Anchor System. (Use A7 Adhesive Anchor System for hollow masonry.)

.7 Adhesive Threaded Inserts:

a. Stainless steel, internally threaded insert.

b. Manufacturer and Product: Hilti HIS-R Insert with HIT HY 200 adhesive.

.7 Pipe Sleeves: As specified in Section 15090 Supports, Anchors and Seals.

.8 Galvanized steel sheet: ASTM A653- Class Z275 zinc coating.

.9 Hot rolled steel sheet: ASTM A1011.

.10 Cold rolled steel sheet: ASTM A1008.

.11 Steel Pipe: ASTM A53 - Type S Grade A or ANSI B36.10.

.12 Neoprene: Premium grade Durometer A 40.

.13 Fasteners: 19 mm diameter minimum.

.14 Stainless Steel: Alloy 316.

Item	**ASTM**	**UNA Designations**
Structural	A666	S31600 or S31603
Architectural	A666	S31600 or S31603
Plates, Sheets and Strips	A240	S31600 or S31603
		Grade
Fasteners	A193	B8A
Castings	A743	CF-8M

.15 Aluminium

Item	**ASTM**	**UNA Designations**
Extruded Shapes - Structural	B211	A96351-T6
Extruded Shapes - Architectural	B221	A96063-T6
Smooth Plates and Sheets	B209	A93003-H16
Checkered or Tread Plates	B632	A96061-T6
Gratings	B221	A96061-T6
Rivets	B316	A96061-T6
Castings	B26	A03560-T6 or A05350-F
Tubing & Pipe	B241	A96061-T6
Fasteners - Bolts	F468	A96061-T6
- Nuts	F467	A96061-T6

.16 Primer: CISC/CPMA 2-75a unless otherwise noted.

.17 Isolation coating: Coal Tar-Epoxy Coating.

2.2 FINISHES

.1 Rough Edges and Mill Scale:

.1 Following completion of fabrication of any item, grind rough edges straight and finishsmooth. Remove mill scale and rust.

.2 Electrolytic Corrosion:

.1 Back paint metal surfaces in contact with dissimilar metal or concrete or masonry, withcoal tar-epoxy coating, 1.0 mm (40 mils) DFT minimum.

.2 Paint galvanized metal surfaces to be in contact with or encased in concrete with rust inhibitive epoxy coating ICI Devoe Coating: Devran 201. Prepare surfaces to SSPC SP1,apply coating to 125 microns DFT.

.3 Aluminum:

.1 Restore aluminum to original mill finish after fabrication. Buff and brighten exposedaluminum surfaces, which have been damaged during construction.

.2 Paint the surfaces to be in contact with aluminum with coloured coal tar-epoxy coating where aluminum is intended to be in contact with dissimilar metals, concrete, or masonry.

.3 Use anodizing quality aluminum where anodizing is required or where aluminum is to bepainted.

.4 Carbon Steel:

.1 Hot dip galvanize metal fabrications where carbon steel is intended to be exposed toatmospheric conditions or sewage.

.2 Hot dip galvanize the surfaces to be in such contact where carbon steel is intended to bein contact with either concrete, brick or mortar.

.5 Galvanizing:

.1 Hot-dip galvanized items after fabrication. Galvanize steel scheduled for exposure toexterior conditions or corrosive materials.

.2 Clean surfaces to be galvanized of slag and impurities immediately before being galvanized or cadmium plated.

.3 Where specified or detailed, galvanize plates and other structural shapes in accordancewith ASTM A123. Where fabrications are too large to be hot-dipped, employ zinc metallizing.

.4 Repair of Damaged Galvanized Surfaces:

a. Repair hot-dip galvanized coatings damaged by welding, cutting, rough handlingduring shipping or erection or otherwise, in accordance with ASTM A780 using organic zinc-rich primer. Dry film thickness on repairs to exceed original coatingthickness by 25 percent.

.6 Shop Finishes:

.1 Aluminum Finish:

a. Where shop finishing is specified or indicated, after fabrication or forming, prepare surfaces, shop prime, and factory finish in accordance with PPG specifications for the Manufacturer's Duranar two-coat fluoropolymer enamel system for aluminum. Shop finishing: Performed by an accepted applicator. Minimum dry film thickness –30 microns (1.2 mil).

b. Color: To be determined by the Contract Administrator.

c. After installation, touch-up shop finished surfaces damaged during construction.

d. Anodized finish: Anodizing Architectural Class I Anodic Coating 0.018 mm (0.7 mil) thickness, one-hour coating 215 RI (AA-C22A41 clear) preceded by a caustic etch.

.7 Stainless Steel:

.1 Remove rust and postweld discoloration from stainless steel by grinding, using only stainless steel tools.

.2 Passivate stainless steel, which was cleaned by grinding, with a solution of 12-15 percentnitric acid and 3 percent hydroflouric acid.

.3 During finishing ensure no carbon steel gets into contact with the stainless steel surfaces.

.4 Finishes: 2B mill finish.

.8 Steel Finish:

.1 Where shop finishing is specified or indicated, after fabrication or forming, preparesurfaces, shop prime, and factory finish in Stelcolor 8,000 Series.

.2 Shop finishing: Performed by an accepted applicator. Minimum dry film thickness –30 microns (1.2 mil).

.3 After installation, touch-up shop finished surfaces damaged during construction.

2.3 FABRICATION – GENERAL

.1 Where possible, verify dimensions on Site before preparing Shop Drawings or proceeding with shop work. Fit and shop assemble insofar as possible various sections of the work anddeliver to the Project Site in the largest practical sections.

.2 The general dimensions and details of the metal fabrications are shown on the Drawings where practical. Such details and dimensions are suggested concepts for design.

.3 Assume responsibility for the correctness of the actual detailed dimensions used in fabricationand carefully check the same, by field measurement.

.4 Variations from suggested details are subject to acceptance in writing by the Contract Administrator. Such acceptance does not in any way waive the above mentioned responsibility.

.5 Wherever overlapping or contacting surfaces cannot be avoided, completely seal weld these surfaces. Rusting or deterioration of finish in such areas will require remedial seal welding andrefinishing.

.6 Fabricate the work true to dimensions and square. Accurately fit members with hairline joints and join using adequate fastening. Assemble members without twists or open joints.

.7 Construct finished work free from distortion and defects detrimental to appearance and performance.

.8 Stainless steel grain direction: One direction throughout.

.9 File or grind exposed welds smooth and flush. Finish to match adjacent surface finish. Do not leave grinding marks. Construct internal and external corners with sharp lines. Provide continuous welds unless otherwise accepted by the Contract Administrator in writing. Brighten and buff aluminum and stainless steel welds to match appearance of adjacent surface.

.1 Remove weld spatter and slag. After finish grinding and smoothening welds, passivatewelds with pickling paste.

.10 Fabricate metal work complete with components required for anchoring to concrete; bolting orwelding to structural steel frames; standing free; or resting in frames or sockets, in a safe and secure manner.

.11 Countersink exposed fastenings, where such are accepted in writing, and make as inconspicuous as possible with bolts cut off flush with nuts. Construct fastenings of the samematerial and finish as the base material on which they occur.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

.1 Install work of this Section using skilled craftsmen and in accordance with Manufacturer's recommendations where applicable.

.2 Install metal fabrications in the correct locations and positions, plumb, level, structurally sound, securely fastened, free from defects detrimental to finished appearance and to acceptance of the Contract Administrator.

.3 Perform drilling of steel, concrete or masonry to fasten the work of this Section.

.4 For aluminum and stainless steel items, and exterior locations, use stainless steel anchors.

.5 After installation, spot prime bolt heads and nuts, field rivets, field welds and any abrasions ordamage to the shop coat of primer.

.6 Touch-up galvanized steel where galvanizing is damaged during installation with zinc rich primer.

.7 Apply isolation coating to surfaces between dissimilar metals, and between metal and concrete, mortar, grout or masonry.

.8 Where items are specified to be installed by other Sections, fabricate items to the appropriatetrade with necessary instructions and templates required for proper installation. Include required fastenings, such as screws, bolts, expansion shields and similar items.

.9 Tolerances: CAN/CSA S16.

.10 Deliver items to be cast into concrete with instructions for setting.

3.2 INSTALLATION – ANCHORS AND FASTENERS

.1 Use anchor bolts of sufficient length to embed into concrete to develop full strength of the anchor or 200 mm minimum, the maximum governs, and project the threaded portion a minimum of 50 mm for the installation of the nuts.

.2 Do not offset bolts by deformation.

.3 For submerged conditions where bolts are used, use lock nuts or nuts with lock washer.

3.3 FASTENER SCHEDULE

.1 Unless indicated otherwise on the Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless indicated otherwise.	
Exterior and Interior Wet Areas	Stainless steel headedanchor bolts.	
Submerged and CorrosiveAreas	Stainless steel headedanchor bolts	
2. Anchor Bolts Cast into Concrete for Equipment Bases		
Interior Dry Areas	Hot dip galvanized carbon steel headed anchor bolts, unless otherwise specified with equipment	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts, unless otherwise specified with equipment	
3. Drilled Anchors for Metal Components to Cast-in-Place Concrete (e.g., Ladders, Handrail Posts, Electrical Panels, and Equipment)		
Interior Dry Areas	Stainless steel wedge or drop in expansion anchors	Use undercut anchors foroverhead and ceiling installations.
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel Adhesive anchors or Stainless heavyduty sleeve anchor	Use undercut anchors foroverhead and ceiling installations.
4. Anchors in Grout-Filled Concrete Masonry Units		
Exterior and Interior Wet and Dry Areas	Hot-dip galvanized steel headed anchor bolts, or stainless steel heavy duty sleeve anchors, or stainlesssteel adhesive anchors	
5. Anchors in Hollow Concrete Masonry Units		
Exterior and Interior Wet and Dry Areas	Stainless steel adhesive anchors with screen tube	
Service Use and Location	Product	Remarks

Service Use and Location	Product	Remarks
6. Connections for Structural Steel Framing		
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections	Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members andfor Exterior areas
7. Connections for Steel Fabrications and Wood Components		
Exterior and Interior Wet and Dry Areas	Hot-dip galvanized carbon steel bolted connections	
8. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	Stainless steel bolted connections, unless otherwise specified with equipment	
9. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

.2 Anti-seizing Lubricant: Use on all stainless steel threads.

.3 Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 49 degrees C.

END OF SECTION

TORONTO

SECTION 05502

METAL FABRICATIONS (STRUCTURAL)

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 A Comply with Section 05500, Metal Fabrications (Basic).

1.2 REFERENCES

.1 A Refer to Section 05500, Metal Fabrication (Basic).

PART 2 PRODUCTS

2.1 STEEL LINTELS AND SHELF ANGLES

.1 CSA G40.20/21 – 300W hot-dip galvanized after fabrication.

.2 Where lintel or shelf angle size is not shown, design lintels to NBC 9.20.5.2 Lintels or Arches.

.3 Provide adjustable lintel anchors where indicated and detailed.

2.2 EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING

.1 Steel angle support frames to be embedded in concrete shall be stainless steel, A276, AISI Type 316, unless indicated otherwise.

.2 Provide stainless steel welded anchors for stainless steel support frames.

2.3 CHECKERED FLOOR PLATE

.1 Design Requirements:

1. Floor plate shall have regular pattern of raised diamond or lines on top surface for better grip.

2. Design floor plates and frames.

3. Subdivide floor plates with side larger than 1000 mm by reinforcing each subdivision with stiffeners.

4. Limit deflection under a concentrated midspan load of 5.0 kN to 1/360th of the span, and under superimposed 15 kN/m2 uniformly distributed load, 6 mm maximum.

5. Provide handles or lifting holes as detailed.

   a. Lifting holes or handles on process and sanitary sumps shall be gas tight.

6. Provide hinges as indicated and hold down fasteners.

.2 Fabricate angle frames and border bars with the following features:

.1 Corners neatly fitted, welded, mitred.

.2 Shop welded border bars.

.3 Weld strap anchors to angle frames for casting into concrete.

.4 Size angle frames to fit floor plate with clearances between frames and floor plate not exceeding 3 mm on any side.

.3 Fabricate floor plates on process and sanitary sumps with the following features:

.1 Gastight.

.2 Hinged.

.3 Hold open assembly.

.4 3 mm full face neoprene border gasket secured in place with a suitable adhesive.

.5 Gastight lifting handles.

.6 Countersunk stainless steel screws to fasten plate down.

.4 Where indicated, fabricate checkered floor plate with 50 mm thick Styrofoam SM insulation and 1.3 mm thick galvanized backpan secured to underside of checkered plate.

.5 Material:

.1 Aluminum: ASTM B632/B632M, Alloy 6061-T6.

.6 Minimum Thickness:

.1 Aluminum: 10 mm, unless shown otherwise on Drawings.

.7 Surface shall be raised-lug pattern or diamond tread, unless shown otherwise on Drawings.

.8 Slip-Resistant Surface:

.1 Provide for all exterior checkered floor plates and where indicated on Drawings.

.2 Manufacturers and Products:

a. IKG/Borden, MEBAC 2.

b. W.S. Molnar Co., SLIPNOT Grade 2-Medium.

2.4 STAIRS

.1 Material

.1 Aluminum: ASTM B632, Alloy 6060-T6.

.2 Fabricate stair as detailed on Drawings and install using stainless steel anchor bolts

.3 Fabricate stairs with open grating treads of welded grating with slip-resistant, 32 mm cross hatch solid nosing.

.1 Manufacturers:

a. Borden Metal Products Ltd.

b. Fisher & Ludlow Ltd.

2.5 ALUMINUM LADDERS

.1 Fabricate aluminum ladders of the lengths required as indicated on Drawing.

.2 Flat Stringer Ladder

.1 Fabricate ladders with the following features:

a. Welded construction with 50 mm schedule 80 pipe and 25 mm wide by 19 mm deep top-fluted rungs.

b. Stringers spaced 500 mm apart and rungs equally spaced at 300 mm centers.

c. Locate the bottom rung 300 mm above the finished floor, roof or platform.

d. Fabricate attachment brackets to space ladder 175 mm clear from finished architectural wall.

e. Weld attachment brackets to the stringers. Locate within 300 mm of the top and bottom of each ladder and at intermediate points spaced not more than 1200 mm o.c.

f. Reinforce stringer extensions above the top rung to provide rigid support for the personnel using the ladder.

g. Grind welds smooth.

h. Finish: Architectural Class I Anodic Coating, AA-C22A41 clear.

2.6 LIFTING HOOKS

.1 Design hooks to withstand loads imposed with a minimum safety factory of 3.

.2 Material: 316 Stainless Steel.

.3 Cast hooks into concrete slab or beams at location shown.

2.7 METAL GRATING

.1 Design:

.1 Design metal grating to support loads indicated on Drawings but not less than 4.8 kPa (100 psf) or 4.5 kN (1000 lbs) concentrate loads apply to mid span.

.2 Grating deflection shall not exceed L/180.

.2 Product:

.1 Grating shall be aluminum, unless noted otherwise on Drawings.

.2 Grating shall be serrated.

.3 Installation:

.1 Anchor grating to supporting members with clips and bolts with spring as indicated or at 300 mm centre to centre minimum.

.2 Grating supporting equipment shall be weld to supporting members with 5 mm fillet welds, at 300 mm centre to centre, 50 mm long.

.3 Use stainless steel bolts for aluminum construction.

2.8 PLATFORMS

.1 Design's Qualification: Calculations and Shop Drawings required for Contractor design must be stamped by a registered engineer, licensed in Province of Ontario.

.2 Design Criteria:

.1 Comply with the requirements of OBC 2012.

.2 Serrated open grating.

.3 Uniform Live Load: 4.8 kPa minimum.

.4 Uniform Collateral Dead Load (not including self-weight): 0.5 kPa minimum. Design platforms to accommodate small piping or conduits hanging from underside.

.5 Maximum Deflection: 6 mm or L/240.

.6 For support points, locate to suit. Point loads at all support points are 12 kN maximum.

.7 Do not use existing building framing or walls as part of lateral load resisting system. Anchor directly to concrete slab only.

.8 Design platforms to accommodate openings for piping, ducting, and electrical services as shown on Drawings.

.9 Design platforms for additional requirements indicated on Drawings.

.3 Design and provide other items such as grating, stairs, bolts, welds, anchors, etc. in compliance with the requirements of this section.

.4 Field measure areas around equipment prior to fabrication. Design platforms and grating so that gaps around perimeter of equipment do not exceed 75 mm clearance.

.5 Material:

.1 Aluminum: ASTM B632/B632M, Alloy 6061-T6.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Clean off dirt on installed miscellaneous metal surface.

END OF SECTION

DIVISION 6

WOOD AND PLASTICS

TORONTO

SECTION 06100

ROUGH CARPENTRY

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 REFERENCES

.1 Conform to the latest edition of the following:

.1	CAN/CSA O80 Series	-	Wood Preservation
.2	CAN/ULC-S102	-	Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
.3	CSA O121-M	-	Douglas Fir Plywood
.4	NLGA	-	National Lumber Grades Authority

1.3 QUALITY ASSURANCE

.1 Each piece of pressure treated lumber and fire-retardant treated lumber supplied to the job Site shall be shop marked with the pressure treatment brand, and ULC monogram respectively, in accordance with CAN/CSA O80-M.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Store lumber in a dry area. Stack 150 mm clear of floor and with 6 mm spacers 1200 mm apart across each layer.

.2 Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural and aesthetic properties. Vent to allow air movement. Tie covering to keep in place.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Dimension lumber: Grade stamped, dressed, kiln dried lumber having a maximum moisture content at time of installation, of 15% for 50 mm or less in thickness, and 19% for stock over 50 mm thick in accordance with NLGA.

.1 Interior blocking, furring, nailers: NLGA, 122c - Standard Light Framing Grade Spruce, Pine or Fir (S-P-F), S4S.

.2 Fire retardant treatment of lumber and plywood: "Dricon" fire retardant treatment by J.A. Biewer, conforming to CAN/CSA-O80.20 and CAN/CSA-O80.27 respectively, to provide a flame spread rating of 25 or less in accordance with ULC test method CAN/ULC-S102.

.3 Plywood: 19 mm thick, waterproof, grade stamped exterior grade Douglas fir plywood, unsanded in accordance with CSA O121-M.

.4 Rough hardware: Bolts, anchors, nails, screws, expansion shields and other fastenings required to frame and fix rough carpentry as follows:

.1 Hardware for lumber to lumber in exterior locations: Steel screws or spiral nails hot-dip galvanized to ASTM A-153. Wood screws shall be countersunk head, full thread type.

.2 Hardware for lumber to metal in exterior locations: Self-drilling with fluoropolymer type barrier coating.

.3 Hardware for lumber to masonry or concrete in exterior locations: Drilled-in expansion shields or drilled in self-drilling masonry concrete screws with fluoropolymer type barrier coating.

.4 Hardware in interior locations: As specified above, but with electrogalvanized coating.

2.2 SELECTION OF LUMBER PIECES

.1 Carefully select all members; select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections.

.2 Discard wood members with defects which will render a piece unable to serve its intended function; lumber may be rejected by Engineer whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mould, as well as for improper cutting and fitting.

PART 3 EXECUTION

3.1 MISCELLANEOUS WOODWORK

.1 Install miscellaneous wood blocking, strapping and nailers required for attachment of Work of all trades, in addition to roof woodwork. Set accurately so that they will be completely concealed.

.2 Except where steel supports are specifically shown, provide wood blocking and supports in metal stud partitions for fastening of items such as casework and other wall mounted accessories. Have respective trades approve the location of such wood blocking.

.3 Use fire retardant lumber for blocking/framing in ceiling spaces, partitions and bulkheads.

.4 Install temporary wood protection strips at door jambs in high traffic areas.

END OF SECTION

TORONTO

DIVISION 7

THERMAL MOISTURE AND PROTECTION

TORONTO

SECTION 07100

WATERPROOFING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Conform to Sections of Division 1 as applicable.

1.2 REFERENCES

.1 Conform to the latest edition of the following:

.1 ASTM C836, Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

.2 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

.3 ASTM D570, Standard Test Method for Water Absorption of Plastics.

.4 ASTM D903, Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

.5 ASTM D1876, Standard Test Method for Peel Resistance of Adhesives (T-Peel Test).

.6 ASTM D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.7 ASTM D3767, Standard Practice for Rubber-Measurement of Dimensions.

.8 ASTM D5385, Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

.9 ASTM E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.

.10 ASTM E154, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls or as Ground Cover.

.11 CAN/CGSB 11.3, Hardboard.

.12 CAN/CSA A179, Mortar and Grout for Unit Masonry.

.13 CSA B111, Wire Nails, Spikes and Staples.

1.3 SUBMITTALS

.1 Product Data

.1 Submit manufacturer's Product data in accordance with Section 01330.

a. Submit Product data for each Product indicating: Installation details, physical properties and detailed application and installation instructions.

.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01330 indicating:

a. Typical layouts and special details as required for:

(a) Final configuration, sequence, method of attachment to excavation support system, means and methods of supporting membrane externally or internally which will not puncture or injure membrane and which will prevent sagging or loss of contact with excavation support system.

(b) Location of each membrane penetration and membrane penetration details.

.3 Samples

.1 Submit the following samples in accordance with Section 01330. Submit samples of the following:

a. Waterproofing membrane, 300 mm x 300 mm12” x 12”.

b. Prefabricated drainage sheet, 300 mm x 300 mm12” x 12”.

c. All required accessories.

.4 Certificates

.1 Submit certifications for items required at least eight weeks prior to installation of Work of this section.

.2 Submit manufacturer's certification that waterproofing system materials and accessories supplied are compatible and meet Specification requirements and that supervisor and installer is approved by membrane manufacturer.

.3 Submit names of successful membrane installations in which certified personnel have performed tasks of comparable complexity and scope within preceding five years.

.4 Submit inspection reports and certification by manufacturer confirming that installations are in accordance with the Contract Documents and manufacturer's recommendations.

.5 Submit Quality Control Plan detailing quality control procedures to be used to meet manufacturer and Specification requirements. Obtain acceptance of Quality Control Plan from Engineer before starting the Work of this Section.

1.4 QUALITY ASSURANCE

.1 Manufacturer's qualifications: Perform Work of this section by company manufacturer's having minimum of ten years recent experience in Work of comparable complexity and scope.

.2 The Work of this section shall be performed by a qualified applicator trained and approved by waterproofing manufacturer.

.3 Applicator shall have minimum three years proven satisfactory experience in this type of Work, having adequate equipment and skilled personnel to complete the Work of this section in an efficient and workmanlike manner.

.4 Applicator must be a member in good standing, prior to bidding, of the Sealant and Waterproofing Association of Ontario.

.5 Mock-Up

.1 Construct one 10 m² mock-up of waterproofing system in location acceptable to Engineer. Show stages of application.

.2 Demonstrate performance.

.3 Arrange for Engineer's review and acceptance; allow 48 hours after acceptance before proceeding with Work.

.4 Mock-up may remain as part of Work if accepted by Engineer. Remove and dispose of mock-ups not forming part of Work.

.6 Pre-Installation Meeting

.1 Prior to commencing the Work of this section, arrange for manufacturer's technical representative to visit Site and review with Contractor and Engineer procedures to be adopted, conditions under which Work will be done and inspect substrates designated to receive the Work, in order that any alternative recommendations may be made should adverse conditions exist.

1.5 MANUFACTURER'S INSPECTIONS

.1 Manufacturer's representative shall visit Site prior to commencing the Work and verify, in writing, that conditions and substrates are acceptable to receive this work.

.2 Manufacturer's representative shall visit Site during this Work and verify in writing, that application is in accordance with this Specification and manufacturer's recommendations. Upon completion of this Work, manufacturer's representative shall verify, in writing, that the application has been completed in accordance with this Specification and manufacturer's recommendation.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver Products to Site undamaged and with seals and labels intact. Inspect containers to verify that they have not been opened.

.2 Store Products as required by the manufacturer.

1.7 SITE CONDITIONS

.1 Do not install waterproofing system on wet surfaces that would cause waterproofing to hydrate prematurely.

.2 Do not install waterproofing during rain, showers, inclement weather or conditions detrimental to a proper installation.

.3 Maintain air temperature and structural base temperature at waterproofing installation area above 5°C for twenty-four hours before, during and twenty-four hours after installation.

.4 Keep flammable Products away from spark or open flame. Post "NO SMOKING" signs. Do not allow spark producing equipment to be used during installation and until all vapours have dissipated.

1.8 WARRANTY

.1 Submit warranty for waterproofing Work in accordance with the General Conditions, except warranty period extended to ten years against defects and deficiencies. Promptly correct to satisfaction of Engineer and at no expense to the Owner, any defects and/or deficiencies which become apparent within the warranty period. Defects include but are not limited to leakage.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Use Products of only one manufacturer for the Work of this section. The Contractor to ensure that all materials are compatible in order to provide a water-tight finish which meets or exceeds the performance criteria as set out within the Contract.

.2 Waterproofing system: Pre-applied, integrally bonded sheet waterproofing membrane 1.7 mm thick. When covered with poured-in-place/precast concrete membrane shall form an integral bond to prevent water migration through concrete.

.3 Acceptable Products

.1 "Sikaproof A-12" by Sika Canada Inc.

.2 "Coreflex 60" by DRE Industries

.3 Or approved equivalent

2.2 ACCESSORIES

.1 Protection board: In accordance with CAN/CGSB 11.3; 6 mm thick.

.2 Mechanical fasteners: In accordance with CSA B111; hot dip galvanized.

.3 Adhesive: Recommended by waterproofing membrane manufacturer.

.4 Prefabricated drainage sheet: Lightweight geocomposite drainage board consisting of dimple-raised core bonded to a high strength geotextile fabric, 11 mm deep x 1220 mm wide:

.1 "Sarnadrain" by Sika Canada Inc.

.2 "Aquadrain 15XP" by CETCO.

.3 Or approved equivalent.

.5 Joint tape: Recommended by installer and acceptable to Engineer.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify condition of previously installed Work upon which this section depends. Report defects to Engineer. Commencement of Work means acceptance of existing conditions.

.2 Verify that substrates to receive membrane waterproofing are clean, sound, smooth, free of fins and sharp edges and free of curing agents, loose and foreign matter, oil and grease detrimental to waterproofing membrane adhesion.

.3 Have manufacturer's technical representative verify that conditions are acceptable for installation of membrane waterproofing, including installation of reinforcement and pouring of concrete.

.4 Allow a minimum of seven days curing time before application on new concrete.

3.2 PREPARATORY WORK

.1 Install drainage sheet over lagging in accordance with manufacturer's recommendations.

.2 Terminate waterproofing at strut penetrations or anchor tie backs as per manufacturer's recommendations. Include additional lap length to tie in waterproofing of openings upon removal of struts.

.3 Prepare all surfaces as per manufacturer's recommendations to ensure water-tight finish.

.4 Protect waterproofing membrane to prevent damage caused by backfill or construction traffic.

3.3 INSTALLATION

.1 Install membrane waterproofing in accordance with reviewed Shop Drawings and manufacturer's recommendations.

.2 Waterproofing termination details to follow system per manufacturer's recommendations.

.3 Control joints shall be installed with Sika Hydrotite CJ 725 or approved equivalent.

.4 Take particular care at vertical/horizontal junctions and corners and to seal around all penetrations and obstructions to ensure 100% waterproofing coverage

.5 Cut and attach a strip of panel waterproofing roll centered over all soldier piles. Extend roll a minimum 100 mm onto the lagging on both sides of soldier piles.

.6 Detail around all penetrations and tie-backs with 19 mm cant of trowel grade sodium bentonite compound over substrate a minimum of 150 mm around penetrations and tie backs. Cut panel rolls to fit snugly around all penetrations and tie-backs.

.7 Inspect finished installation and repair any damaged areas, prior to concrete placement.

.8 Temporarily protect completed waterproofing from precipitation and from contact with ground water in accordance with manufacturer's recommendations until ready for placing of concrete.

.9 Remove temporary protection for inspection before placing of concrete.

.10 Ensure that completed waterproofing system is acceptable to Engineer and manufacturer's representative.

3.4 CLEAN-UP

.1 Upon completion of this Work, remove debris, equipment and excess materials from Site.

END OF SECTION

TORONTO

SECTION 07800

FIRE STOPPING AND SMOKE SEALS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

.2 Work of this section includes but is not necessarily limited to, the following:

a. Firestopping and smoke seals at penetrations through fire rated assemblies to match fire rating of such structures, in accordance with the Contract Documents, including but not limited to the following locations:

(a) Penetrations through fire resistance rated masonry and gypsum board

(b) Top of fire resistance rated masonry walls and gypsum board walls

(c) Intersection of fire resistance rated masonry and gypsum board

(d) Control joints in fire resistance rated masonry and gypsum board

(e) Openings and sleeves installed for future use in fire resistance rated separations

(f) Perimeter of floors at exterior walls

(g) Process and building services penetrations through floors

.2 Ensure firestopping system provides fire-resistance rating (flame and temperature) not less than fire resistance rating of surrounding floor, wall or assembly, in accordance with requirements of OBC.

.3 Firestop system rating: Comply with F, FH, FT, or FTH ratings as required by authorities having jurisdiction.

1.2 RELATED SECTIONS

.1 Divisions 16: Mechanical, Electrical and Communications: Firestopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers) and electrical/communication assemblies (i.e. inside bus ducts).

1.3 REFERENCES

.1 Conform to the latest edition of the following:

.1 ULC-S115, Standard Method of Fire Tests of Firestop Systems

.2 CAN/ULC S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials

.3 ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops

.4 ASTM E2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi Story Test Apparatus

.5 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgements

1.4 QUALIFICATION

.1 Subcontractor qualifications: Accredited firm with not less than five years satisfactory experience as recommended by firestopping/smoke seal manufacturer.

1.5 SUBMITTALS

.1 Shop Drawings: Submit in accordance with Section 01330.

.2 Submit manufacturer's Product data for each material to be used, and fire test certifications for assemblies as applicable to the Work.

.3 Submit details of each type of penetration and materials to be incorporated as smoke stop and/or firestopping assembly.

1.6 QUALITY ASSURANCE

.1 Job mock-up: Provide sample application at each type of penetration at the Site, in the presence of Engineer. After approval, such mock-up to constitute standard of acceptance for remainder of Work.

.2 Firestopping assemblies through fire rated structures are to comply with ULC or Warnock Hersey approved assemblies.

.3 An approved manufacturer’s representative to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer’s written recommendations published in their literature and drawing details.

.4 Firestop systems do not re-establish the structural integrity of load bearing partitions/assemblies or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer’s engineering judgement derived from similar ULC or cUL system designs or other tests will be submitted to local Authorities Having Jurisdiction for their review and approval prior to installation. Engineer judgement drawings must follow the requirements set forth by the International Firestop Council.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original unopened containers or unopened packages, with manufacturer's labels attached, installation instructions, and lot numbers intact and legible.

.2 Store materials in original containers, out of weather, and at a temperature below 32°C (90°F).

1.8 PROJECT CONDITIONS

.1 Unmixed liquid components of foam are to rest in their original, unopened containers at a temperature between 18°C and 27°C (65°F and 80°F) for twelve hours before use.

.2 Sealant may be applied at temperatures ranging from -38°C to +71°C (-35°F to +160°F).

.3 Do not apply materials when temperature of substrate or ambient air exceeds manufacturer's stated limits.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Fire stopping and smoke seal systems - general: Asbestos-free systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with ULC-S115, and suitable to actual Project application and installation conditions.

.1 Acceptable manufacturers of rated systems:

a. Hilti

b. A/D Fire Protection Systems

c. Tremco

d. Dow Corning

e. 3M

f. Or accepted equal

.2 Firestop fibre: Mineral fibre (complete with galvanized steel insulation clips and) bearing ULC or Warnock Hersey label, in width 25% - 33% larger than the space to be filled. Use one of the following:

.1 "Firebarrier Firestopping" by A/D Fire Protection Systems

.2 "RXL Safe" by Roxul

.3 "Fire-Bloc 1" by M.W. McGill and Associates Limited

.3 Cable management: Re-penetrable device for installation in wall and floor applications and resists temperatures up to 100°C. Steel with zinc coating, ABS plastic and glass-fiber fabric:

.1 "Speed Sleeve CP 653" by Hilti Canada.

.4 Firestop Sealant: flexible, acrylic based firestop sealant, silicone free, for use in fire-rated joints and through penetrations. "CP 606" by Hilti or accepted equal. Size 200 mm x 127mm wide x 50 mm high. Firestop Block to be in accordance with ASTM E814.

.5 Damming materials, supports and anchorages: To firestopping/smoke and seal manufacturer's recommendations, as required by assembly.

.6 Sheet metal closures: Galvanized sheet metal closures and fasteners appropriate to adjacent structures to be secured to. Sheet metal to be in accordance with ASTM A653/A653M with ZF75 zinc coating designation.

PART 3 EXECUTION

3.1 PREPARATION

.1 Remove combustible materials and loose impediment from penetration opening and involved surfaces.

.2 Remove oil and other free liquids from penetration opening. Clean metal substrates with non-alcohol solvent.

3.2 INSTALLATION

.1 Install firestopping and smoke seal systems in accordance with manufacturer's instructions and fire rated assembly requirements to establish continuity and integrity of fire separations.

.2 Install primers as recommended by firestop Product manufacturers.

.3 Install temporary forming, damming and back-up as required. Remove after firestopping and smoke seal materials have achieve initial cure and able to resist displacement.

.4 Use resilient, elastomeric firestopping systems in the following locations:

.1 Openings and sleeves for future use.

.2 Penetration systems subject to vibration or thermal movement.

.3 Penetration systems in acoustical containment enclosures.

.5 Trowel and tool exposed firestop Product surfaces to uniform, smooth finish.

.6 Repair damaged firestopped surfaces to acceptance of Engineer.

3.3 FIBRE FIRESTOPPING INSTALLATION

.1 Install fibre firestopping with minimum 25% to 33% compression in accordance with Product manufacturer's recommendations.

.2 Butt succeeding sections of firestopping tightly against preceding piece. Do not leave any void.

3.4 FOAM INSTALLATION

.1 Follow manufacturer's installation instructions for damming penetration.

.2 Seal gaps or cracks left after damming materials are in place.

.3 Immediately after mixing, dispense liquid foam into penetration opening in accordance with manufacturer's installation instructions.

.4 Do not overfill penetration openings with liquid foam. Foam expands approximately three times its original volume during cure. Comply with the following:

.1 When dispensing liquid foam continuously, be sure the thickness of liquid foam does not exceed 25 mm at any given spot.

.2 If opening is not filled when cured foam has completed its expansion, repeat injection and cure procedure until opening is filled to desired level.

.5 Leave temporary damming in place for twenty-four hours to allow foam to fully cure.

3.5 SEALANT INSTALLATION

.1 Apply sealant from cartridge or with trowel or putty knife from pail as applicable to detail or condition. Ensure sealant contacts with substrates of opening.

3.6 FIELD QUALITY CONTROL

.1 Perform manufacturer's in-line quality control check at least once daily, and upon changing to new lot of material, to ensure performance of both dispensing equipment and foam Product prior to installing penetration seals.

.2 Inspect cured penetration seal after twenty-four hour cure by removing temporary damming materials to examine seal.

.3 Cured foam should completely fill penetration. Fill remaining gaps with freshly mixed foam or fire stop sealant. Reinspect after added material has cured twenty-four hours.

.4 Damming materials required to achieve a specific fire rating must remain in penetration. Sheet metal closures which are shown on Drawings are to be reinstalled after inspections.

3.7 IDENTIFICATION

.1 Identify each firestop penetration assembly with permanent label listing following:

.1 Assembly and rating in hours.

.2 Date of installation.

.3 Installing company's name and telephone number.

3.8 ADJUSTMENT AND CLEANING

.1 Clean up foam or sealant spills following manufacturer's instructions on container label.

.2 Trim excess cured foam with a sharp knife or blade if required for finished appearances.

.3 Remove equipment, materials and debris, leaving area in undamaged, clean condition.

END OF SECTION

TORONTO

SECTION 07900

SEALANTS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED WORK

.1 Sealing of existing expansion and control joints in masonry elements: as noted on drawings.

.2 Read other Sections of Specifications for extent of sealing specified in those Sections. Do all other sealing indicated, specified or required.

1.3 REFERENCES

.1	CGSB 19-GP-5M-76	Sealing Compound, One-Component, Acrylic Base, Solvent Curing
.2	CAN/CGSB-19.13-M87	Sealing Compound, One-Component, Elastomeric, Chemical Curing
.3	CAN/CGSB-19.17-M90	Sealing Compound, One-Component Acrylic Emulsion Base
.4	CAN/CGSB-19.22-M89	Mildew-Resistant Sealing Compound for Tubs and Tiles
.5	CAN/CGSB-19.24-M90	Multicomponent, Chemical-Curing Sealing Compound
.6	CAN/CGSB 19-GP-13M	Clear Silicone, One Component, Chemical Cure

1.4 DESCRIPTION

.1 Provide joint sealant work required to seal building tightly from exterior and interior, to withstand action of elements and to complete building envelope, and all other joint sealant work, unless specified to be included under other Sections.

1.5 SUBMITTALS

.1 Provide cured, colour samples of manufacturer's standard range of colours in each type of sealing and caulking compound for colour selection by Engineer. Submit samples of primer, bond breaker tape and joint backing material, if requested.

.2 Submit product information from sealant manufacturers prior to commencement of work of this Section verifying:

.1 Selected sealant materials are from those specified.

.2 Composition and physical characteristics.

.3 Surface preparation requirements.

.4 Priming and application procedures.

.5 Suitability of sealants for purposes intended and joint design.

.6 Test report on adhesion, compatibility and staining effect on samples of materials used on Project.

.7 Sealants compatibility with other materials and products with which they come in contact including but not limited to sealants provided under other Sections, insulation adhesives, bitumens, brick, limestone, concrete, masonry, metals and metal finishes, ceramic tile, plastic laminates, paints.

.3 Suitability of sealants for temperature and humidity conditions at time of application.

1.6 QUALITY ASSURANCE

.1 Perform work of this Section by recognized and established sealant applicator having experience using skilled mechanics trained in use of sealing equipment and specified materials. Submit proof of experience upon Engineer's request.

.2 Prior to start of work, arrange for Project Site meeting of all parties associated with work of this Section. Presided by Engineer, include Contractor, Sub-Contractor, Testing Company's Representative and manufacturer’s representative.

.3 Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of this Section. Discuss also following items:

.1 Weather conditions under which work will be done.

.2 Anticipated frequency and extent of joint movement.

.3 Joint design.

.4 Suitability of durometer hardness and other properties of material to be used.

.5 Recommendations of manufacturer for mixing of multi-component sealants.

.6 Number of beads to be used in sealing operation and priming operation if required.

.4 Mock-Up:

.1 At Site, in area(s) designated by Engineer, erect sample panels 1m (39") long for each type of sealant joint design, showing location, size, shape and depth of joint complete with backup materials, primer, caulking and sealant, bond, colour and quality of installation work. Construct additional samples if required to obtain approval. Do no sealing work until samples have been approved. Approved samples shall become standard of comparison for sealing and caulking work on Site and shall become part of Work.

.5 Provide these samples for each building under this contract.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver caulking and sealing materials to Site in original, unopened containers with manufacturers labels and seals intact. Labels shall identify manufacturer's name, brand name of product, grade and type, application directions and shelf life or expiry date of product.

.2 Handle and store materials in accordance with manufacturer's printed directions. Store flammable materials in safe, approved containers to eliminate fire hazards.

.3 Do not use caulking and sealing materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.8 PROJECT CONDITIONS

.1 Do not apply any sealant under adverse weather conditions, when joints to be sealed are damp, wet or frozen or when at ambient temperatures below 5°C (40°F). Maintain minimum temperature of application during application and for 8 hours after application. Consult manufacturer for specific instructions before proceeding and obtain Engineer's approval.

1.9 WARRANTY

.1 Warrant work of this Section against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct to satisfaction of Engineer and at no expense to City, any defects or deficiencies which become apparent within warranty period. Defects include, but are not limited to cracking, crumbling, melting, shrinkage, sag, failure in adhesion, cohesion or reversion, air and moisture leakage, marbling or streaking due to improper mixing, discolouration due to dirt pick-up during curing and staining of adjacent materials.

PART 2 PRODUCTS

2.1 MATERIALS

.1 **Colours:** Selected by Engineer from manufacturer's standard range to match colour of predominant materials to which sealant is applied.

.2 **Formulation:** non-bleeding, non-migrating, capable of supporting their own weight. Use self-levelling type for horizontal surfaces and non-sag type at vertical and soffit applications. Use 1 manufacturer's product for each Type specified.

.3 **Sealant Type A**: CAN/CGSB-19.24-M, Type 2, Class B, multi-component modified urethane base chemical curing, Dymeric by Tremco Limited. SILICONE

.4 **Joint Backing**: locations as indicated on drawings preformed, compressible, resilient, non-waxing, non-extruding, non-staining strips of closed cell polyethylene or urethane foam, rubber tubing or non-migrating plasticized vinyl with shore 'A' hardness of 20 and tensile strength between 140 kPa and 200 kPa. Sizes and shapes to suit various conditions, diameter 25% greater than joint width. Backing shall be compatible with sealant, primer and substrate.

.5 **Bond Breaker Tape:** as recommended by sealant manufacturer.

.6 **Joint Primer**: non-staining, suitable for substrate surfaces, compatible with joint forming materials and as recommended by sealant manufacturer.

.7 **Cleaning material**: non-corrosive, non-staining, solvent type, xylol, methyl-ethyl-ketone (MEK), toluol or as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Ensure joints are suitable to accept and receive sealants. Commencement of work implies acceptance of surfaces and conditions.

.2 Do not apply sealant to masonry until mortar has cured and masonry cleaning complete.

.3 Before any sealing work is commenced, test materials for indications of staining or poor adhesion.

3.2 PREPARATION

.1 Remove existing caulking and/or sealant from all joints where indicated on Drawings and at all exterior applications requiring new sealants. Ensure that all joint interfaces are clean.

.2 Clean joints and spaces which are to be sealed and ensure they are dry and free of dust, loose mortar, oil, grease, oxidation, coatings, form release agents, sealers and other foreign material.

.3 Clean porous surfaces such as concrete, brick masonry and stone by soft bristle brushing, light tooling or light abrasive blasting as required to obtain clean and sound surfaces free of sealant residue.

.4 Remove laitance by light abrasive cleaning as directed by Engineer.

.5 Remove oils by light abrasive cleaning as directed by Engineer.

.6 Remove loose particles present or resulting from blasting by thorough brushing or vacuuming.

.7 Clean ferrous metals of rust, mill scale and foreign materials by wire brushing, light grinding or light abrasive cleaning as directed by Engineer.

.8 Wipe non-porous surfaces such as metal and glass to be sealed, except pre-coated metals, with clean rags soaked with solvent recommended by sealant manufacturer and wipe dry with clean cloth. Do not allow solvent to air-dry without wiping. Clean pre-coated metals with solutions or compounds which will not injure finish, and which are compatible with joint primer and sealant. Check ferrous metal surfaces are painted before applying sealant.

.9 Examine joint sizes and where depth of joint exceeds required depth of sealant correct to achieve proper following width/depth ratio:

.1 Minimum width of joint shall be four times anticipated movement, but not less than 6mm (1/4") wide; depth of sealant to be 6mm (1/4") for joints 6 to 13mm (1/4 to 1/2") in width.

.2 Maximum sealant depth not to exceed half of joint width when measured through centre section of bead for joints between 13mm (1/2") to 32mm (1-1/4") in width.

.3 Maximum joint size in single application - 50mm (2") wide, 16mm (5/8") depth.

.10 Install joint backing material to achieve correct and uniform joint profile.

.11 Where joint design or depth of joint prevents use of joint backing material, apply bond breaker tape to prevent three-sided adhesion.

.12 Do not stretch, twist, puncture or tear joint backing. Butt joint backing at intersections. Install bond breaker tape at back of joint where joint backing is not required or cannot be installed.

.13 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.

.14 Where surfaces adjacent to joints are likely to become coated with sealant during application, mask them prior to priming and sealing.

.15 Do not exceed shelf life and pot life of materials, and installation times, as stated by manufacturers.

.16 Be familiar with work life of sealant to be used. Do not mix multiple component materials until required for use.

.17 Use materials as received from manufacturer, without additions, deletions and adulterations of materials.

.18 Mix multiple component sealants and bulks sealants using mechanical mixer capable of mixing without mixing air into material, strictly in accordance with manufacturer's directions and recommendations. Continue mixing until material is homogeneously

blended, uniform in colour and free from streaks of unmixed material. Install compound prior to start of hardening or curing cycle.

.19 Seal joints in surfaces to be painted before surfaces are painted. Where surfaces to be sealed are prime painted in shop before sealing check to make sure prime paint is compatible with primer and sealant. If they are incompatible, inform Engineer and change primer and sealant to compatible types approved by Engineer.

.20 Where irregular surface or sensitive joint border exists, apply masking tape at edge of joint to ensure joint neatness and protection.

.21 Prime sides of joints as recommended by sealant manufacturer for type of surface being sealed prior to application of joint backing, bond breaker or sealant.

3.3 APPLICATION

.1 Apply sealant using hand operated guns or pressure equipment fitted with suitable nozzle size and equipment approved by sealant manufacturer. Apply in accordance with manufacturer's directions and recommendations.

.2 Force sealant into joint and against sides of joints to obtain uniform adhesion. Use sufficient pressure to completely fill all voids in joint regardless of variation in joint widths and to proper joint depth as prepared. Ensure full firm contact with interfaces of joint. Superficial pointing with skin bead shall not be acceptable.

.3 Finish face of compound to form smooth, uniform beads. At recesses in angular surfaces, finish compound with flat face, flush with face of materials at each side. At recesses in flush surfaces, finish compound with concave face flush with face of materials at each side.

.4 Compound may be tooled, provided that such tooling does not damage seal or tear compound. Avoid pulling of sealant from sides.

.5 Tool surfaces as soon as possible after sealant application or before any skin formation has occurred, particularly when using silicone sealants.

.6 Joint surfaces shall be straight, neatly finished, free from ridges, wrinkles, sags, dirt, stains, air pockets and embedded foreign matter or other defacement and be uniform in colour, free from marbling and/or colour streaking due to improper mixing or use of out of shelf life products.

.7 Solvent curing sealants shall not be used indoors.

.8 **Sealant Applications**: Use 1 of sealants specified for each type in following locations. Ensure sealant chosen (from specified under each type under "MATERIALS") for each location is recommended by manufacturer for use for conditions encountered.

.9 **Type A** (non-traffic bearing): Joints between metal frames and adjacent masonry and/or concrete construction in exterior walls, exterior and interior; control and expansion joints in exterior and interior surfaces of poured-in-place concrete walls, unit masonry walls; between masonry and flashings; between steel elements and masonry; and all other

locations where sealing is required or noted on Drawings and except where sealing specified in other Sections.

.10 Joint designation in preceding paragraphs and fact that Drawings do not show all locations to be sealed, does not limit responsibility of this Section to seal all locations except those indicated in other Sections of Work, required to create and ensure continuous enclosure.

3.4 FIELD QUALITY CONTROL

.1 Where work or materials fail to meet requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.

3.5 REPAIR

.1 Remove any compounds not complying with requirements specified herein. Exercise care in removal operations not to mar or damage finishes adjacent to joints. Repeat preparation, priming and installation of new material as specified to provide finished work complying with specified requirements, and acceptable to Engineer. Do such repair work at no extra cost to City.

3.6 CLEANING

.1 Immediately clean adjacent surfaces which have been soiled and leave Work in neat, clean condition. Remove excess materials, compounds smears or other soiling resulting from application of sealants. Use recommended cleaners and solvents.

3.7 PROTECTION OF COMPLETED WORK

.1 Provide approved, non-staining means of protection for completed joint sealant installations where required to protect work from mechanical, thermal, chemical and other damage by construction operations and traffic.

.2 Maintain protection securely in place until completion of Work. Remove protection when so directed by Engineer.

END OF SECTION

DIVISION 8

DOORS AND WINDOWS

TORONTO

SECTION 08100

METAL DOORS AND FRAMES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 REFERENCES

.1 Conform to the latest edition of the following:

.1	ASTM A653/A653M	-	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
.2	CAN4-S104-M	-	Standard Method for Fire Tests of Door Assemblies
.3	CAN4-S105-M	-	Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104
.4	CSA W47.1	-	Certification of Companies for Fusion Welding of Steel
.5	CSA W59-M	-	Welded Steel Construction (Metal Arc Welding)

1.3 SUBMITTALS

.1 Shop Drawings

.1 Submit in accordance with Section 01330. Clearly show in detail, gauges of metal Work, assemblies, large screen frame sections and assembly details, fastenings, hardware cutouts and reinforcing, anchorage and finish.

.2 Indicate doors and frames which are fire rated.

.3 Submit manufacturer's Product data brochure as part of Shop Drawing submittal.

1.4 COORDINATION

.1 Coordinate with finish hardware Supplier to ensure proper preparation of hollow metal doors and frames for finish hardware.

.2 Coordinate with electrical division for doors requiring conduits.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect Work against rust and damage during manufacture and delivery. Handle carefully to prevent distortion and wracking.

.2 Protect hollow metal Work from damage. Replace damaged Work which cannot be satisfactorily repaired, restored or cleaned. Store materials on site in a manner to prevent damage.

PART 2 PRODUCTS

2.1 DESCRIPTION AND SOURCE

.1 Doors are of the insulated/sound deadened, steel-stiffened type using the spot welding or adhesive method to attach face sheets to the rib stiffeners.

.2 Frames are of the welded type. Knockdown frames are not permitted.

.3 Source doors and frames from one of the following:

.1 Fleming Door Products Limited

.2 Artek Door

.3 Baron Metal Industries

.4 Daybar Industries Limited

2.2 MATERIALS

.1 Sheet steel: Commercial grade sheet steel conforming to ASTM A653/A653M, with ZF75 zinc-iron alloy coating designation. Sheet steel thicknesses specified are base metal thicknesses prior to galvanizing.

.2 Hollow Metal Doors (and Transom Panels)

.1 Facings, rails, stiles: 1.5 mm thick (16 ga) steel.

.2 Interior stiffeners: 0.91 mm thick (20 ga) steel.

.3 Sound deadening and insulating material: Semi-rigid fibreglass, 24 kg/m^3 minimum density, to fill core space.

.4 Top caps: Rigid PVC extrusions conforming to CGSB 41-GP-19Ma.

.3 Hollow Metal Door Frames

.1 Steel: 1.5 mm thick (16 ga) steel.

.2 Hardware reinforcement: 3.4 mm thick (10 ga) steel.

.3 Channel door spreaders: 1.2 mm thick (18 ga) steel.

.4 Frame Anchors

.1 Frames in masonry: Adjustable "T-strap" anchors and base anchor.

.2 Frames in precast (concrete): Countersunk galvanized expansion bolts complete with base anchors, and spacers behind hollow metal frame.

.3 Frames in steel channel sub-frames: Countersunk fluorocarbon coated self drilling screws complete with spacers behind hollow metal frame.

.4 Labeled frames: To conform to ULC or Warnock Hersey requirements.

.5 Frames in gypsum board partitions: Steel anchor clips and adjustable base anchors of suitable design securely welded inside each jamb.

.6 Floor anchors: Minimum 3.5 mmthick adjustable hot-dip galvanized base anchors with two holes for bolting to floor.

.5 Rubber bumpers: Glynn-Johnson GJ64.

.6 Conduit in hollow metal frames: To CSA C22.2 No. 83-M. EMT galvanized cold rolled steel tubing.

2.3 FABRICATION

.1 Arc weld joints in accordance with CSA W59-M to produce a finished unit, square, true and free of distortion. Continuous weld joints unless specified otherwise. Execute welding by a firm fully approved by Canadian Welding Bureau to requirements of CSA W47.1.

.2 Accurately form profiles.

.3 Perform all cutting in door fabricator's shop.

.4 Ream and remove burrs from cutouts and from drilled and punched holes.

.5 Finish Work free from warp, open seams, buckles, weld and grind marks and other surface defects detrimental to attainment of a good paint finish in field.

.6 Doors that do not require labels shall have label holes properly filled at the factory prior to shipping to Site.

.7 Hollow Metal Doors

.1 Flush welded type, seamless, of sizes to conform to details and schedules, and reinforced to receive hardware fastenings.

.2 Provide cutouts for glass and door louvres.

.3 Vertically stiffen doors with galvanized metal stiffeners at 150 mmo.c. For bonded face sheets, apply continuous mastic adhesive to stiffeners into which, bond face sheets. For spot welded face sheets, apply welding at 150 mm o.c. Fill voids with fibreglass insulation. Fill and grind smooth weld marks.

.4 Weld doors on the hinge side with a minimum of ten points of 13 mm welds in the following locations:

a. Top and bottom

b. On either side of the hinge

c. At the intermediate points between the hinges

.5 Weld doors on the strike side with a minimum of eight 13 mm welds in the following locations:

a. Top and bottom

b. On either side of the hinge

c. Two welds above and below the strike, spread equally between the top and bottom welds

.6 After welding, dress and fill door joints. Clean, sand, flood coat with air drying paste filler and again sand to eliminate unevenness or irregularities.

.7 Using premoulded PVC, cap top of exterior doors, and interior doors on which the tops can be seen from stair landings or other high elevations.

.8 Blank, drill, reinforce and tap doors to receive hardware.

.8 Hollow Metal Door Frames

.1 Assemble using welded construction only.

.2 Weld vertical centre mullion where indicated at double door openings.

.3 Cut frame mitres accurately and weld continuously on inside of frame profile.

.4 Grind welded frame corners to smooth finish, fill with metallic paste filler, sand smooth, and prime paint.

.5 Make cutouts to suit hardware. Blank, drill, tap and reinforce frames to receive template hardware. Protect mortised butts and strike cutouts with metal mortar guard boxes welded on inside of frames. Reinforce frames for installation of hardware.

.6 Weld, grind smooth and seal a continuous integral steel weather drip at head of exterior door frames.

.7 Provide three door bumpers per single door frame, two per double door frame without centre mullion, six per double door frame with centre door mullion.

.9 Hollow Metal Frames for Glazed Screens and Borrowed Lights

.1 Assemble using welded construction. Construct large screens in sections with provision for on-site assembly to suit site conditions.

.2 Form perimeter frames, tubular mullions and transoms with 50 mmface members. Accurately cope and mitre sections to fit together, carefully align and weld on inside of frame.

.3 Accurately cut, mitre and fit steel glazing stops. Loosely screw in position with cadmium plated countersunk tamperproof oval head screws spaced at maximum 450 mmo.c. and 50 mmfrom each end.

.4 Prepare frames by grinding, sanding and filling same as specified for door frames.

.10 Fire Rated Doors and Frames

.1 Fabricate doors and frames for hourly rating noted on door schedules in conformance with CAN4 S104-M and CAN4 S105-M. Furnish door and frames with the appropriate label of a testing organization accredited by Standard Council of Canada in conformance with the foregoing standards.

.2 Label the entire assembly of fire rated screens containing doors.

.3 Locate fire rating label on doors on hinged edge midway between top hinge and head of door. Locate fire rating label on frames in door rebate.

.4 Mortise, reinforce, drill and tap doors to receive template hardware and reinforce for surface mounted hardware, all as per requirements of foregoing standards.

.11 Temperature Rise Limit

.1 Where located in a firewall, fabricate doors to achieve the Temperature Rise Limit (TRL) indicated in the Ontario Building Code.

.2 Provide such doors with a combined fire rating/temperature rise limit label. Locate as previously specified.

.12 Insulated hollow metal transom panels: Same as for hollow metal door construction complete with drip flashings on exterior panels.

.13 Preparation for security system: Hollow metal doors will be monitored to a central security system. Prepare frames and doors to accommodate concealed rotary switch hinge (C.R.S.) at the centre hinge point. Provide frame with metal mortar guard at back side of hinge and with a 19 mm diameter rigid galvanized steel conduit from top of mortar guard to 300 mm above door head.

.14 Masonry anchors: Fit specified anchors into frames. Furnish number of anchors on each jamb as follows:

.1 Frames up to 2285 mm height: Three "T" anchors.

.2 Frames 2285 mm to 2440 mmheight: Four "T" anchors.

.3 Frames over 2440 mm height: One "T" anchor for each 600 mm or fraction thereof of height.

.15 Stud wall anchors: Fit specified anchors into frames. Furnish number of anchors for each jamb as follows:

.1 Frames up to 2285 mm height: Four anchors.

.2 Frames 2285 mm to 2440 mm height: Five anchors.

.3 Frames over 2440 mm height: Five anchors plus one additional for each 600 mm or fraction thereof over 2440 mm.

PART 3 EXECUTION – NOT USED

3.1 INSTALLATION

.1 Building-in of hollow metal frames in masonry is specified in Section 04200 - Concrete Unit Masonry.

3.2 DOORS

.1 Install doors to swing shut with minimum clearances of 1.6 mm at heads, 2 mm at jambs and 6 mm over finished floor surfaces. Check with door schedule for conditions requiring greater clearance from floor for air movement.

.2 Install doors to swing freely but not loosely on their hinges, to close tightly and evenly on their frames without binding or rattling in the latched position.

.3 Do not install warped, twisted or other defective doors.

.4 Field trimming or cutting of wood doors is not permitted. All cutouts for mortise hardware, grilles and glass, and all bevelling and prefitting shall have been done in the door manufacturer's plant.

.5 Secure plastic laminate transoms with concealed pins at head and clips at bottom corners.

3.3 FINISH HARDWARE

.1 Install building finish hardware in accordance with finish hardware schedule appended to Section 087100. Carefully examine Section 08700 for installation requirements.

.2 Consider hardware manufacturers recommended mounting heights as a general guide unless conditions such as intermediate rails, line of glass light, etc. dictate otherwise. Installer must carefully check manufacturers' installation instructions packed with hardware Products. In particular, the installation heights when using mullions and/or vertical rod devices may be predetermined by certain manufacturers.

.3 Hardware Location:

.1 Hardware location dimension shall be as follows; measured from finish floor to centre line of hardware unless indicated otherwise:

a. Locksets/latchsets centre line of strike: 1034 mm

b. Deadlocks/mortise night latch: 1524 mm

c. Exit devices (centre line of strike): 1000 mm

d. Push plates: 1000 mm

e. Door pulls: 1000 mm

.2 Hardware locations are to pre-determined standard industry recommendations. On custom doors, mount hardware across intermediate rail to meet architectural design considerations.

.4 Protect installed hardware from damage.

.5 Install kickplates on four sides with continuous pressure-sensitive two-sided adhesive tape supplied with hardware.

.6 Thresholds: Site measure openings before cutting. Set thresholds on two continuous beads of sealant conforming to Section 07900.

.7 Door closers and holders: Install door closers in such a manner that door opening is unaffected, and that maximum swing is permitted. Prior to installing closer to the door, it is the responsibility of the installer to:

.1 Index the arm attachment to properly position the arm to the closer.

.2 Adjust the back check positioning valve in order to maintain an effective backcheck range.

.8 Weatherstripping of Doors

.1 Install weatherstripping effectively to tightly seal entire perimeter of doors. Secure in place with non-ferrous "Tec" screws, in accurate alignment.

.2 Maintain integrity of weatherseal at head of doors fitted with closers. Adapt weatherstripping as required to achieve specified performance and provide any necessary accessories.

3.4 ELECTRIFIED HARDWARE

.1 Install electrified hardware and associated devices in accordance with manufacturers recommendations.

.2 Provide interconnecting wiring to power operators and controls back to panel in door framing for power connection by electrical division.

.3 All wiring will be supplied and installed by electrical division including conduit, boxes and other electrical appurtenances, including connections and terminations.

.4 Be responsible for ensuring that all wiring work is done in accordance with the Suppliers wiring diagrams and directions.

.5 Arrange for testing and commissioning of system by the distributor of the system.

3.5 INSPECTION

.1 Coordinate with finish hardware Supplier who provides inspection service during hardware installation and upon completion.

.2 Adjust or rectify finish hardware items found to be improperly installed. Remove defective materials and replace with new materials supplied by the finish hardware Supplier at no cost to the Owner.

3.6 CLEANING

.1 Wipe clean doors and frames of dust created from the door and hardware installation process.

.2 Clean and polish all items of hardware and leave free from disfigurement.

END OF SECTION

TORONTO

SECTION 08700

FINISH HARDWARE

TABLE OF CONTENTS

PART 1 GENERAL

1.1 REQUIREMENTS OF REGULATORY AGENCIES

.1 Use ULC listed and/or Warnock Hersey International labelled hardware for doors in fire separations and exit doors.

1.2 QUALITY ASSURANCE

.1 Standards: Comply with standards specified in this section.

.2 Qualifications of manufacturers: Products supplied under this section shall be from manufacturers regularly engaged in manufacture of similar items and with history of successful production acceptable to the Engineer.

1.3 SUBMITTALS

.1 Submit the following as Shop Drawings in accordance with Section 01330:

.1 Three copies of a detailed finish hardware list reviewed by a qualified AHC member of American Society of Hardware Consultants. List all items proposed to be furnished and delivered under this section.

.2 Manufacturer's specifications, catalogue cuts and other data required to demonstrate compliance with specified requirements.

.2 Identify each hardware item by manufacturer, manufacturer's catalogue number, material, function, finish and location of item in Work.

.3 Review of hardware list by Engineer shall not relieve Contractor from responsibility for furnishing all required finish hardware.

1.4 SAMPLES

.1 Deliver physical samples of approved finish hardware items to Engineer within fifteen Calendar Days.

.2 Identify each sample by label indicating applicable Specification paragraph or line number, brand name and number, finish and hardware package number.

.3 Substitute new samples for those rejected by Engineer.

.4 Engineer will retain samples until completion of Project, at which time, samples will be returned to Supplier.

.5 Do not deliver any hardware to Site until all samples have been approved.

1.5 PRODUCT HANDLING

.1 Packaging and marking: Individually package each unit of finish hardware, complete with proper fastenings and appurtenances, clearly marked on outside to indicate contents and specific locations in the Work.

.2 Replacements: In the event of damage, immediately make all repairs and replacements necessary to approval of Engineer and at no additional cost to Owner.

1.6 MAINTENANCE

.1 Maintenance data: Submit maintenance data, parts list and manufacturer's instructions for each type of door closer, lockset, latchset, door holders and fire exit hardware for incorporation into maintenance manual specified in Section 01330.

.2 Brief maintenance staff regarding proper care, cleaning and general maintenance.

.3 Supply four sets of wrenches for door closers, locksets and fire exit hardware.

1.7 DELIVERY AND STORAGE

.1 Store finish hardware in locked, clean and dry area on site.

.2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.3 Maintain inventory list with hardware schedule.

1.8 HARDWARE LIST

.1 The Supplier shall thoroughly check the hardware list forming part of this section and shall bring to the attention of the Engineer any errors or omissions therein.

.2 Confirm degrees of swing for door holders and closers.

1.9 DOOR SCHEDULES

.1 The Supplier shall thoroughly check the door schedules and Working Drawings to ensure that hardware listed can be used as specified in accordance with building codes and function. Bring to attention of the Consultant any errors or omissions therein.

.2 Doors shown on Drawings and omitted from the schedules shall be included on the detailed finish hardware list.

1.10 WARRANTY

.1 Warrant all exit devices for three years and door closers for ten years.

PART 2 PRODUCTS

.1 Manufacturers: Products listed in the hardware schedule are from the first manufacturers listed below.

.1	Hinges:	Hager Hinge Canada
.2	Door closers:	LCN
.3	Cylinders:	Schlage

.4	Locksets/latchsets/deadlocks:	Schlage
.5	Exit devices:	Von Duprin
.6	Overhead door stops/stays:	Glynn-Johnson
.7	Flatware:	Gallery Specialty Hardware
.8	Weatherstrip/threshold:	Aluminum Door Supplier

.2 Fasteners: Furnish all finish hardware with all screws, bolts and other fasteners of suitable size and type necessary to anchor hardware in position for trouble-free service under heavy duty usage.

.1 Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors acceptable to Engineer, depending on material to which hardware is to be applied and recommendations of hardware manufacturer.

.2 Fastenings shall harmonize with hardware as to material and finish.

.3 Exposed screws for installing hardware shall have Phillips or Robertson heads.

.4 Finishes: Hardware shall match finish of locksets. Take special care to coordinate all various manufactured items furnished under this section, to ensure an acceptable uniform finish.

2.2 MATERIALS

.1 Full Mortise Hinges

.1 Non-removable pins at outswinging exterior doors.

.2 Ball bearing type "BB".

.2 Exit Devices/Mullions

.1 Exterior doors equipped with exit devices must have security deadlatching and cylindrical dogging.

.2 All doors equipped with exit devices to have lever trim to match lock/latchsets.

.3 Locksets/Latchsets/Strikes

.1 All mortise sets to come complete with three point anti-friction latchbolt, thru-bolted trim.

.2 All mortise levers to be solid stainless steel or forged brass as specified.

.4 Door Closers

.1 Use full through bolt fastening, "CTB". With "Top Jamb" application, supply arm through bolt fastening.

.2 Spring power is to be of proper size to operate door efficiently. All door closers to be supplied as multi-sized. For exterior doors, supply closers multi-sized but pre-adjusted to size 4 for "Top Jamb" application, or size 5 for "Parallel Arm" application. For interior doors, supply closers multi-sized but pre-adjusted to size 3 for "Regular Mount" or "Top Jamb" application or size 4 for "Parallel Arm" application. It is the responsibility of the contractor to make final adjustment on the door closers. This final adjustment is to include closing speed, latching speed and backcheck.

.3 All door closers are to be supplied with full cover and are to be of a complementary design from one model type to the next. Door closers are to be of the same manufacturer throughout the Project.

.4 Finish door closers supplied for all exterior door locations and for wet or damp interior door locations are to be with special rust inhibitor paint protection, "SRI".

.5 Where specified for labelled wood fire doors, supply through bolts "CTB" for installing closers.

.6 Supply screws for door closer arms/brackets of sufficient length to penetrate jamb head seals and still provide adequate securement to the frame surface.

.7 Protect all door closers, except those having a built-in stop system such as "DS (Door Saver) or "CUSH" (Cushion Stop) models, with an auxiliary door stop. Such auxiliary stops shall be as specified, and may include either overhead, floor or wall mounted types.

.5 Kickplates/Armour Plates

.1 1.2 mm minimum thickness stainless steel, Type 304, #4 finish, rounded corners, free of rough or sharp edges; drill for countersunk fixing with stainless steel flat head screws flush with finished surface. Supply with 3M tape only where specified.

.2 Where door pulls are scheduled on one side of door and push plates on other side issue installation instructions so that the pull is secured through door from reverse side and countersunk flush with door prior to installation of push plate.

.6 Wall Stops

.1 Furnish wall stops of height to engage doors.

.2 Where wall stops cannot be used, use overhead door stops and/or floor stops as specified. Adjust to proper degree of stop.

2.3 KEYING

.1 All locksets, panic hardware and key switches will be supplied complete with Medeco high security, removable core cylinders, master keyed to a grand master key system. Supply cylinders less cores. Supply temporary cores for use during the construction period which shall be master keyed and keyed differently.

.2 Supply the following:

.1 Three keys for each permanent cylinder core

.2 Two keys for each construction (temporary core)

.3 Three construction master keys

2.4 FINISHES-DESCRITPION

.1	600	Primed for paint
.2	605	Polished Brass
.3	606	Satin Brass
.4	612	Satin Bronze
.5	613	Oil Rubbed Bronze
.6	618	Polished Nickel (on brass or bronze base metal)
.7	619	Satin Nickel (on brass or bronze base metal)
.8	622	Flat Black (on brass or bronze base metal))
.9	625	Polished Chrome (on brass or bronze base metal)
.10	626	Satin Chrome (on brass or bronze base metal)
.11	628	Satin Aluminum (anodized)
.12	628/B	Extruded Satin Aluminum/Brush
.13	628/P	Extruded Satin Aluminum/Pile
.14	629	Polished Stainless Steel
.15	630	Satin Stainless Steel
.16	631	Flat Black Steel
.17	632	Polished Brass Steel
.18	633	Satin Brass Steel
.19	640	Oil Rubbed Bronze Steel
.20	645	Polished Nickel Steel
.21	646	Satin Nickel Steel

.22	651	Polished Chrome Steel
.23	652	Satin Chrome (on steel base metal)
.24	671	Flat Black Aluminum
.25	689	Satin Aluminum Paint
.26	693	Flat Black (painted/powder coat)
.27	695	Oil Rubbed Bronze (painted/powder coat)
.28	702	Satin Chrome Aluminum
.29	703	Oil Rubbed Bronze Aluminum
.30	ALUM	Extruded Aluminum Mill Finish (thresholds)

PART 3 EXECUTION

3.1 DELIVERY

.1 Stockpile all items sufficiently in advance to ensure their delivery to the site in a timely manner to ensure orderly progress of Work.

3.2 INSTALLATION INSTRUCTIONS

.1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their Work to receive hardware.

.2 Furnish manufacturer's instructions for proper installation of each hardware component.

.3 Fully adjust all non-sized or universal door closers in strict accordance with the manufacturer's printed instructions for spring power closing speed, latching speed and backcheck at the time of installation.

3.3 EXAMINATION

.1 Confirm kickplate and threshold sizes before ordering.

.2 Do not use wall stops on drywall, demountable or moveable partitions.

3.4 KEY SECURITY

.1 Deliver to, and install all cylinders at the jobsite.

.2 Key all doors to receive locks according to an approved key schedule.

3.5 INSTALLATION

.1 Hardware installation is specified in Section 08100 – Metal Doors and Frames

3.6 ADJUSTMENT

.1 Coordinate with hardware installer and adjust all items of hardware to operate smoothly. If a manufacturer's representative has done this Work, forward written confirmation of same.

.2 Prepare or replace any hardware found defective.

3.7 HARDWARE SCHEDULE

.1 As per list following this section.

.1 D1 – Insulated H.M. Door and Frame (Double Door from generator Room) – LHRA/RHRA 2x915x2150x45 – 3/4h

a.	Hinges – Hager BB1168 – 4 ½" x 4" NRP	630
b.	Exit Device – Von Duprin CD-9847NL-OP-LBR x 992L-NL-MD x 4'0 x RHR 626	
c.	Exit Device – Von Duprin CD-9847EO-LBR x 4'0 x LHR	626
d.	Mortise Cylinder – Schlage 80-110	626
e.	Closer – LCN 4111-RH (LCN / ST 2779)	689
f.	Overhead Stop – Glyn Johnson 1055	630
g.	Kickplate – Gallery GSH 80A – 203 x 825 (Rounded Corners) – HM Door Screws 630	
h.	Weatherstrip - KN Crowder W-13 – 1 @ 2000 & 2 @ 2150	628
i.	Door Sweep - KN Crowder W-24S x 10000	628
j.	Threshold - KN Crowder CT-10 x 2000	628
k.	Astragal - KN Crowder W-25 x 2135	628

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TORONTO

SECTION 08700

FINISH HARDWARE

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.1 Packaging and marking: Individually package each unit of finish hardware, complete with proper fastenings and appurtenances, clearly marked on outside to indicate contents and specific locations in the Work.

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.1 Maintenance data: Submit maintenance data, parts list and manufacturer's instructions for each type of door closer, lockset, latchset, door holders and fire exit hardware for incorporation into maintenance manual specified in Section 01330.

.2 Brief maintenance staff regarding proper care, cleaning and general maintenance.

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.1 Warrant all exit devices for three years and door closers for ten years.

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.1 Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors acceptable to Engineer, depending on material to which hardware is to be applied and recommendations of hardware manufacturer.

.2 Fastenings shall harmonize with hardware as to material and finish.

.3 Exposed screws for installing hardware shall have Phillips or Robertson heads.

.4 Finishes: Hardware shall match finish of locksets. Take special care to coordinate all various manufactured items furnished under this section, to ensure an acceptable uniform finish.

2.2 MATERIALS

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.1 Non-removable pins at outswinging exterior doors.

.2 Ball bearing type "BB".

.2 Exit Devices/Mullions

.1 Exterior doors equipped with exit devices must have security deadlatching and cylindrical dogging.

.2 All doors equipped with exit devices to have lever trim to match lock/latchsets.

.3 Locksets/Latchsets/Strikes

.1 All mortise sets to come complete with three point anti-friction latchbolt, thru-bolted trim.

.2 All mortise levers to be solid stainless steel or forged brass as specified.

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.1 Use full through bolt fastening, "CTB". With "Top Jamb" application, supply arm through bolt fastening.

.2 Spring power is to be of proper size to operate door efficiently. All door closers to be supplied as multi-sized. For exterior doors, supply closers multi-sized but pre-adjusted to size 4 for "Top Jamb" application, or size 5 for "Parallel Arm" application. For interior doors, supply closers multi-sized but pre-adjusted to size 3 for "Regular Mount" or "Top Jamb" application or size 4 for "Parallel Arm" application. It is the responsibility of the contractor to make final adjustment on the door closers. This final adjustment is to include closing speed, latching speed and backcheck.

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.4 Finish door closers supplied for all exterior door locations and for wet or damp interior door locations are to be with special rust inhibitor paint protection, "SRI".

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.6 Supply screws for door closer arms/brackets of sufficient length to penetrate jamb head seals and still provide adequate securement to the frame surface.

.7 Protect all door closers, except those having a built-in stop system such as "DS (Door Saver) or "CUSH" (Cushion Stop) models, with an auxiliary door stop. Such auxiliary stops shall be as specified, and may include either overhead, floor or wall mounted types.

.5 Kickplates/Armour Plates

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.2 Supply the following:

.1 Three keys for each permanent cylinder core

.2 Two keys for each construction (temporary core)

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PART 3 EXECUTION

3.1 DELIVERY

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3.2 INSTALLATION INSTRUCTIONS

.1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their Work to receive hardware.

.2 Furnish manufacturer's instructions for proper installation of each hardware component.

.3 Fully adjust all non-sized or universal door closers in strict accordance with the manufacturer's printed instructions for spring power closing speed, latching speed and backcheck at the time of installation.

3.3 EXAMINATION

.1 Confirm kickplate and threshold sizes before ordering.

.2 Do not use wall stops on drywall, demountable or moveable partitions.

3.4 KEY SECURITY

.1 Deliver to, and install all cylinders at the jobsite.

.2 Key all doors to receive locks according to an approved key schedule.

3.5 INSTALLATION

.1 Hardware installation is specified in Section 08100 – Metal Doors and Frames

3.6 ADJUSTMENT

.1 Coordinate with hardware installer and adjust all items of hardware to operate smoothly. If a manufacturer's representative has done this Work, forward written confirmation of same.

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END OF SECTION

DIVISION 9

FINISHES

TORONTO

SECTION 09600

EPOXY FLOOR COATING

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PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 QUALITY ASSURANCE

.1 Subcontractor qualifications: Performed by the material manufacturer or its trained licensed applicator. Applicator to have minimum five years of acceptable continuous experience in application of flooring systems similar in size and scope. Submit proof of compliance to this requirement to the Engineer.

.2 Furnish flooring system from a single manufacturing source.

.3 Preinstallation Meeting

.1 Before commencing the Work of this section arrange a Site meeting to be attended by representatives of the Contractor/applicator/manufacturer, the Engineer, and the Owner's Representative. Discuss design details, surface conditions, application procedures, and suitability of flooring systems for use intended and alternative recommendations.

.2 Prior to the start of the Work, submit letter from flooring manufacturer confirming qualifications of applicator and identifying flooring system to be applied for the Work of this section.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01330.

.2 Shop Drawings: Submit manufacturer's Product data confirming compliance with requirements specified herein. Submit in addition, proof of Subcontractor's qualifications specified. Submit adhesive Product data confirming specified requirement.

.3 Submit on 300 x 300 mm rigid substrate, two samples of floor coating.

.4 Identify samples with Project name, coating type, date of submission, colour, finish surface, manufacturer's name and Subcontractor's name.

1.4 DELIVERY, STORAGE AND PROTECTION

.1 Deliver materials to Site in manufacturer's sealed, labelled containers in sequence to meet building schedule. Carefully unload material and deliver clean and undamaged.

.2 Remove defective or damaged materials from the Site and replace at no additional cost to Owner.

.3 Avoid damage to this Work by other trades during application and curing period, as Work proceeds, and on completion of each area, install barricades and provide signage at all entrances. Barricades shall remain in place during the curing process.

.4 Store containers of coating components and other volatile materials in well ventilated places where they will not be exposed to excessive heat or direct sun rays. Keep tightly closed when not in actual use. Remove used cloths from building at the end of every working shift and when not in use, take precautions against spontaneous combustion by drenching with water or placing in air-tight covered metal containers in a cool place.

.5 Be responsible for prevention of fire or explosion caused by improper storage of materials, rags, emptied containers, etc. during course of Work. Vapours may be heavier than air and travel along floor and be ignited at locations distant from handling site and flash back. Post "No Smoking" signs in areas of storage and mixing and strictly enforce this requirement. Provide and maintain CO_2 or appropriate fire extinguishers of minimum 9 kg capacity. Repair damage to storage area or surrounding area at no cost to Owner.

.6 Place covers over adjacent Work before surface preparation and coating commence and keep in place until Work is complete.

.7 If required provide continuous ventilation and exhausting to exterior to convey fumes and vapours from Work area during coating application.

.8 Read and be familiar with manufacturer’s literature and comply with precautions, handling procedures and equipment requirements.

.9 Use protective clothing and equipment as necessary to protect applicators during preparation and application.

.10 Remove and dispose of waste material in accordance with federal, provincial and local safety codes.

1.5 QUALIFICATION OF APPLICATOR

.1 Retain a Subcontractor trained, licensed and approved by the material manufacturer, or by tradesmen in direct employ of material manufacturer.

1.6 WARRANTY

.1 Warrant Work of this section against defects and deficiencies for a period of five years from date Work is certified as substantially performed in accordance with the general conditions of the Contract.

.2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Engineer and at no expense to the Owner.

.3 Defects shall include but not limited to flooring showing loss of bond, cracking deterioration or wear.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Slab-on-grade system: high solids, low-voc, flexible and crack-bridging seamless waterproof epoxy membrane/coating. Top coat shall be two-component, high solids, silicone free, glossy epoxy resin coating for light to medium duty traffic.

.1 Sika Canada “Sikafloor 265” with “Sikafloor 261 – System 1” top coat, 20-30 mils thick.

.2 Or accepted equal from Stonhard or Euclid Chemical

.2 Suspended slab system: two-component, fast curing, solvent free, elastomeric and crack bridging, polyurethane waterproofing membrane.

.1 Sika Canada “Sikalastic Duochem 390” membrane, 25-30 mils thick with “Sikafloor 261 – System 1” top coat, 20-30 mils thick.

.2 Or accepted equal from Stonhard or Euclid Chemical

.3 Non slip surfacing: Use 100% aluminum oxide particles utilizing #32 mesh or natural silica aggregate. Texture: #32 mesh coarse grain particles by Sika or #2 by Stonhard or medium texture.

.4 Thinners and cleaners: As recommended by floor coating manufacturer.

.5 Primer: If part of system, use material compatible with floor coating, as recommended by floor coating manufacturer.

.6 Sawcut/expansion joint filler: As recommended by floor coating manufacturer, colour to match epoxy coating. Location of backer rod and depth of joint filler to be installed as per manufacturer's recommendation. Minimum depth of load bearing joint filler to be 25 mm.

.7 Colour: As selected by Engineer from the manufacturer's standard colour range.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Confirm presence of vapour retarder under the floor slab.

.2 Examine existing environmental and Project conditions under which flooring Work is to be applied. Report to Engineer in writing, any discrepancies or defects which will affect proper completion of Work. Commencement of Work implies acceptance of existing conditions.

.3 Quality of concrete: Not less than twenty-eight days old structurally sound, steel trowel finish, clean, dry and free of all contaminants.

3.2 SURFACE PREPARATION

.1 Mask all adjacent surfaces which could become marred or otherwise damaged.

.2 Lightly blast clean concrete floor to a depth of maximum 0.31 mm to receive epoxy coating, to provide a sound, roughened, irregular surface, with weak concrete removed and surface holes, and voids exposed. Ensure finished surface is hard and sound with the texture of medium to coarse sandpaper with some surface aggregate exposed.

.3 Equip dry blasting equipment with a self contained vacuum to eliminate airborne dusting. Use portable blast cleaning equipment, i.e. "Blastrac" wheelabrator system.

.4 Complete removal of dust and debris as soon as blast cleaning is completed by vacuum cleaning and magnetically brooming.

.5 Concrete repairs: Repair deficiencies that have shown up in concrete surfaces after surface preparation has been completed. Remove any protruding steel reinforcing fibres which may interfere with or show through finished epoxy coating.

.6 Patching: Patch cracks, holes, joints and rough areas epoxy patching materials. Patching material shall consist of 100% solids epoxy mixed with patching materials to a paste consistency. Place patching materials as required using hand trowels or putty knives as recommended by manufacturer.

3.3 INSPECTION OF SUBSTRATE

.1 Have the technical representative of the coating material manufacturer inspect the prepared substrate. Prior to coating installation, obtain a written confirmation from the coating material manufacturer that the prepared floor substrate is suitable to receive the coating material.

3.4 MIXING

.1 Mix and prepare materials in compliance with manufacturer's standards for the particular material to be applied.

.2 Clean containers used for storage, mixing and application of materials free of foreign materials and residue.

3.5 APPLICATION

.1 Provide a uniform temperature of not less than 16°C (61°F) ambient during installation and for 48 hours following completion of the Work.

.2 Apply flooring to the minimum thickness of two coats at 203 microns (8 mils) dft per coat. Apply to a tightly compacted condition, and free from surface holes, depressions and ridges.

.3 Install base 200 mm in height.

3.6 SURFACE PROTECTION

.1 Protect Work of other trades in progress or completed against contamination and make good at own expense any such damage. Provide adequate covering by drop cloths, masking or tarpaulins to adjacent surfaces which are to be left as is or which are to receive a different floor treatment.

3.7 FIELD QUALITY CONTROL

.1 Periodic review by flooring manufacturer's representative to be performed at each critical stage of application, such as; start of surface preparation, completion of surface preparation, priming substrate, and mixing and application of flooring system. Submit certified/signed field reports by flooring manufacturer's representative. Final report to indicate application is in accordance with flooring manufacturer's recommendations and instructions.

3.8 CLEANING UP

.1 Remove masking and other protection provided under this section.

.2 Flooring Work will not be considered complete until all spatters, drippings and smears have been cleaned and removed or made good to the satisfaction of the Engineer.

END OF SECTION

TORONTO

SECTION 09900

PAINTING

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PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

.2 Work of this section includes but is not necessarily limited to, the following:

.1 Interior Painting

a. Exposed building surfaces as indicated on Room Finish Schedule(s)

b. Hollow metal doors, frames and transom panels

c. Fire doors and frames

d. Exposed steel items for the work of all trades

e. Pipe bumpers

f. Access panels and doors

g. Screens

h. Steel supports for wood benches

i. Wood fitments unless plastic laminated as noted

j. Natural gas piping

k. Finish painting of prime painted diffusers, registers and grilles

l. Conduit, piping, ductwork, lighting panels, etc. exposed to view in areas listed on the Room Finish Schedule

.3 The following surfaces are not to be painted:

.1 Exterior concrete surfaces

.2 Surfaces scheduled as having “No Finish” in room finish schedules

.3 Exposed concrete floors

.4 Stainless steel piping

1.2 REFERENCES

.1 Department of Justice Canada

.1 Canadian Environmental Protection Act (CEPA).

.2 Environmental Protection Agency (EPA)

.1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24, (for Surface Coatings).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Master Painters Institute (MPI)

.1 MPI Architectural Painting Specifications Manual.

.5 National Fire Code of Canada

.6 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

.7 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act (TDGA).

1.3 QUALITY ASSURANCE

.1 Qualifications

.1 Contractor: Minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Journeymen: Qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.

.3 Apprentices: Working under direct supervision of qualified tradesperson in accordance with trade regulations.

.2 Conform to the standards contained in the Master Painters Institute Architectural Painting Specification Manual, latest edition (hereafter referred to a MPI Painting Specification) for all painting procedures including preparation and application of materials. MPI Painting Specification Manual as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

.3 All paint manufacturers and Products used shall be as listed under the “Approved Products” section of the MPI Architectural Painting Specification Manual.

1.4 SUBMITTALS

.1 Product Data

.1 Submit Product data and instructions for each paint and coating Product to be used.

.2 Submit Product data for the use and application of paint thinner.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS). Indicate VOCs during application and curing.

.2 Samples

.1 Submit full range colour sample chips to indicate where colour availability is restricted.

.2 Submit duplicate 200 x 300 mmsample panels of each paint and stain with clear coating with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:

a. 3 mm plate steel for finishes over metal surfaces.

b. 13 mm maple plywood for finishes over wood surfaces.

c. 50 mm concrete block for finishes over concrete or concrete masonry surfaces.

d. 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions

a. Submit manufacturer's installation and application instructions.

.6 Closeout submittals: Submit maintenance data for incorporation into maintenance manual. Include following:

a. Product name, type and use.

b. Itemized list complete with manufacturer, Product number, paint type and colour coding for all colours used for Owner’s later use in maintenance.

c. MPI Environmentally Friendly classification system rating.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading

.1 Pack, ship, handle and unload materials to jobsite with containers and labels intact.

.2 Acceptance at Site

.1 Identify Products and materials with labels indicating:

a. Manufacturer's name and address.

b. Type of paint or coating.

c. Compliance with applicable standard.

d. Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Storage and Protection

.1 Provide and maintain dry, temperature controlled, secure storage.

.2 Store materials and supplies away from heat generating devices.

.3 Store materials and equipment in well ventilated area with temperature range 7°C to 30°C (45°C to 86°F).

.5 Store temperature sensitive Products above minimum temperature as recommended by manufacturer.

.6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

.7 Remove paint materials from storage only in quantities required for same day use.

.8 Fire Safety Requirements

.1 Provide one 9 kg fire extinguisher adjacent to storage area.

.2 Store oily rags, waste Products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.9 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers; steel, metal and plastic waste in accordance with WMP.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, regional and municipal regulations.

.7 Ensure emptied containers are sealed and stored safely.

.8 Unused paint and coating materials must be disposed of at legal hazardous material collections site.

.9 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous Products and are subject to regulations for disposal. Information on these controls can be obtained from provincial Ministries of Environment and regional levels of government.

.10 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.11 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.12 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

a. Retain cleaning water for water-based materials to allow sediments to be filtered out.

b. Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

c. Return solvent and oil-soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

d. Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

e. Empty paint cans are to be dry prior to disposal or recycling (where available).

.13 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

1.6 SITE CONDITIONS

.1 Heating, Ventilation and Lighting

.1 Provide heating facilities to maintain ambient air and substrate temperatures above 10°C (50°F) for twenty-four hours before, during and after paint application until paint has cured sufficiently.

.2 Provide continuous ventilation for seven days after completion of application of paint.

.3 Coordinate use of existing ventilation system with Engineer and ensure its operation during and after application of paint as required.

.4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.5 Provide minimum lighting level of 323 lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels

.1 Unless pre-approved written approval by Product manufacturer, do not perform painting when:

a. Ambient air and substrate temperatures are below 10°C (50°F).

b. Substrate temperature is above 32°C (90°F) unless paint is specifically formulated for application at high temperatures.

c. Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.

d. The relative humidity is under 85% or when the dew point is more than 3°C (38°F) variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3°C (38°F) below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint Work.

e. Rain or snow is forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

f. Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand “normal” adverse environmental factors.

.2 Perform painting Work when maximum moisture content of the substrate is below:

a. Allow new concrete and masonry to cure minimum of twenty-eight days.

b. 15% for wood.

c. 12% for gypsum board.

.3 Test for moisture using calibrated electronic moisture meter. Test concrete floors for moisture using "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

.3 Apply paint when previous coat of paint is dry or adequately cured.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Paint materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.): As listed in the MPI Approved Products List (APL) are acceptable for use on this Project.

.1 Painting shall be premium grade.

.2 Provide paint materials for paint systems from one manufacturer.

.2 Only qualified Products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this Project.

.3 Conform to latest MPI requirements for exterior and interior painting Work including preparation and priming.

.4 Shellac and turpentine: Highest quality Product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.

.5 Provide paint Products meeting MPI "Environmentally Friendly" ratings based on VOC (EPA Method 24) content levels.

.6 Use MPI listed materials having minimum E2 or E3 rating where indoor air quality (odour) requirements exist.

.7 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:

.1 Water-based for concrete, concrete block and gypsum board

.2 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.

.3 Manufactured without compounds which contribute to smog in the lower atmosphere.

.8 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

.9 All materials and paints shall be lead and mercury free and shall have low VOC content where possible.

.10 All paint materials shall have good flowing and brushing properties and shall dry or cure free of blemishes or sags.

.11 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by local code requirements and/or authorities having jurisdiction.

2.2 COLOURS

.1 General: Colours for some elements to be painted are based on certain Product brands as indicated on the Drawings. Other Products may be used on the condition that colours selected by the Engineer must be matched at no extra cost even if it requires custom matching.

2.3 PAINT MIXES

.1 Perform colour tinting operations prior to delivery of paint to site.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.4 Thin paint for spraying in accordance with paint manufacturer's instructions.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Maximum 5	Maximum 10
Gloss Level 2 - Velvet-Like Finish	Maximum10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

2.5 EXTERIOR PAINTING SYSTEMS

.1 Concrete, Concrete Block

.1 EXT 3.1A - Latex gloss finish

.2 Structural Steel and Metal Fabrications: Exposed steel, pipe bollards

.1 EXT 5.1D - Alkyd semi-gloss finish.

.3 Galvanized metal (not chrome passivated): Exterior miscellaneous metal, hollow metal doors and pressed steel frames, rooftop ducts, vents, and piping, as indicated and as specified.

.1 EXT. 5.3B - Alkyd semi-gloss finish

.2 For hot-dip galvanized surfaces, apply polyamine epoxy tie-coat in lieu of cementitious primer and apply alkyd topcoat.

.4 Natural Gas Piping

.1 Paint surface of exterior natural gas piping

.2 EXT 5.1D - Alkyd, semi-gloss finish, yellow colour

2.6 INTERIOR PAINTING SYSTEMS

.1 Concrete Vertical Surfaces

.1 INT 3.1C - Latex, semi-gloss finish.

.2 Concrete masonry units: Concrete block:

.1 INT 4.2D - High performance architectural latex, semi-gloss finish.

.3 Structural steel and metal fabrications: Exposed structural and miscellaneous metals

.1 INT 5.1C-DD - dry fall, water based acrylic, semi-gloss finish.

.4 Galvanized metal (not chrome passivated): Doors, frames, ferrous metal pickets/railings, miscellaneous steel, pipes, exposed decking underside, and ducts

.1 INT 5.3K - water based acrylic, semi-gloss finish (over water based primer).

.2 For hot-dip galvanized surfaces, apply polyamine epoxy tie-coat in lieu of cementitious primer and apply alkyd topcoat.

.5 Galvanized metal (not chrome passivated): Exposed decking underside, and ducts

.1 INT 5.3H- dry fall, water based acrylic, flat finish.

.6 Gypsum board: Gypsum wallboard:

.1 INT 9.2B - High performance architectural latex, flat for ceilings; semi-gloss for walls.

.7 Interior of all Pipe Spaces and Ducts Visible Through Grilles, and all Surfaces Visible Through Louvres Occurring in Ceilings

.1 INT 10.1A - Latex, flat finish, black colour unless indicated otherwise.

Note: Prepare surfaces as required by applying proper primers on the surface to which paint is applied. For surfaces above ceilings, paint surfaces after all services have been installed and prior to ceiling installation.

.8 Piping and Conduit (except gas piping)

.1 INT 5.1C-G5 - dry fall, water based acrylic, semi-gloss finish.

.9 Natural Gas Piping

.1 INT 5.1C-G5 - INT 5.1C-G5 - dry fall, water based acrylic, semi-gloss finish, yellow colour

.10 Fire Protection Piping

.1 INT 5.1C-G5 - dry fall, water based acrylic, semi-gloss finish, red colour.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

.1 Examine substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer damages, defects, and unsatisfactory or unfavourable conditions before proceeding with Work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with Work until conditions fall within acceptable range as recommended by manufacturer.

.3 Surface Preparation

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Engineer.

.4 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual regarding specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air, as appropriate for the given condition.

.2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.6 Use trigger operated spray nozzles for water hoses.

.7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

.5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

.2 Apply wood filler to nail holes and cracks.

.3 Tint filler to match stains for stained woodwork.

.7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1 m.

.8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast Products from surfaces, pockets and corners to be painted by brushing with clean brushes or other suitable means.

.9 Touch up of shop primers with primer as specified.

3.4 APPLICATION

.1 Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application

.1 Apply paint in uniform layer using brush and/or roller type suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray Application

.1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.

.4 Brush out immediately all runs and sags.

.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

.5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish closets and alcoves as specified for adjoining rooms.

.9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.5 MECHANICAL/ELECTRICAL EQUIPMENT

.1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.

.2 Other unfinished areas: Leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.3 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.4 Do not paint over nameplates.

.5 Keep sprinkler heads free of paint.

.6 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.7 Paint fire protection piping red.

.8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.9 Paint natural gas piping yellow.

.10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.11 Do not paint interior transformers and substation equipment.

3.6 SITE TOLERANCES

.1 Walls: No defects visible from a distance of 1 m at ninety degrees to surface.

.2 Ceilings: No defects visible from floor at forty-five degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.7 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Engineer. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Engineer.

.6 Painted surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the painting inspection agency inspector.

.1 Runs, sags, hiding or shadowing by inefficient application methods.

.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.

.3 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.4 Damage due to application on moist surfaces or caused by inadequate protection from the weather.

.5 Damage and/or contamination of paint due to wind-blown contaminants (dust, sand blast materials, salt spray, etc.).

.7 Painted surfaces rejected by the inspector shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

END OF SECTION

TORONTO

DIVISION 13

INSTRUMENTATION AND CONTROL

TORONTO

SECTION 13010

PROCESS CONTROL – GENERAL

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INTENT

.1 This section contains General and Specific Requirements for process control and instrumentation for R.C. Harris Water Treatment Plant – Standby Generators.

1.2 REFERENCES

.1 Comply with the requirements of Division 1. Be responsible for all the requirements of this Section and of Division 1. No additional cost will be considered for non-coordination between this Section and the other Sections in the Specification.

.2 Refer Division 16 for instructions that apply to the Work of Section 13010.

.3 Refer to the City's Process Control System (PCS) Implementation Guidelines (obtain the most up to date version from the City).

.4 Refer to the City's *PCS Modules User Manual* (Prior to commencing the development of the program, obtain the most up to date version from the City).

.5 Have the material, equipment, installation and workmanship also meet the latest edition and requirements of the following:

.1 Ontario Electrical Safety Code.

.2 Canadian Standards Association (CSA).

.3 Canadian Electrical Manufacturers Association (CEMA).

.4 Institute of Electrical and Electronics Engineers (IEEE).

.5 National Electrical Manufacturers Association (NEMA).

.6 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.7 International Society for Measurement and Control (Formerly the Instrument Society of America, ISA).

.8 Electronic Industries Association/Telecommunications Industries Association (EIA/TIA 606).

.9 National Fire Code, National Fire Protection Association (NFPA): 820, Fire Protection in Wastewater Treatment Plants.

.10 Underwriters Laboratory, (UL): 508, Standards for Safety, Industrial Control Equipment.

.11 Deutsche Industrie – Norm (DIN); VDE0611, Specification for modular terminal block for connection to copper conductors up to 1,000V AC and up to 1,200V DC.

1.3 SCOPE OF WORK

.1 See Specification Section 01110 - Summary of Work for the scope of R.C. Harris Standby Generator under this Contract.

.2 The work in this Section generally consists of the supply of all labour, tools, services, provision of all products required, for a complete, integrated, operational instrumentation and control system for the R.C. Harris Water Treatment Plant – Standby Generator in accordance with the Contract Specifications and Drawings.

.3 In general, the work involves the supply, installation, programming, testing, start-up and commissioning of the necessary instrumentation and controls as indicated in the specifications under Division 13 and Contract drawings. The following is a summary of the major work.

.4 The scope of work related to the standby generator shown in contract drawing series I001 includes:

.1 Mechanical Control Panel (FHA-ELS-CP-0101)

a. Supply and install a new control panel as per Contract Specifications and Drawings. Refer to drawing I005.

b. Connect interlock conditions from the new control panel to the exhaust fan, combustion air supply fan, combustion air supply flow switch, combustion air damper, and air damper switch, as shown on the Contract Drawings.

c. Commission the control panel and integrate it with the new generator control panel, new gas detection controller, and the existing FHA-SPC-RPU-2022 as shown as per the Contract Specifications and Drawings.

d. Coordinate with the generator control panel supplier all wiring interconnections between the two control panels. Perform testing and commissioning for all interconnections in accordance with the City's standards.

.2 Flowmeter Installation and Integration (FHA-ELS-FIT-0101 & FHA-ELS-FIT-0102)

a. Supply and install a new magnetic flowmeter FHA-ELS-FIT-0101 for the cooling water and a new insertion thermal mass flowmeter FHA-ELS-FIT-0102 for the natural gas supply for the generator in the specified location as per Contract Specifications and Drawings.

b. Calibrate and commission the flowmeters and integrate with the existing FHA-SPC-RPU-2022 as shown as per the Contract Specifications and Drawings.

.3 Float Switch Integration (FHA-ELS-LSH-0101)

a. Supply and install a new float switch FHA-ELS-LSH-0101 for monitoring the generator spill containment in the specified location as per Contract Specifications and Drawings.

b. Commission the float switch FHA-ELS-LSH-0101and integrate it into the existing FHA-SPC-RPU-2022 as shown in Contract Specifications and Drawings.

.4 Gas Detector (FHA-ELS-CT-0101 & FHA-ELS-AIT-0101 & FHA-ELS-AIT-0102)

a. Supply, install, configure, and commission the new gas detection system controller FHA-ELS-CT-0101 as shown on the Contract Specifications and Drawings.

b. Supply, install, calibrate, and commission the new gas detectors FHA-ELS-AIT-0101(methane gas) and FHA-ELS-AIT-0102 (CO gas) wired to the new gas detection controller FHA-ELS-CT-0101 as shown on M201B drawing and specified under Division 13.

c. Connect dry contacts for the gas detectors from the new gas detection system controller to the existing FHA-SPC-RPU-2022 as shown in the contract Specifications and Drawings.

d. Supply, install, and commission a new combination horn and beacon powered from the new gas detection controller FHA-ELS-CT-0101 as shown in the Contract Specifications and Drawings.

e. Connect dry contacts from the new gas detection system controller FHA-ELS-CT-0101 to the horn and beacon as shown in the Contract Specifications and Drawings

f. Configure the new gas detection system controller FHA-ELS-CT-0101 to actuate the horn and beacon on the following alarms:

- Methane Hi-Hi alarm
- CO Hi-Hi alarm
- Flame detection alarm

.5 Flame Detector (FHA-FDT-AIT-0101)

a. Supply, install, calibrate, and commission a new flame detector FHA-ELS-FDT-0101 wired to the new gas detection controller FHA-ELS-CT-0101 as shown on M201B drawing and specified under Division 13.

b. Connect dry contacts for the flame detector from the gas detection controller to the existing FHA-SPC-RPU-2022 as shown in the contract Specifications and Drawings.

.6 Ambient Temperature Sensor (FHA-ELS-TIT-0101)

a. Supply and install a new temperature sensor FHA-ELS-TIT-0101 as shown in the Contract Specifications and Drawings. Mount the sensor on the wall at a height of approximately 5ft. inside the generator room.

b. Connect the sensor to the existing FHA-SPC-RPU-2022 as shown in the Contract Specifications and Drawings.

.7 Power Monitor Installation and Testing

a. Supply and install one Eaton PXM1000 power meters inside each of the existing FHA-SPC-RPU-2022 and FHA-SPC-RPU-1223 as shown in the Contract Drawings.

b. Connect new power monitors to the new gateway in the existing FHA-SPC-RPU-2022 and the existing Multinet- FE gateway in the existing FHA-SPC-RPU-1223 as shown on the Contract Drawings.

c. Connect the new power meters into the existing network cabinets as shown on the Contract Drawings.

d. Provide all interconnecting cables for network connections including CAT 6 cable and connectors.

e. Horizontal CAT6 cable segments shall meet the requirements of the TIA-568-C specification for CAT6 cable.

.8 Integration of new Standby Generator and ATS

a. Connect new wiring from the new standby generator FHA-ELS-GEN-0100 and new ATSs FHA-ELS-TS-0400 and FHA-ELS-TS-0300 to the existing FHA-SPC-RPU-2022 and FHA-SPC-RPU-1223 as shown in the Contract Drawings. Refer to E202 and E205 for the location details of FHA-ELS-TS-0400, FHA-ELS-TS-0300, FHA-SPC-RPU-2022 and FHA-SPC-RPU-1223.

.5 The scope of work related to the Filter CV Shutdown System shown in contract drawing series I101 includes:

.1 Existing FLT-CP-0005 and FLT-CP-0006 Control Panels

a. Demolish and remove interior components inside existing control panels FLT-CP-0005 and FLT-CP-0006. Retain existing enclosures and rename/retag them FLT-JB-0005 and FLT-JB-0006, respectively.

b. Install new wiring between existing panels FLT-UPS-0001 and FLT-CP-0005 as shown on the Contract Drawings.

c. Install new wiring between existing panels FLT-UPS-0002 and FLT-CP-0006 as shown on the Contract Drawings.

.2 Filter CV Shutoff Control Panel

a. Supply and install the Filter CV Shutoff Control Panel FLT-CP-0007 supplied under division 13 as shown on the Contract Drawings.

b. Install new conduit and wiring between existing MCC-0400 and the Filter CV Shutoff Control Panel FLT-CP-0007 for the monitoring of: Source A power, Source B power, and Tie Breaker switchover, as shown on the Contract Drawings.

.3 Filter CV Panels

a. Supply and install new Filter CV panels FLT-CP-0005 and FLT-CP-0006 supplied under division 13 as shown on the Contract Drawings.

.6 The scope of work related to all contract drawing series includes:

.1 Field Wiring and Conduit

a. Supply and install all conduit and field wiring for equipment supplied under division 13 as shown on the Contract Drawings.

.2 Tagging of Field Devices.

a. Provide all field device tags listed in The Contract Document And Drawings.

b. Provide required tag spreadsheets for all equipment as per specification Section 13040.

.3 SCADA System:

a. Develop new process graphics, sub-pictures, devices sub-pictures, setpoints, trends, alarm pages, run-hour graphics, HMI database and menus. Comply with the City's SCADA Standards for software development as specified in the City's *Process Control System Implementation Guidelines* using City's standard modules.

.4 Commissioning and Training:

a. Comply with the requirements set out in Division 1.

b. Demonstrate loop checks for the I/O identified by this scope of work. Before requesting witnessed loop checks, carry out Contractor's own field and loop check tests to verify that the equipment operates as intended. Correct any problems or deficiencies prior to requesting witnessed checks.

c. On site loop check must exercise the entire loop, including the field equipment and SCADA screens. Each loop check must be witnessed by, and successfully demonstrated to the Engineer for sign-off approval.

d. Provide Factory Acceptance Test (FAT) to demonstrate the operational functionality of PLCs, SCADA hardware, software and communications.

Notify the Contract Administrator/Engineer ten (10) days in advance of FAT such that this test may be witnessed by the appropriate parties. Submit test report after the test duly signed by the Contract Administrator and contractor. Use only pre-approved test format. Comply with the *Process Control System Implementation Guidelines* for FAT requirements

e. Provide Site Acceptance Test (SAT) to demonstrate the correct operation of control system with both hardware and software in place. Provide site support services upon request by System Integrator during system SAT. Notify the Contract Administrator ten (10) days in advance of SAT such that this test may be witnessed by the appropriate parties. Submit filled in test forms after commissioning. Comply with the *Process Control System Implementation Guidelines* for SAT requirements.

f. Coordinate closely with the Engineer and System Integrator when carrying out all work to demonstrate overall system integrity, allowing sufficient time for the essential portions of SCADA and PLC software to be installed and tested.

g. Maintain record drawings (As-Builts) for all drawings.

h. Provide testing and verification services for all Network equipment as per the City's ITM standards and requirements.

.5 General:

a. Ensure the continuous operation of the existing systems and equipment.

b. At all times, ensure that work being carried out by the Engineer or the City's operational staff is properly coordinated with all ongoing construction activities and are unhampered by unnecessary delays or obstructions.

c. Demonstrate operational systems and put all equipment into operational services to the satisfaction of the Engineer. Satisfactory performance of the system shall be assessed on the basis of the entire control system being fully operational and in use under peak load conditions during the process run. Refer to Division 1 General Requirements for testing, start-up and commissioning requirements.

d. All functionality described in this Section shall be fully implemented.

e. All equipment performance requirements shall be based upon worst case scenarios.

f. Provide documentation in timely manner and as specified.

g. Provide all the necessary power supplies, signal conditioners, terminal blocks, and all other accessories as required to make a complete working system for the various monitoring and control loops. Provide all the necessary relays, signal isolators, to realize the intent of the design.

.7 At any time, ensure other ongoing activities, in close proximity or otherwise, do not disturb or interrupt the operation of the existing systems or the work already commissioned or placed into operation. Should any such activity poses a risk to this work or to the system operation, advise the Engineer and the City immediately.

.8 Contractor and System Integrator shall coordinate with plant operation to develop and submit a **Transition Plan** or **Work Plan** for Plant Operation and PCS Staff to review and approve before starting the work of RPU/SCADA upgrades, in terms of shutdown items, dates, duration, temporary monitoring, and operation methods.

1.4 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Division 1 – General Requirements

.2 Division 15 - Mechanical

.3 Division 16 – Electrical

1.5 SUBMITTALS

.1 Submittal to be in accordance with the Section 01330 – Submittals.

.2 Drawing Index: Prepare a clear, typed index listing the number and title of all proposed Purpose-made drawings and submit for review within fourteen (14) days after award of contract.

.3 Milestone Schedule: Prepare and submit a proposed schedule of instrumentation and control work per General Conditions, indicating the following major milestones as a minimum.

.1 Hardware shop drawings submission – including initial issue of Product Data Sheets.

.2 Preliminary issue of operating and maintenance instruction manual.

.3 Panel inspection and factory acceptance testing (FAT).

.4 Signed calibration sheet or report on each field instrument.

.5 Report on proper site installation, inspection, and loop checks.

.6 Final submission and sign-off of Product Data Sheets.

.7 Site Acceptance Testing (SAT).

.4 Unless otherwise specified or indicated, submit shop drawings, specifications sheets or product data sheets for all instruments, devices, junction and terminal boxes. All dimensions, rating, curves, etc. to be in SI units.

.5 Product Data Sheets:

.1 Product Data Sheets specifying instruments and equipment form part of this document. Complete the blank spaces on these sheets with the information noted below and any other data pertinent to the equipment and the application.

.2 Initial submission for review to accompany Shop Drawings:

a. The product manufacturer and the supplier or representative.

b. The complete model or catalogue number(s) including any special options.

c. The available adjustment range(s) and the project operating range(s).

.3 Second Submission during pre-commissioning, testing and calibration period:

a. Serial numbers, part numbers, dates of installation and calibration.

b. Any special procedures required to duplicate calibration.

c. This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.

.4 Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:

a. All of the above information.

b. Phone and fax numbers of contact person for product support/service.

.5 Where there is any discrepancy, the description provided on the Product Data Sheet takes precedence over the model number given in the data sheet.

.6 Purpose-made Drawings:

.1 Prepare Purpose-made drawings neatly and accurately by means of Micro-Station V8 or as otherwise advised. Do not use external references or customized file extensions. Provide fully portable electronic AutoCAD file copies of all P&IDs, network architecture, RPU, and loop drawings.

.2 No typical drawings are acceptable for “As-Built” drawings.

.3 Make submissions on reproducible material such as Mylar, Vellum or legal-size paper, complete with a title block containing the Engineer’s E.O. number, your project number and company logo, a drawing and project title as stated in the Contract drawings, and a referenced drawing number (related to a file name if applicable). Provide tabular columns to record the original submission date, a revision number, date and reason for subsequent revisions, and signature of authorized issuing staff member.

.4 Submit, as a minimum, the following Purpose-made drawings:

a. Scaled, referenced, front of panel layouts, and general arrangement drawings.

b. Scaled, referenced, internal panel layouts (may be combined with the above).

c. Equipment and/or panel block wiring diagrams showing termination identification at each item of equipment, inter-wiring and cable numbering, all peripheral equipment, any RPU module DIP switch settings, pin assignments for D-shell connectors, plugs and jacks, and instrument/equipment tag numbers.

d. Submit, prior to the installation or fabrication of the instruments and panels, complete loop wiring diagrams showing all the wiring between instruments and devices.

e. Submit, prior to installation, layout drawings of each Control Panel showing construction details, materials and construction, bill of materials, location of instruments and devices, dimensions, etc.

f. Where issued, loop drawings are typical for guidance only. Submit itemized instrument wiring arm drawings for all analog process loops and discrete connections, generally in accordance with ISA S5.4 format and as a minimum incorporating the following details: RTU terminal numbers, Control Cabinet terminal numbers, field terminal numbers, wire numbers, contact orientation, power source identifications and equipment numbers. The “Micro-Station” files for these drawings are to be edited with “Record Drawing” detail and made accessible to the Engineer during the Upgrades.

g. List of expendable materials and quantities.

h. List of Instrument, Equipment and Panel Identification Nameplates.

.7 Vendor Equipment Shop Drawings:

.1 Submit Shop Drawings for all field and panel mounted instruments, controllers, gauges and similar products. Manufacturers’ documentation will be accepted only if the following information is clearly indicated and highlighted for the equipment proposed. Submit the following:

a. An itemized quotation from the proposed instrument or equipment vendor, (prices removed), including tag numbers, quantities, options being provided and a full description and performance data.

b. Installation details depicting mounting assemblies, physical dimensions, process connection sizes (e.g. flange ratings & styles).

c. Termination details clearly indicating the type and lengths of external wiring required and electrical connections;.

d. Power supply rating, input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements.

e. Exact catalogue model numbers for each piece of equipment and its accessory options, and clearly referenced by the respective instrument or equipment tag name given in this document (improperly tagged items shall be rejected).

f. A separate sheet with manufacturers' recommended list of spare parts including individual pricing with the shop drawings.

.2 Contractor shall note compliance and variance in writing or the specification shall have precedence over approved vendor drawings. Stamp the shop drawings submitted as either "COMPLIES EXACTLY WITH SPECIFICATION" or "DEVIATES FROM SPECIFICATION" as appropriate. In the latter case, describe deviations exactly and indicate how they impact the specified duty of the component. The Engineer will assess acceptability of submission.

.8 Submission Format:

.1 A complete set of Purpose-made Drawings, Shop Drawings, and the initial submission of the Product Data Sheets shall be bound into one volume and issued for approval before the commencement of work.

1.6 OPERATING AND MAINTENANCE MANUALS

.1 In addition to requirements for operating and maintenance instruction manuals specified in earlier sections, include the following:

.1 Manufacturer's hardware and distribution software manuals:

.2 Special instructions or procedures, including system, software and instrument trouble-shooting techniques.

.3 Systematic procedures for operations personnel to start up, shut-down, manually override and locally operate all related equipment in accordingly titled manual sections.

.4 Recommendations on equipment maintenance and suggested spare parts.

.5 Final Shop Drawings and signed-off Product Data Sheets as defined in this Specification.

.6 Copies of Record drawings of all Purpose-made Drawings.

.7 Name, address(s) and telephone number(s) for local qualified system and/or product service representatives

.2 Provide operating and maintenance instruction manual for Instrumentation & Controls in a separate indexed and tabbed manual, or separate indexed and tabbed section of the overall manual binder. Arrange sections in a logical, concise manner, and provide a

cross- reference to enable all equipment/instruments to be located from its correct equipment tag.

.3 Prior to submission of final operating and maintenance instruction manuals, and at least thirty days prior to instrumentation and control system testing and commissioning commencing, submit to and review with the Engineer, two copies of the proposed data for the instrumentation and control work Section of the operating and maintenance instruction manuals.

.4 The delivery of manuals must be complete prior to application for a Certificate of Substantial Performance of the Work.

1.7 PROJECT INSTRUMENTATION SYSTEMS INTEGRATOR QUALIFICATIONS

.1 The work under this project shall be performed by the general contractor's dedicated system integration team.

.2 System integration team's experience and credentials should be submitted to the Engineer and the City for review prior to first project meeting.

.3 The System Integration Team shall have experience in providing Process Control System and SCADA integration services, preferably in the water and wastewater industries. The System Integration Team shall have the following expertise:

.1 PLC and SCADA programming and configuration in accordance with the scope of work as outlined in this tender, specifications, drawings, and addenda.

.2 Commissioning of PLCs, SCADA, instrumentation, network and control systems of comparable magnitude as outlined in this tender, specifications, drawings, and addenda.

.3 Configuring instrumentation and verification of calibration as require to meet the scope of work as outlined in this tender, specifications, drawings, and addenda.

.4 Troubleshooting instrumentation and control systems as outlined in this tender, specifications, drawings, and addenda.

.5 Complying with Process Control Systems Standards related to the municipal water and wastewater industry.

.4 Personnel: Project lead of the System Integration Team shall have a minimum of five (5) years' experience of managing or leading process control systems and SCADA implementation projects similar in scope and complexity in water or wastewater industry. The programmer(s) of the System Integration Team shall have experience in programming Emerson Programmable Automation Controllers – PACSytems RX3i and GE Proficy iFix SCADA/HMI with Emerson Machine Edition, Proficy iFix, client's standard software shell program, function blocks and other software programming modules. The programmers are required to demonstrate to the City that they have adequate working experience in complying with client specific Process Control Standards and programming practices. The System Integration Team shall have sufficient resources available to provide services and perform project tasks to meet project schedule. Substitution staff shall be provided when required to ensure a seamless transition in the event of illness,

vacation, and/or attrition. Any substitutions to the project team member should meet the qualifications outlined above and must be pre-approved by the City prior to starting work on the project.

.5 All member of the System Integration Team are required to attend a full day software training workshop performed by City staff unless the person has attended such workshop before. The training will be based on Toronto Water PCS Implementation Guidelines, including but not limited to:

.1 Tagging structure

.2 FAT and SAT procedures and implementation

.3 Use of existing RPU and SCADA modules

.4 Procedures, protocols and cyber security policies of accessing SCADA system on site.

PART 2 PRODUCTS

2.1 TERMINAL BLOCKS

.1 Refer Section 13320 – Panel Wiring for terminal blocks specifications.

2.2 WIRE AND CABLE

.1 Refer Sections 13305 – Field Wiring and Section 13320 – Panel Wiring.

.2 All wire and cable must be sized and installed in accordance with the H.E.P.C. Safety Code Requirements. No control wire smaller than # 14 gauge shall be used except where so indicated on the drawings or as specified in other Sections.

.3 Provide all concrete coring between floors as required.

.4 Provide adequate slack on cable harnesses to permit easy removal of I/O and other printed circuit cards and/or modules and instruments during service or repair.

.5 All feeders shall be run in continuous lengths between power supply point and the load with no splices.

.6 All wiring for signal system shall be identified as to circuit numbers with approved markers on the cables at all panels and terminal strips. Where hand written markers are necessary, use the manufacturer's recommended indelible marker pen. Printing must be neat, capital alpha characters.

2.3 WIRING IDENTIFICATION

.1 Refer Sections 13305 – Field Wiring for field and 13320 – Panel Wiring for panel wiring.

.2 All instrumentation and control wiring is to be identified with markers as specified. The identification is to consist of the coding as detailed on the drawings and as specified herein.

.3 Tag field wires with the field device tag and terminal information:

.1 For devices connected to control panels or RPUs, show field source and destination information.

.2 For devices connected to other panels (e.g. switchgear) show field source information.

.3 Label wires at both ends with the same information.

.4 Wire number should not change unless there is a function change in the wire run i.e. a fuse, a relay, etc. Wires passing through a junction box without a change in function would retain the same wire number.

.5 Generally, keep the wire tag to 18 characters or less. For longer tags, use smaller font.

.4 Field source information consists of the following:

.1 In most cases, the device type (up to 4 characters) and loop number (up to five characters) make up the device tag information needed on the labels.

.5 The destination information consists of the following:

.1 Use the rack, slot and point information for RPUs and termination strip and terminal number for control panels.

.2 Inside an RPU panel, the wires and terminals are numbered by rack, slot and point/terminal.

.6 Termination Strip Numbering:

.1 The RPU number (if more than one RPU in the panel), Rack and Slot information should be on a separate tag at the top of the respective terminal strip. The terminal strip would just need the terminal number.

.2 Terminal numbers may be sequential with interspersed shields.

.3 The module termination numbers need to be specific; for example GE analog input cards use Term-5 for Channel-3.

.7 Cable Numbers:

.1 Field cables should be tagged with the field device tag information at both ends.

.2 Where cables carry wires from multiple field devices, the cable tag should use the device tag of the junction box.

.3 For cables tags, use P or C or I added to the device tag for Power, Control and Instrument respectively as some devices such as valves have all three cables.

.4 Cable numbering should show the Junction Box relevant numbers in that a cable runs to a JB, but the wiring itself would not have such designation.

.5 For example, in the case of a Cable from a Junction Box to an RPU, assign a unique "loop/device number" to the Junction Box and treat it as a Device.

.6 A Cable schedule will be provided showing Cable I.D., Cable Type, Origin, and Destination.

.8 Wire Markers:

.1 Wire markers available from Brady amongst others allow more than one line of characters if required but one line should be used if possible.

.2 Wire markers should be kept to a minimum for ease of installation and readability. A single line of text should be used, minimizing the characters as much as possible.

.9 Use colour codes wires in communication cables, matched throughout system.

.10 Maintain phase sequence and colour coding throughout.

PART 3 EXECUTION

3.1 COORDINATION

.1 Carefully examine and monitor for compatibility, any instrumentation and control work provided as part of the Work of Sections of the Specification other than the Sections governed by this Section, or the City, and ensure that all trades involved are aware of any coordination problems or details.

.2 Incompatible work, such as instrument process connections, mounting of equipment, analog, discrete or communication wiring, voltages, or inconsistencies resulting from insufficient coordination of other related work, is to be satisfactorily resolved at no additional cost to the Contract.

.3 When scheduling site inspection, FAT, commissioning, or SAT with the Engineer, allow at least 10 working days advance notice.

.4 Coordinate with all programming and on-site actions with the generator switchgear vendor. The system integrator shall attend the Switchgear RPU software FAT sessions.

3.2 MANUFACTURER’S SERVICES AND INSTALLATION CERTIFICATION

.1 Comply with the requirements of the Section 01751 – Pre-startup, Start-up and Commissioning.

.2 Allow in the tender for all the necessary services and expenses of a trained, qualified manufacturer’s representative for each device as specified in the specification, to ensure correctness of installation, testing, start-up, commissioning and training. The qualified representative is to:

.1 Provide onsite supervision of installation for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as required by the Engineer.

.2 Supervise testing and calibration of equipment. Supervise retesting and recalibration of equipment at no additional cost to the City.

.3 Provide written certification stating that the work has been completed satisfactorily.

.4 Provide a complete Installation, Start-up Checklist and sign off on the start-up work completed.

.5 Provide operation and maintenance instruction to the City's operating staff.

.3 Provide supervision of installation as required by the manufacturers for all equipment in this Division. The City/Engineer may order additional supervision at no cost to the City if, in their opinion, installation procedures are compromised.

.4 Provide all materials, labour and equipment to make any adjustments to the installation as required by the manufacturer or the Engineer to effect performance.

.5 On completion of installation and testing, obtain certification from the manufacturers that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer.

.6 Include the service of the trained personnel to inspect and commission the equipment when ready for starting and to instruct the operating personnel in the operation and maintenance of the equipment. Time spent on site by the trained personnel must be witnessed by the Engineer.

3.3 GENERAL INSTALLATION REQUIREMENTS

.1 Provide all necessary installation detail drawings and sufficient supervision to ensure that the installation of the instrument and the control system components is done to the satisfaction of the Engineer as work progresses.

.2 Provide all necessary adjusting, field calibration, testing and check-out of all equipment and control loops. After loop check-out, submit written test results to the Engineer. All instrument calibration procedures to be witnessed by the Engineer.

.3 Supply any materials and/or test facilities necessary for commissioning. The use of the City's facilities, if suitable, may be considered upon written request.

.4 All tag labeling of the existing wiring to be maintained, and be consistent with the current City's tagging standard. Refer 13040 *Equipment Tag Standard.*

.5 Field measure lengths for cables, and similar items prior to ordering. Mechanically protect cables and adequately secure in place without sagging.

.6 Install the instrumentation and auxiliary devices such that they are accessible for operation and maintenance.

.7 When installing conduit entry, protect internally mounted equipment from vibration, shock and metal filings. Conduit entries must maintain the equipment or panel EEMAC rating.

.8 Advise the Engineer in sufficient time to avoid delays to the Project of any perceived problems regarding implementation of installation details or standard practices for the particular application or if any requirements of this Specification, or a drawing detail, contradicts the equipment manufacturer's instructions or recommendations in a manner, which could be detrimental to its operation, including the possibility of inducing adverse side effects elsewhere.

.9 Prior to the shutdown of any operating equipment, provide a written notice 48 hours in advance to the City/Engineer. Shut down of equipment is limited to a length of time determined by the City. Make all arrangements to minimize down time.

3.4 SYSTEM WIRING REQUIREMENTS

.1 Provide all required system wiring in accordance with the *Process Control System (PCS) Standards*. Refer Sections 13305 – Field Wiring and Section 13320 – Panel Wiring.

.2 Provide all required system wiring. All wiring shall conform to the latest revision of the O.E.S.C. and to the Electrical Area Classification for Hazardous Locations where applicable.

.3 Where specific wiring types are not specified (except AC power wiring) provide types of wiring as recommended by the system component manufacturers.

.4 Provide conduit for all system wiring, except for power cords with integral plugs, and except where duct, tray or similar raceway are indicated. Unless otherwise specified, conduit and wiring requirements specified in Section 16110 – Conduit Systems apply to the work of this Section.

.5 Unless otherwise specified, install analog signal cabling, including transducer cables and network cables in separate dedicated R.S. conduits away from AC power and other EMF sources. Ultrasonic sensor cabling must be installed strictly in accordance with manufacturer's instructions.

.6 Communication and analog signal conductor shields must be isolated and taped back at one end and terminated at a single ground point at the other as shown on the loop drawings. If the correct grounding information is unclear, confirm exact shield termination and isolation details with the equipment manufacturer and the Engineer.

.7 Seal all conduit terminations to prevent moisture penetration.

.8 Using suitable permanent wire markers and terminal block tags, number all control panel terminal blocks as indicated on the drawings.

.9 Install lightning and surge protection on all analog signal cabling entering or exiting buildings. Provide two spare units.

.10 Seal all conduit terminations to prevent moisture penetration.

.11 Install signal isolators (24V DC externally powered if not loop-powered devices) on all analog loops with signal cabling running outside buildings, speed control signals into variable frequency drives, and any situation where potential EMF could damage electronic equipment. Provide two spare isolators.

3.5 IDENTIFICATION AND TAGGING

.1 All equipment and wiring identification and tagging shall comply with the City's current tagging standard. Refer to Section 13040 – Equipment and Data Tagging.

.2 Submit with the Shop Drawings, a typed lists indicating all nameplate wording as well as proposed types, sizes and styles.

.3 Prior to installation of new items, apply identification nameplates to each instrument, panel, telemetry device and controller. Where existing instruments are re-used, or connected into the new system/control panel(s), provide identification nameplates for these instruments also.

.4 Wiring:

.1 Identify all RPU I/O signals on field terminal rails with appropriate tag.

.2 Identify all wiring at both ends with appropriate, permanent wire markers.

3.6 MODIFICATIONS TO EXISTING EQUIPMENT

.1 Provide all hardware, wiring etc. to connect the instrumentation added, moved or modified under this and other Divisions for a complete, and operating system. Verify the actual site conditions and modify the proposals to effect the desired result without additional charge to the contract.

.2 During the tendering period, visit the site and ascertain the actual conditions and the extent of the work.

.3 Do not remove existing equipment from service without written approval.

.4 Prior to removing any control and monitoring equipment, ensure that all signals required for other devices are maintained.

.5 Removal of wiring means the disconnection and complete removal of related cables, conduit and wiring from the equipment involved.

.6 Remove and replace with new all conduit and cable between new switchgear/MCC/VFD and the existing RPU.

.7 Terminate new wiring as shown on the drawings.

.8 Leave in place existing wiring and equipment not required to be modified, whether or not it meets current codes unless there is a definite safety hazard. Draw to the attention of the Engineer any such condition.

.9 Equipment taken out of service shall be removed and delivered to the City or left in place as directed by the Engineer.

3.7 SITE ACCEPTANCE TESTING (SAT)

.1 SAT Testing shall follow the *Process Control System Implementation Guidelines.* The System Integrator and Manufacturer shall use the "FAT and SAT Check Sheets" and "Process Logic Check Sheets" for the SAT, fill up the form with all the testing items and submit to Engineer and City for review prior the SAT.

3.8 TRAINING

.1 Comply with the requirements of the City's *Process Control System (PCS) Implementation Guidelines Training* document. See Supplement documents.

.2 Submit a course outline to the Engineer for approval thirty (30) days prior to the start of the course. The Engineer reserve the right to modify the course content.

3.9 PROCESS PERFORMANCE OPERATION

.1 Provide all labor and materials necessary to support the process and the instrumentation and control system for the duration of the contract performance run. During this operation all equipment is expected to run in automatic mode.

3.10 WARRANTY AND GUARANTEE PERIOD ACTIVITIES

.1 During the warranty period, hardware service should be provided by a factory trained service representative who shall be on-site within 24 hours of a service request, 7 days/week, including weekends and holidays. The service representative shall be equipped with all necessary tools, testing equipment, spare parts, and expertise to perform the service in one visit.

.1 For each service call submit a report giving the following information:

a. Part numbers, description and prices for items replaced.

b. Revised hard copy/soft copy listings of program changes.

c. Hours worked by maintenance personnel.

d. Reason for the service call, and whether preventative, unscheduled or corrective maintenance was carried out.

e. Name of City's technician present during repairs. Explain the problem and solutions to the City's technician.

f. Description of problem as discovered on arrival at site and itemized report of activities performed to isolate and correct problem.

g. Identification of any required actions to prevent similar future occurrence.

h. Name of attending operations representative, time of call and time of arrival on site.

.2 A single contact point shall be provided for all hardware such that the City's representative need only call a single phone number irrespective of which piece of hardware has failed.

.3 Spare Components/Firmware & Software Upgrades:

a. The supplier should have access to a dedicated spare parts inventory for each component provided. Parts shall be available within 24 hours of a service parts request, seven (7) days/week.

b. Include key spare parts that are not normally available immediately from stock, in the Recommended Spare Parts List.

3.11 SUPPLEMENTS

.1 Supplements listed below, following "End of Section", are part of this specification:

.1 Factory Acceptance Test-Check Sheet

.2 PCS Site Acceptance Test-Check Sheet

.3 Process Logic Test Sheets

.4 Field Installation Testing Log

.5 Instrument Testing Log

.6 Training.

.7 Alarming

.8 PCS Documentation

END OF SECTION

PCS FACTORY ACCEPTANCE TEST
CHECK SHEET
A1 - Field Points

Date:
Plant:
Process:
Location:
RPU:

Device	Tag	Signal Type	RPU Termination			I/O Address	RPU Address	Description (Limited to 40 Characters)	Field Device Range	RPU Device Range		SCADA Device Range		Eng. Units Decimal points	Eng. Units	SCADA Range Test			☑ Pass/Fail		Comments
			Rack	Slot	Point					Zero	Span	Zero	Span			Min	Mid	Max	OIT	SCADA	

Signatures and Date: PCS Analyst/Developer ________________ PCS Coordinator ___________________ Consultant ___________________

PCS FACTORY ACCEPTANCE TEST
CHECK SHEET
A2 - Virtual (SCADA) Points

Date:
Plant:
Process:
Location:
RPU:

Device	Tag	Description (Limited to 40 Characters)	RPU Address	I/O Type	Access R or R/W	Min Value	Max Value	Set Point /Alarm TP	Eng. Units	Reset DB (% Of TP)	Time Delay	Alarm Priority	Alarm NACK	Alarm ACK	Alarm Normal	Paging Group	Security Area	Alarm Area	Remote Ack Tag	Alarm Ack ition	☑ Pass/Fail			Comments
																					Win 911	OIT	SCADA	

Signatures and Date: PCS Analyst/Developer ________________ PCS Coordinator ____________________ Consultant ____________________

TORONTO Water

PCS FACTORY ACCEPTANCE TEST
CHECK SHEET
A3 - Data Logging&Trending

Date:
Plant:
Process:
Location:

Tag	*(If replacing the old Historian tag)*	Signal Type	SCADA		Description (Limited to 40 Characters)	Min Value	Max Value	Eng. Units	DataLog Atributes		Trended	☑ Pass/Fail	Comments
			Node Name	Address					Freq.	Deviation			

Signatures and Date: **PCS Analyst/Developer** _____ **PCS Coordinator** _____ **Consultant** _____

TORONTO Water

PCS FACTORY ACCEPTANCE TEST
CHECK SHEET
A4 - Communication Signals
DATA EXCHANGE WITH OTHER CONTROLLERS

Date:
Plant:
Process:
Location:
RPU:

ProducerPLC	
ExchangeName	
ExchangeID	
Destination	
ProducedPeriod	
DestinationType	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

ConsumerPLC	
ExchangeName	
ExchangeID	
ProducerID	
UpdateTimeout	
TimeStampRefAddress	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

No.	Source Tag	Description (Limited to 40 Characters)	Data Type	PLC Address		☑ Pass/Fail	Comments
				Source	Destination		

Signatures and Date: PCS Analyst/Developer _____ PCS Coordinator _____ Consultant _____

ConsumerPLC	
ExchangeName	
ExchangeID	
ProducerID	
UpdateTimeout	
TimeStampRefAddress	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

ProducerPLC	
ExchangeName	
ExchangeID	
Destination	
ProducedPeriod	
DestinationType	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

No.	Source Tag	Description (Limited to 40 Characters)	Data Type	PLC Address		☑ Pass/Fail	Comments
				Source	Destination		
1							
2							
3							
4							
5							

TORONTO Water

PCS SITE ACCEPTANCE TEST
CHECK SHEET
A1 - Field Points

Date:
Plant:
Process:
Location:
RPU:

Device	Tag	Signal Type	RPU Termination			I/O Address	RPU Address	Description (Limited to 40 Characters)	Field Device Range	RPU Device Range		SCADA Device Range		Eng. Units Decimal points	Eng. Units	SCADA Range Test			☑ Pass/Fail		Comments
			Rack	Slot	Point					Zero	Span	Zero	Span			Min	Mid	Max	OIT	SCADA	

Signatures and Date: **PCS Analyst/Developer** ________________ **PCS Coordinator** ___________________ **Consultant** ___________________

PCS SITE ACCEPTANCE TEST
CHECK SHEET
A2 - Virtual (SCADA) Points

Date:
Plant:
Process:
Location:
RPU:

Device	Tag	Description (Limited to 40 Characters)	RPU Address	I/O Type	Access R or R/W	Min Value	Max Value	Set Point /Alarm TP	Eng. Units	Reset DB (% Of TP)	Time Delay	Alarm Priority	Alarm NACK	Alarm ACK	Alarm Normal	Paging Group	Security Area	Alarm Area	Remote Ack Tag	Alarm Ack ition	☑ Pass/Fail			Comments
																					Win 911	OIT	SCADA	

Signatures and Date: **PCS Analyst/Developer** ________________ **PCS Coordinator** ___________________ **Consultant** ___________________

TORONTO Water

PCS SITE ACCEPTANCE TEST
CHECK SHEET
A3 - Data Logging&Trending

Date:
Plant:
Process:
Location:

Tag	Previous Tag *(If replacing the old Historian tag)*	Signal Type	SCADA		Description (Limited to 40 Characters)	Min Value	Max Value	Eng. Units	DataLog Atributes		Trended	☑ Pass/Fail	Comments
			Node Name	Address					Freq.	Deviation			

Signatures and Date: **PCS Analyst/Developer** _____ **PCS Coordinator** _____ **Consultant** _____

TORONTO Water

PCS SITE ACCEPTANCE TEST
CHECK SHEET
A4 - Communication Signals
DATA EXCHANGE WITH OTHER CONTROLLERS

Date:
Plant:
Process:
Location:
RPU:

ProducerPLC	
ExchangeName	
ExchangeID	
Destination	
ProducedPeriod	
DestinationType	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

ConsumerPLC	
ExchangeName	
ExchangeID	
ProducerID	
UpdateTimeout	
TimeStampRefAddress	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

No.	Source Tag	Description (Limited to 40 Characters)	Data Type	PLC Address		☑ Pass/Fail	Comments
				Source	Destination		

Signatures and Date: **PCS Analyst/Developer** _____ **PCS Coordinator** _____ **Consultant** _____

ConsumerPLC	
ExchangeName	
ExchangeID	
ProducerID	
UpdateTimeout	
TimeStampRefAddress	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

ProducerPLC	
ExchangeName	
ExchangeID	
Destination	
ProducedPeriod	
DestinationType	
StatusRefAddress	
DataRefAddress	
DataLength(Bytes)	

No.	Source Tag	Description (Limited to 40 Characters)	Data Type	PLC Address		☑ Pass/Fail	Comments
				Source	Destination		

Signatures and Date: PCS Analyst/Developer _____ PCS Coordinator _____ Consultant _____

TORONTO Water

Process Logic Test Sheet

Date: _____

Test ID	Equipment Location, Identification and Process Condition
1	(Type description of the objective of the Test)

Facility-Process	Device Operation	Mode	Current State	Action/ Transition	Final State/Effect	Con	City	Comments	Issue Log
	Normal	Local	List the tags and their current state relevant to testing the transition or action and observing the final state or effect. List the HMI Symbol And Colour and shape.	Describe the action or transition that is being tested, e.g. Field Mounted Start P.B. is Depressed	List the tags and their expected final state. List the HMI symbol expected colour and shape.			During the test, note any deviation from the expected final state or effect	
	Normal	Computer Manual							
	Normal	Transfer from Local to Computer							
	Normal	Transfer from Computer to Local							
	Normal	Computer Automatic							
	Local Abnormal	Device Operation Permissives							
	Local Abnormal	Emergency Stop							
	Computer Manual Abnormal	Uncommanded Operations							
	Computer Manual Abnormal	Unresponsive Commands							
	Computer Manual Abnormal	Device Operation Permissives							
	Computer Manual Abnormal	Device Alarms							
	Computer Manual Abnormal	Emergency Stop							
	Computer Auto Abnormal	Uncommanded Operations							
	Computer Auto Abnormal	Unresponsive Commands							
	Computer Auto Abnormal	Device Operation Permissives							
	Computer Auto Abnormal	Device Alarms							
	Computer Auto Abnormal	Emergency Stop							

TORONTO Water

FIELD INSTALLATION TESTING LOG

Date: _____

Page ____ of ____

#	DEVICE OR EQUIPMENT	IDENTIFICATION	DEVICE INSPECTION				STATUS												CONTROL										TESTED	ACCEPTED	REASON (S) FOR NON - ACCEPTANCE
							CONTROLLER (RPU) INPUTS									FIELD			CONTROLLER (RPU) OUTPUTS						FIELD						
			PRODUCT ACCEPTANCE	INSTALLATION ACCEPTANCE	CALIBRATION ACCEPTANCE	LOCAL PANEL SWITCHES	LOCAL/REMOTE CONTROL	RUNNING / OPEN	CLOSED	ANALOG INPUT 1	ANALOG RANGE OK	ANALOG INPUT 2	ANALOG RANGE OK	FIELD ALARMS	OTHER	OTHER	LOCAL INDICATORS	REMOTE INDICATORS	OTHER	START / OPEN	STOP	CLOSE	SETPOINT 1	SETPOINT 2	OTHER	LOCAL HANDSWITCHES	REMOTE HANDSWITCHES	OTHER	AUTO LOGIC			
1																														
2																														
3																														
4																														
5																														
6																														
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19																														
20																														

TORONTO Water

INSTRUMENT TESTING LOG

Date: _____

Page ____ of ____

#	INSTRUMENT	TAG NUMBER	STATUS				DOCUMENTS					TEST AND CALIBRATION																				
				Existing			Records Available					Results																				
			New	Re-Used	Re-Calibrated	Repaired	Technical Manufacturer Data Sheet	P&ID,Control Schematic, Electrical dwgs	Contract Specifications	Origional Calibration Reports	Maintenance Reports	Test Date	Installation & Applicaation Meets Design & Manufacturers Recommendation	Span in Engineering Units	Calibrated Range In Engineering Units	Mini. Calib. Range In Engineering Units	Mini. Calib. Range In (m/A)	Max. Calib. Range In Engineering Units	Max. Calib.Range In (m/A)	Instrument Reading At 25% (m/A)	Instrument Reading At 50% (m/A)	Instriment REading At 75% (m/A)	Instrument Reading At 100% (m/A)	Instrument Reading At 75% (m/A)	Instrument Reading At 50% (m/A)	Instrument Reading At 25% (m/A)	Error (Diff. In Engineering Units)	Error %	Accepted (A) / Rejected (R)	Reasons Of Non-Acceptance
1	Instrument																														
2																															
3																															
4																															
5																															
6																															
7																															
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1. Training

1.1 General

Training of City's Operation and Maintenance staff shall be provided by the Consultants and the Contractor. The training provided by the Consultants is to emphasize the application of instrumentation, process devices and SCADA system technology for the control of the plant treatment and supply processes. The training provided by the Contractor is to explain, demonstrate and review both the instrumentation, process devices and SCADA hardware and software that have been installed under the contract for the control of the plant's treatment and supply process.

Training by the Consultants includes the newly constructed work and the application of SCADA technology to the new and existing Process Control System (PCS).

Training by the Contractor for Operations staff will include the review of the hardware and software installed and configuration of SCADA and RPU software supplied under the contract. In addition, it also includes training on how to monitor the process, adjust process setpoints and respond to process alarms. Training for maintenance staff will include troubleshooting of malfunctioning field devices, calibration and repairs of instruments and equipment.

1.2 Training by Consultants

1.2.1 General

The Consultants shall provide training to the City's Operation and Maintenance staff on the operation of the plant treatment and supply process through the SCADA HMI system. The training shall include the following:

1. Operation and control of the plant treatment and supply process from the Control Room workstation or equivalent.
2. Operation and control of individual processes at the Area Operator Work Station. (This training is only required if there is a difference between the HMI in the Control Room and the HMI on the Area Operator Work Station.)
3. Operation and local control of individual equipment at the Local Control Panels.
4. Operation of the RPU and how devices and equipment are connected to it.

Training shall be provided at the plant in two stages; first stage will be in a "classroom" to be followed by the second stage which is the practical demonstration (hands on training)on the operation of the plant or facility (or newly constructed work) through the SCADA system.

The Consultants shall provide all required pertinent training material to each Operation and Maintenance staff. Typically, the SCADA Operation Manual shall be used as a guide during training.

1.2.2 Consultants' Training Courses and Schedule

Training of the newly installed SCADA system shall commence one month prior to the newly constructed process treatment or supply work being completed for its intended use and placed into operation. Generally, this would also be about a month prior to substantial completion of the contract but where it is intended to place the work into operation prior to substantial completion because of mandatory connections to existing process or other processes constraints, then the training for the treatment or supply process and SCADA system must occur one month prior to the intention to place into operation the newly constructed work through the SCADA system.

The Consultants shall use the following table as a guideline when designing a training schedule. The actual amount/duration of training will depend on the specific project complexity.

	Course	Duration	Class Size	Number of Classes
1.	Operation and control of the plant treatment or supply process from the Control Room work station or equivalent, including the use of the SCADA Operation Manual prepared by the Consultants.	8 hours	10	3
2.	Operation and control of individual processes at the Area Operator Work Station. (This training will only be required if the HMI is different than the Control Room Work station)	4 hours	10	3
3.	Operation and local control of individual equipment at the Local Control Panels and RPUs.	4 hours	10	3

1.2.3 Operation and Control from the Control Room Work Station

Training on the operation and control of the SCADA system from the Control Room workstation shall be carried out in a "classroom" on the theoretical and practical aspects of the SCADA system as it relates to both the new treatment or supply process and current installed (or expanded) SCADA system and its integration to the existing treatment or supply process to be followed by the hands-on demonstration from the Control Room workstation.

Consultants shall review, train and demonstrate (hands on training) to staff the following:

1. Overview and features of the newly installed SCADA system, including design of system, configuration and system architecture. Include the identification (tagging) of installed hardware, network routing, operator work stations and servers. The training will cover everything from how the signal is generated to how the signal gets to the HMI.

2. The user interface functions such as log-on, log-off, password protection, etc.
3. The screen displays of newly installed SCADA system. (This may not be necessary if the expansion is relatively small. In this case, proceed to the next item below.)
4. Screen display of integrated SCADA system for data, trending and plant and process control system schematics.
5. Procedure for the control of treatment process through the SCADA system using the integrated HMI screens and overview of the process which can be controlled from each location.
6. Procedure for navigation of available screen display of daily operating data, trending and plant/process schematics as well as changes or modifications technique for these displays.
7. Emergency response of critical treatment process under SCADA failure mode of operation.
8. The availability and control of backup equipment under failure mode for both automatic and manual switchover.

1.2.4 Control of Equipment at the Area Operator Station

(This section will only be required if the Area Operating Station HMI is different than the Control Room Work Station HMI) Control of treatment or supply process equipment may be necessary at the Area Operator Station because of the failure of the SCADA system or that maintenance work has to be performed at the Central Operator Station. The Consultants shall review, demonstrate and train Operation and Maintenance staff on the availability or capability of control at the Area Operator Station of the following:

1. All equipment monitored and controlled at the Operator Station.
2. Manual adjustments of equipment controller's set-points.
3. Control of backup equipment under failure mode, both automatic and manual switchover.
4. Where redundant area processors are provided, demonstrate the switch-over procedure.

1.2.5 Control of Equipment at the Local Area Control Panels and RPU

Control of plant treatment process equipment at the Local or Area Controller Panels is at the lowest control hierarchy (besides the Local Hand Stations which is common for all equipment) of the SCADA system. At the panel, each individual piece of equipment can be turned on or off and process equipment controllers' set-points manually adjusted.

Consultants shall review, demonstrate and train staff (hands on training) on the following:

1. Procedure for manual switch-over of backup equipment.
2. Key critical process procedure prior to manually switching over of backup equipment.

3. Review alarm and statues of the equipment that has failed prior to manually switching over of backup equipment.
4. Lockout equipment that must not be restarted from the Area Operator Station or at the Central Operator Station when it is under the control of Local or Area Controller Panels.

1.3 Training by Contractor

1.3.1 General

The Contractor shall provide training of the City's personnel in the proper operation and maintenance of the equipment and systems installed under this project.

The Contractor shall provide on-the-job training of the City's personnel for equipment as specified. Training shall include instruction of operation personnel in equipment operation and preventative maintenance and instruct plant mechanics, electricians and electronics technicians in normal maintenance or repair.

1.3.2 Submission of Training Material

The Contractor shall supply the following information to the City. Due to phased testing and start-up activities, separate submittals may be prepared for equipment items or systems. The material shall be reviewed and accepted by the Consultants and the City no later than one month prior to delivery of the training.

1. Detailed lesson plans for each training session are to be supplied to the City one month prior to the session taking place. In addition, training manuals, handouts, visual aids and other reference materials shall be included. The City reserves the right to approve and request modifications to the plan and/or materials.
2. Date, time, and subject of each training session and identity and qualifications of individuals to be conducting the training. The City has the right to request a change of inspector if necessary.
3. Concurrent classes will not be allowed in training schedule.

1.3.3 Training Requirements

The training to be provided by the Contractor shall be as follows:

1. The Contractor shall conduct training sessions for the City's operation and maintenance personnel to instruct the staff on the proper operation, care and maintenance of the equipment and systems installed under the contract. Training shall take place at the site of the work and under the conditions as specified. Vendor operation and maintenance manuals shall be available to City's personnel at least 5 working days prior to the date scheduled for the individual training session.
2. Field training session shall take place at the site of the equipment. The Contractor shall provide a training facility with a capacity for at least 10 persons for classroom training.

3. Formal detailed written lesson plans shall be prepared for each training session. Lesson plans shall include an outline of the material to be presented together with description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject. One complete set of originals of the lesson plans, training manuals, handouts, visual aids and reference material shall be the property of the City and shall be properly bound for proper organization and easy reproduction in an identical manner into the equipment Operation and Maintenance Manual. The Contractor shall furnish enough copies of the required training manuals to meet the needs of the training session at least 5 working days prior to each training session.

4. Each training session shall be comprised of time spent both in the classroom and at the location of the equipment. The training session shall cover the following topics for each equipment or system:

    (i) Familiarization

    (ii) Safety

    (iii) Operation

    (iv) Calibration

    (v) Troubleshooting

    (vi) Preventive maintenance

    (vii) Corrective maintenance

    (viii) Parts

    (ix) Local representatives

    (x) Equipment Operation and Maintenance Manuals

5. The City may perform video recording of the training session(s) or retain the services of a commercial video taping service to perform the video recording. After the recording session, the material may be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers providing training sessions that the training session(s) may be videotaped.

1.3.4 Contractor Training Courses and Schedule

The Contractor shall use the following table as a guideline when designing a training schedule. The actual amount/duration of training will depend on the specific project complexity.

	Course	Duration	Class Size	Number of Classes
1.	Operation and control of the plant treatment process at the Central Operator's Station. Review of SCADA and RPU software configuration and programming carried out by the Contractor and its integration to the existing SCADA system. Use the SCADA and RPU software manual and Equipment Maintenance Manual prepared by the Contractor. Explain and demonstrate all safety interlocks. Both classroom and training at the Central Operator's Station required.	8 hours	10	3
2.	Operation and control of individual processes at the Area Operator Station. Demonstrate RPU process control and explanation of the RPU software programming and its linkage to the Area Operator Station.	4 hours	10	3
3.	Operation and local control of individual equipment at the Local or Area Controller Panels. Demonstrate safety interlocks and manual setting of local controllers and by-passing under emergency condition.	4 hours	10	3

All training shall be conducted and completed by the Contractor *prior to* operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 4 hours of classes scheduled for any one day. The Contractor will not be permitted to perform the operational testing and commissioning until the training has been completed to the satisfaction of the City.

1.3.5 Contractor's Classroom Training for Operation Staff

Classroom training of equipment for Operation staff will include:

1. Using slides, PowerPoint and drawings, discuss the equipment specific location in the plant and an operational overview.

2. Purpose and function of the equipment.
3. A working knowledge of the operating theory of the equipment.
4. Start-up, shutdown, normal operation, and emergency operation procedures, including a discussion on system integration and electrical interlocks, if any.
5. Review, demonstrate and train Operation staff on the RPU and OIT program logic and stepping through the program from beginning to the end to show and explain how the control of the equipment is carried out and how to resolve programming / control problem(s).
6. Identify and discuss safety items and procedures.
7. Routine preventative maintenance, including specific details on lubrications and maintenance of corrosive protection of the equipment and ancillary components.
8. Operator detection, without test instruments, of specific equipment trouble symptoms.
9. Required equipment exercise procedures and intervals.
10. Routine disassembly and assembly of equipment if applicable (as judged by the City on a case-by-case basis) for purposes such as operator inspection of equipment.
11. Calibration of the unit, showing staff how to make set point adjustments.

1.3.6 Contractor's Hands-on Training for Operation Staff

Hands-on equipment training for Operations staff will include:

1. Identify location of equipment and review the purpose
2. Identifying instrumentation:
    (i) Location of primary element.
    (ii) Location of instrument readout.
3. Discuss purpose, basic operation and information interpretation.
4. Discuss, demonstrate, and perform standard operating procedures and checks.
5. Discuss and perform start-up and shutdown procedure.
6. Perform the required equipment exercise procedure.
7. Perform routine disassembly and assembly of equipment if applicable.
8. Identify and review safety items and perform safety procedures, if feasible.
9. Calibration of the unit, showing staff how to make set point adjustments.

1.3.7 Contractor's Classroom Training for Maintenance Staff

Classroom equipment training for the maintenance and repair personnel will include:

1. Theory of operation.
2. Description and function of equipment.
3. Start-up and shutdown procedures.
4. Normal and major repair procedures.
5. Equipment inspection and trouble shooting procedure including the use of applicable test instruments and the “pass” and “no pass” test instrument readings.
6. Review, demonstrate and train Maintenance staff on trouble shooting of the RPU and OIT when the system crash. Explain and train staff on the RPU and OIT program logic and stepping through the program from beginning to the end to show and explain how the control of the equipment is carried out and how to resolve programming / control problem(s). Demonstrate and train Maintenance staff on trouble shooting and replacement of the CPU, network interface units, network communication modules, power supply, controllers, I/O cards etc.
7. Routine and long-term calibration procedures.
8. Safety procedures.
9. Preventative maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, welding jigs, etc.

1.3.8 Contractor’s Hands-on Training for Maintenance Staff

Hands-on equipment training for Maintenance staff shall include:

1. Locate and identify equipment components
2. Review the equipment function and theory of operation.
3. Review normal repair procedures.
4. Perform start-up and shutdown procedures.
5. Review and perform the safety procedures.
6. Perform City’s-approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and trouble shooting of equipment problems.
7. Demonstrate and train Maintenance staff on replacement of the CPU, network interface units, network communication modules, power supply, controllers, I/O cards, etc.
8. Review and use equipment manufacturer’s manual.

1. Alarming

1.1 General

This guideline shall be complied with in all control systems or equipment that generate alarms for process control applications. It shall also include details on the types of alarms that are required to be brought into the control system. Some examples have been provided herein, and the requirements of each specific facility will be determined at the detailed design stage.

Consultants shall comply with this design guideline in the design of the works and ensure that the contract documentation for construction conform to this requirement. Any proposed deviation must have the prior approval of the City

Uniformly applied principles of alarming will assist operators in responding appropriately to abnormal situations and this design guidelines will:

1. determine information that needs to be alarmed,
2. prioritize alarm information given to operators.

1.2 Operating Conditions

Plant control rooms are not normally staffed. Operators (Plant Technicians) work in the process area and are trained and experienced on processes within the work area. Cross training on other areas is a goal, but not all operators will necessarily have the same level of skill and knowledge.

Work areas in the plant are staffed 24 hours a day.

1. In wastewater treatment plants, operators are assigned to one or more processes within a work area.

2. At water treatment plants, an operator may be assigned to the whole plant or a work area comprising part of the plant.

The process equipment is fully automated. Equipment automatically shuts down when operating beyond its safe limits. Auxiliary safety equipment starts automatically when needed; for example, ventilation fans during high toxic gas concentrations.

1.3 Operation Practices

Operators will periodically, typically every 45 to 60 minutes, review alarm summary displays for their process(es) or work areas on PCS workstations. After dealing with the alarms that have come up, operators will return to other duties.

Operators will be paged for immediate alarms. These alarms represent conditions that must be dealt with immediately and cannot wait for the periodic alarm summary display review.

Important alarms that affect more than one operator are required to be paged to all operators involved. That is, a shut down of one process may affect another process or work area. In cases like this, the operator who is responsible for correcting the problem should be given an alarm message relating to the cause of the problem. Operators who are responsible for dealing with subsequent processes should be given alarm messages relating to the problem. For example, at Highland Creek, if sludge pumping from storage fails, the operator in that area should be paged with the pumping fail message. This operator deals with getting the sludge pumping back in operation. The operator in dewatering should be paged with a loss of sludge feed from storage alarm message. This operator deals with problems in dewatering caused by the loss of sludge feed.

1.4 Alarm Priority

There are 4 levels of alarm priority.

1. Pager (WIN911) Priority alarms require immediate operator attention.

2. High (H) Priority alarms require operator attention within the normal alarm review period (approximately an hour).

3. Medium (M) Priority alarms require operator attention within a shift.

4. Low (L) Priority alarms require operator attention within a shift.

Alarm priorities can be changed at the discretion of the facility manager.

1.5 Alarm Creation and Priority Assignment Guidelines

While adding to or changing the alarm list in the Master PCN during the detailed design stage, the Consultant and City shall give careful consideration to how alarms are generated (referred to as “alarm conditioning”). Simply adding I/O points to the alarm list is not sufficient – Designers shall consider the conditions that can lead to an alarm condition and design the alarm logic and alarm descriptions accordingly.

For example, a low flow switch should not be alarmed if the switch was tripped due to the normal condition of a pump stopping. Another example is a high discharge pressure should not be alarmed if it is only momentary and the designers consider momentary high pressures to be normal conditions.

For new alarm points, the Consultant and the City will review and assign priority for each alarm during detailed design as part of the modifications to the Master Process Control Narrative. Examples presented in this section form a guideline and may not cover every situation. Priority assignment will be made on a case-by-case basis by the Consultant and approved by the City during review of the Master PCN.

Alarms need to be assigned priority consistently across the plant in order to more safely cross train operators on different processes and work areas. Alarms shall be assigned priority consistently across all plants in order to compare performance.

Examples of alarms at plants

Alarm	**Priority**
1. Critical water quality conditions	WIN911
2. Pump fail and its standby unit could not be started up.	WIN911
3. Pump fail and its standby unit was started successfully.	H
4. Safety alarms:	
• Chlorine leak	WIN911
• Chemical spill (ferric chloride, sodium hypochlorite)	WIN911
• Combustible gas (methane, natural gas) concentration high	WIN911
• Toxic gas (carbon dioxide, hydrogen sulfide) concentration high	WIN911
• Flood	WIN911
• Other safety alarms	WIN911
5. High wet well level	M
6. Impending high temperature condition of a pump motor	H
7. Process controller failure.	WIN911
8. Historical logging computer failure	WIN911
9. Failure of auxiliary systems (instrument air, lubrication system, heating, cooling, ventilation system, backup instrument power)	H
10. Instrument failure alarm	H
11. Dissolved oxygen concentration low	M

Example alarms at remote water supply sites

These alarms are needed at central pumping control for direct action to control the process and at the work area to be aware of problems.

Alarm	**Priority**
1. High discharge pressure	WIN911
2. Low discharge pressure	WIN911
3. Power high	WIN911

Alarm	Priority
4. Power fail	WIN911
5. Surge system fail	WIN911
6. Pump fail (all pumps currently have manual remote start/stop)	WIN911
7. Unauthorized access	WIN911
8. Reservoir high	WIN911
9. Reservoir low	WIN911
10. Communications fail	WIN911
11. No Flow (with pump running)	WIN911
12. Flood Alarm	WIN911

Alarms at remote sewage pumping stations

Alarm	Priority
1. Pump failed and its standby unit could not be started up.	WIN911
2. Unauthorized Access	WIN911
3. Flood Alarm	WIN911
4. Communications fail	WIN911

Chlorine leak alarms

1. Chlorine leak alarms are treated differently at the plants. This difference is acceptable as long as minimum safety requirements are met.

2. At the Ashbridges Bay Plant, chlorine leaks require immediate broadcast paging to all personnel because chlorine is stored in tank cars. At the Humber Plant, chlorine leaks require immediate broadcast paging to all personnel because residential areas are very close to the plant.

3. At water treatment plants, chlorine leaks should be paged to the designated operator, but not broadcast. The reported chlorine leak is investigated and if required, the plant's public address system is used to broadcast the alarm.

1.6 Alarm Configuration in Field

Safety alarms are defined as those involving personal safety of the operator, other staff and the public (fire, gas leak, chorine leak, flood, etc.).

1. All safety equipment such as chlorine gas detectors, fire detectors, etc. shall be specified to provide a separate set of contacts for alarm transmission to the control system.
2. All alarms and safety equipment contacts shall be double-pole double-throw, form C rated for 3 Amp AC or 5 Amp DC minimum.
3. Safety alarm loops shall be energized (supervised) in the normal state.
4. Safety alarm loops shall have an alarm circuit test switch which tests lights, horns and circuits for readiness to operate. This switch will be used periodically to test operability of the circuit. A full simulation of safety systems will also be performed periodically to test instruments, controls and controlled equipment with the test switch in normal position.
5. All safety alarms will be monitored by the control system.

The following table shows configuration by alarm type:

Alarm Type	Hardwire to Area Station	Hardwire to Local Horn (130 db)	Hardwire to Local Beacon	Colour (Note 1)	Where Silenced	Where Acknow-ledged
Safety Alarm	Yes	Yes (note 2)	Yes (note 3)	Red	Local (note 4)	Local (note 4)
Other Alarm	No	No	No	Yellow	N/A	Local (note 4)

Notes:

1. Alarm characters are black.
2. Chlorine leak alarm is also hardwired to plant siren at the Ashbridges Bay Plant.
3. Beacons are required at each entrance to the affected area in the case of chlorine leak alarms.
4. Local is the immediate area, panel or nearby designated safe location.

1.7 Alarm Activation

Alarms of any priority may require latching with manual reset at the local panel. Manual reset is required for all alarm conditions which affect personal safety.

Automatic reset of some alarms is acceptable for alarms caused by process changes such as undervoltage (power failure), seal water low pressure or low suction pressure.

Alarm disable (suppression) during start-up or shut-down of a device or a process is acceptable. These alarms are determined during control strategy design on a case-by-case basis or are part of manufacturer designed controls for a particular piece of equipment.

All software functionality associated with a disabled alarm is also disabled.

The ability to manually disable alarms requires a high level of security login.

1.8 Alarm Monitoring

Alarms originating from field contacts or generated by software shall be displayed at area operator stations (if present) and central operator stations. While adding alarms to an existing SCADA system, the Systems Integrator shall follow the colour convention and styles/grouping that already exist so the alarm database remains consistent unless otherwise instructed by Toronto Water.

The preferred alarm monitoring practice is to bring into the SCADA system sufficient alarm details as needed for remote diagnosis of the problem. The alarm and related information should enable appropriate responses to be taken. The amount of alarms from a particular device or facility should be reviewed on a case by case basis for feasibility and economy.

1. In areas of the plant where there are a large number of closely related Medium priority alarms, it is sometimes desirable to annunciate the alarm conditions individually at the area station and retransmit a common alarm to the central operator station.
2. Alarm conditions from auxiliary systems that are essential to the functioning of the control system or process equipment (instrument air supply systems and equipment lubrication systems for example) should be monitored.

WIN911 Priority alarms need more information to be monitored than other types of alarms so that appropriate action may be taken quickly.

1. Example: Sewage pumping station high wetwell alarm needs to be augmented by remote monitoring of wetwell level and pump status. Note that sewage pumping station communications failure would also require immediate paging.
2. Example: Combustible gas alarm needs to differentiate between high combustible gas concentration, sensor fault and maintenance mode. The alarm needs to be augmented by the actual combustible gas concentration.

1.9 Pager Operation

The paging system is to communicate alarms from the process control system, security system and telephone system to personal pagers or phone/cellular phone. The alarm notification system is used to transmit critical alarms from the facility's SCADA system and then transmit them using the Win911 Server.

A pager may be assigned to a process or group of processes within the work area or the work area. An operator who has possession of the pager is responsible for responding to alarms. The same 'beep' tone shall be used for all pager alarms and shall display the alarm text description.

The paging system is configured to handle temporary staff shortages. For example, if a member of the team does not show up for work on time or calls in ill, people on-site need to reassign the paging areas. That is, the paging will roll over from one work area to another or from one process to another. If a page is not acknowledged within a set time, the paging will roll over to another designated person.

The Consultant is to be aware that any modifications or additions to the critical alarms that require notification must be integrated to the existing database that resides within the Win911 Server.

The Consultant is to ensure that the alarm notification complies with current facility standards. The alarm notification techniques vary between facilities and can be in the form of one of the following options;

1. An alphanumeric message that includes the tag name, time and description of the message that is transmitted to either an alphanumeric pager or via a SMS message to a cellular phone. This technique requires a standard dial modem to be installed within the Win911 server.

2. A voice message that includes the tag name, time and description of the message that is transmitted to a telephone or cellular phone. This technique requires a Dialogic card to be installed within the Win911 Server. Voice messages should be approved by the facility's staff for audibility and content.

SECTION 13010-08

PCS DOCUMENTATION

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 This standard describes the requirements for Contractor Manuals, which is to ensure that complete documentation is obtained and maintained.

.2 Contractor is responsible for preparation of the Equipment Operation and Maintenance Manuals for the entire process control system hardware and software. The Contractor shall obtain, prepare and assemble the operation and maintenance data/manual of the equipment and systems as well as installation documentation from the suppliers and manufacturers and the information shall be compiled into the Operating and Maintenance (O&M) Manuals.

1.2 O&M MANUAL GENERAL REQUIREMENT

.1 Submission requirements shall include the following information in the various submittal(s):

.1 An outline of the O&M documentation including a complete list of the manuals. Indicate title, content, and Specification sections covered. Include formats and samples of representative pages of the manuals.

.2 Draft copies in specified quantities of all documentation prior to shipping

.3 Complete, ready-for-test copies in specified quantities prior to field testing or training.

.4 Final documentation reflecting as-built status in specified quantities two months after commissioning.

.2 Quantities of printed and software copies of the O&M are to be specified in the contracts based on a project's needs. If this information is not included, Consultants and Contractors are to provide the following quantities of their respective manuals as detailed below:

Document	Draft Manuals Quantity	Final Version Quantity	Source
Contractor Equipment Operation and Maintenance Manual, including the following: – Control System Hardware Manuals – Software User's Manual – Configuration Manual – Custom Software Manuals – Source Materials – Drawings – copies – Drawings - reproducible	6	6	Contractor

.3 In addition to the printed copies shown above, provide an electronic document version for each submission. (see notes below).

.1 Printed Format:

a. Bind manuals in hard covered, loose-leaf, vinyl flat back binders for holding three-hole, ANSI Standard size A (8.5x11) paper stock.

(a) The manuals may be subdivided into as many volumes as required.

(b) Do not use binders more than 80mm thick.

(c) Use binders that are the same in appearance except for contents labeling.

(d) Lithographically print the Owner's name, Contract description and number and volume number on the front cover of each binder.

(e) Identify the manual title, and volume number on the back edge (spine).

.2 Print documents in accordance with the following requirements:

a. Use a clear 20mm margin on the top, bottom and right edge. Use a clear 30mm margin on the left (binding) edge.

b. Use either ANSI Size A (8.5 x 11) for text and drawings or Size B (11 x 17) for drawings.

c. Do not reduce originals to a degree which compromises legibility.

d. Have no lettering, symbols or characters less than font size 11in height.

e. Use plain font such as Times New Roman

f. Use offset, letterpress, diazo or xerographic print techniques. Do not use Xerograpy for pages which are available as offset or letterpress copies. Provide details which are crisp, black, dense and fully legible.

g. Punch materials for binding with holes to match the binders. Do not re-punch or inaccurately punch pages.

.3 Electronic Format:

a. The Contractor shall structure the electronic documents in the format required by the City and the Consultants shall ensure that these requirements are included in the contract document. The Contractor shall submit the electronic document to the Consultants and the City for inclusion in the Toronto Water Document Management System (eDOCS) so they can be associated with data stored in the Works-wide Maintenance Management System.

b. Provide electronic documents on CD/DVD-ROM.

c. Provide electronic documents in its native format (i.e. Word, Excel, Access, AutoCAD etc) as appropriate. Use the software version cited in Toronto Water standards as the current authorized version.

.4 Contents:

a. Organize operation and maintenance manuals to include the specified information. The order of the material in the manuals may differ from the specifications.

(a) Provide a table of contents in each binder for the contents of all volumes.

(b) Provide a table of contents specific to the material in the binder or manual. Identify subject matter by title and page number.

(c) Provide a list of illustrations with each manual and include the number, title, and page number of each illustration.

.5 Identify products by their functional names in the table of contents and at least once in each chapter or section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Do not use model or catalog numbers or letters for identification exclusively.

.6 Mark each product data sheet to identify the specific products and component parts used and applicable data. Delete inapplicable information.

.7 Supplement product data sheets with drawings and text to fulfill specified requirements of the operation and maintenance manuals.

.8 Provide licenses required for operation, indicating required renewal dates if necessary.

.9 Include the following in the operation and maintenance manuals:

a. Description of equipment and software

b. Theory of operation

c. Applicable circuit diagrams and schematics

d. Calibration procedures

e. Preventive maintenance schedule

f. Corrective maintenance procedures

g. Parts lists applicable to equipment

h. Testing certifications, inspection reports, Contractor's verification reports and final performance acceptance test.

i. Guarantees/warranties and their terms and conditions, as well as their expiry dates.

1.3 CONTRACTOR EQUIPMENT O&M MANUAL – PREPARED BY CONTRACTOR

.1 Equipment and Instrument Descriptions: Provide the following information for each model piece of equipment and instrument:

.1 Manufacturer's design and performance specification data and descriptive literature.

.2 Equipment dimensions, installation requirements, typical mounting details showing methods and materials required for installation and recommendations.

.3 Required and optional accessories lists.

.4 List of recommended spare parts and spare parts provided.

.5 Electrical/pneumatic signal and power connection diagrams.

.6 Operation and maintenance manuals.

.2 Provide a written narrative describing the operating parameters, product maintenance requirements, performance limitations, warranty requirements, and recommended inspection requirements.

.3 Instrument Data Sheets:

.1 Data sheets have been prepared during design and implementation to cover each instrument.

.2 Each instrument will be listed and pertinent information recorded including: tag number and description, complete model number, ranges, setpoints, materials and special mounting details for non-typical applications.

.3 The data sheets will be based on ISA Standard -S20: *Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves*.

.4 The data forms are available for the following instruments:

a. Annunciators.

b. Receiver Instruments.

c. Potentiometer Instruments.

d. Flowmeters – Magnetic.

e. Flowmeters - Orifice Plates and Flanges.

f. Flowmeters - Positive Displacement Meters.

g. Flowmeters - Rotameters (Variable Area Flowmeters).

h. Flowmeters – Turbine.

i. Level Instruments - Capacitance Type.

j. Level Instruments - Displacer or Float.

k. Level Instruments - Gage Glasses and Cocks.

l. Pressure Instruments.

m. Pressure Gages.

n. Pressure Switches.

o. Temperature Instruments - Filled System.

p. Temperature Instruments - Industrial Bimetal and Glass Thermometers.

q. Temperature Instruments - Resistance Temperature Sensors.

r. Temperature Instruments - Thermocouples and Thermowells.

.5 Data forms are also available for the following control devices:

a. Valves - Control Valves.

b. Valves - Pressure Control Valves, Pilots and Regulators.

c. Valves - Pressure Relief Valves.

d. Valves - Self-Actuated Temperature Regulator.

e. Valves - Solenoid Valves.

f. Rupture Discs.

g. Traps and Drainers.

.4 Calibration Certificates and shop drawings for mounting fixtures from the manufacturer shall be submitted for each instrument calibrated prior to installation.

1.4 CONTROL SYSTEM HARDWARE MANUALS – PREPARED BY CONTRACTOR

.1 General:

.1 Cover equipment comprising the system in the hardware instruction manuals. Provide instructions for operation and maintenance of the installed system as well as operation and maintenance instructions for the individual equipment units comprising the system.

.2 Provide a level of comprehension so that an experienced electronics or instrumentation and control technician can understand them. Convey an understanding of how the system operates and provide sufficient procedures for operation and maintenance. Use abbreviated tabular data such as charts, tables, checklists and diagrams, whenever practical, in lieu of written text. Make drawings, tables, etc. an integral part of the manuals.

.3 Standard hardware manuals will be acceptable, provided that sheets are included to explain the specific models and options of the equipment provided.

1.5 ORGANIZATION AND CONTENT

.1 Provide, in an introduction section, a brief explanation of the function of the equipment covered. Be concise and do not include detailed descriptions. Provide a quick orientation to the use and purpose of the manual and its relationship to the system and/or equipment.

.2 Describe, in a safety precautions section, major hazards to personnel and equipment that are peculiar to the equipment or jobs covered. Intersperse specific hazard information, cautions or warning notes at appropriate points throughout other sections of the manual.

.3 Limit a physical description section to physical description (size, dimension, weight, special attachments and physical orientation or clearances for installation and operation. Identify any special environmental (cooling, exhausting, or noise) constraints.

.4 Explain, in a functional description section, how the various functions operate together to cause the desired results. Include block diagrams and flow diagrams for clarification and understanding. Provide text and diagrams which mutually support each other.

.5 Include maintenance oriented operating procedures for the individual equipment in an operating procedures section so that maintenance personnel will be able to verify proper operation.

.6 Describe each equipment, unit, and assembly in detail with regard to technical or theoretical operation. Include information to the component level. Describe each circuit and mechanical mechanism. Cross-reference descriptions so that the functions of each

equipment are covered. Use schematic diagrams, sketches, equivalent diagrams, tables, and graphs to supplement the text.

.7 Include the applicable checkout, troubleshooting, servicing, removal and replacement, and in-place repair procedures which are performed on the equipment, stand-alone and on a system basis. Provide written procedures for each and every adjustment point of the equipment.

.8 Provide a tabular listing of special tools, equipment, and test equipment applicable to the test, adjustment and fault isolation procedures. Write maintenance instructions to enable correct use of test equipment.

.9 Provide checkout procedures to verify the satisfactory operation of the system, subsystem, or unit as applicable. If the checkout requires detailed step-by-step procedure, include such procedures. Clearly indicate why the checkout is performed and what conditions are to be satisfied.

.10 Provide troubleshooting procedures to isolate faulty components. Sequence the troubleshooting procedures in logical progression from malfunction indication to location of the faulty component(s). Indicate special connections or test equipment required for the troubleshooting.

.11 Provide servicing requirements for cleaning, lubricating, replenishing, and other housekeeping and preventative maintenance procedures that apply to the particular equipment. Make reference to the applicable manuals which describe various servicing procedures.

.12 Provide removal and replacement procedures which contain step-by-step instructions for removal and replacement of items which are subject to frequent replacement. If special tools are required, identify them by name and part number.

.13 Provide schematic diagrams, logic diagrams, and associated data necessary for maintenance personnel to trace circuits, make continuity checks, and accomplish general and specific troubleshooting on inoperative or malfunctioning circuits. Provide pin wiring diagrams and cabling and plug tables showing to-and-from wiring information. Provide a symbol chart where necessary to explain graphic symbols that appear on diagrams.

.14 Provide parts lists for equipment. Provide clear traceability from the equipment to the replaceable component. Identify each component part with original manufacturer's name and part number. Identify component parts, or assemblies modified for the project by a part number. The parts lists may be tabulated or may be supplied in the form of engineering or manufacturing drawings.

1.6 SOFTWARE USER'S MANUAL – PREPARED BY CONTRACTOR

.1 Provide a development manual which defines how the various software components are used and how the basic system may be altered using this software.

.2 Describe the following:

.1 Operating system use.

.2 System software including compilers, editors, system utilities and file handlers.

.3 User packages including data base generator, graphics generator, report generator, historical data system, process control language and general operator workstation interface.

.4 System operation including cold start, warm start, time/date initialization and backup procedures.

.5 System reconfiguration and regeneration procedures.

1.7 CONFIGURATION MANUAL – PREPARED BY CONTRACTOR

.1 Provide a configuration manual which describes how software in the final system is configured. Describe the unique data and parameters of the system.

.2 Include the following:

.1 Point database showing parameters of points, including process I/O, internal points and calculations.

.2 Controller configurations, including software, points, control modules, spare I/O and memory.

.3 System memory allocation.

.4 Historical data configuration.

.5 Display organization and configuration.

1.8 CUSTOM SOFTWARE MANUALS – PREPARED BY CONTRACTOR

.1 Provide complete documentation for all software developed specifically to meet requirements of this Contract, i.e. modifications to standard software and nonstandard software.

.1 Structure the documentation such that each level develops a different degree of detail.

.2 Begin with a broad approach (Systems Manual), focus on smaller pieces of the overall system (Subsystem Documentation) and finally pinpoint the finest detail (Program Documentation).

.2 Provide a system's manual which describes the overall content of the systems software. Describe what is included in the software and not how the components function. Provide a global view of the system and a complete description of the interaction of the various software subsystems. Include the following:

.1 Table of contents.

.2 Overall narrative of the system including special techniques and general philosophies.

.3 A block diagram showing the interaction of all subsystems.

.4 A list of subsystems including a brief discussion of the purpose of each.

.5 A list of programs included, categorized by the subsystem to which each belongs.

.6 A description of files or tables within the system which are not unique to any particular subsystem. Files or tables used uniquely within a subsystem may be defined therein.

.3 Provide manuals for each subsystem. Define the components of the particular subsystem, the relationships between the components and, in general, what occurs within the subsystem. For each subsystem, include:

.1 Table of contents.

.2 Overview which describes the purpose and scope of the subsystem.

.3 Narrative which details the operation of the subsystem, completely describing how the subsystem works, what are the specific components (programs, files, process points, tables, etc.) and how they interact.

.4 Flowchart which depicts the overall system, showing components and their interactions.

.5 Report summary which includes a list of reports produced by the subsystem and a layout of each.

.6 Display summary which includes a list of displays produced by the subsystem and a layout of each.

.7 Input/output summary which includes a list of inputs and outputs (e.g., process points, tables, and files) pertinent to the subsystem.

.4 Fully document every program. Define the details of the particular program and show how each function is performed. For each program, include:

.1 Table of contents.

.2 Overview which describes the scope and purpose of the program.

.3 Narrative which describes exactly how the program functions. Include any calculations and process points.

.4 Data flow diagrams (DFD) which show the program and inputs, outputs, files, or process points used.

.5 Program structure chart (PSC) which shows the hierarchy of the program logic.

.6 List of variables which defines each variable name in the program, including specific characteristics (e.g., real, integer, and array).

.5 Provide memory maps of main and mass memory storage. On memory maps, show the numbered locations of absolute storage areas and information stored in these locations.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

R.C. HARRIS WATER FILTRATION PLANT
FILTRATION & BACKWASH - Process Control Narrative

Version	Date	Notes
1.0	August 2001	Draft 1 – Issued for Review.
2.0	October 2001	Draft 2 – Issued for Review.
3.0	November 2001	Process Narrative Issue For Tender
4.0	September 2004	Process Narrative Issued for As Built
5.0	January 2008	Added UPS Monitoring
6.0	March 2012	Updated for Scope of Legacy Alarms Improvement Project: • Updated I/O Descriptions • Added Description of Chlorine Analyzers Control/Reference Selection • Updated Analog Alarms Set Points Tables • Updated Alarm Lists in the Appendix
7.0	May 2015	Modified Filters for SLC Replacement Logic
8.0	February 2017	Updated Chlorine and Liquid Chemical Sections to Reflect Removal of SLC's
9.0	March 2017	Corrosion Control Section Added
10.0	July 2017	Updated Formatting to Create Master Package with RMF PCN

List of Tables

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List of Acronyms

ACP	Area Control Panel
AI	Analog Input
AO	Analog Output
CA	Computer Auto
CBP	Central Back-Up Panel
CM	Computer Manual
CT	Concentration & Time
DI	Digital Input
DO	Digital Output
EBCT	Empty Bed Contact Time
FHA	R.C. Harris Filtration Plant
GAC	Granular Activated Carbon
HMI	Human Machine Interface
I/O	Input/Output
LA	Local Auto
LCP	Local Control Panel
LM	Local Manual
MCC	Motor Control Center
NTU	Nephelometric Turbidity Units

PCN	Process Control Narrative
PCS	Process Control Systems
PID	Proportional, Integrative, Derivative
P&ID	Process & Instrumentation Diagram
PLC	Programmable Logic Controller
PV	Process Variable
PVC	Polyvinyl Chloride
RMF	Residue Management Facility
RPM	Revolutions Per Minute
RPU	Remote Processing Unit
RW	Raw Water
SBS	Sodium Bisulphite
SCADA	Supervisory Control and Data Acquisition
SLC	Single Loop Controller
SP	Set Point
SV	Set-Point Variable
TOO	Transmission Operations Optimizer
VFD	Variable Frequency Drive

9. FILTRATION & BACKWASH

9.1 PROCESS DESCRIPTION

A. Process Overview

- **Reference P&ID Drawing(s)2F-P&ID-I-1201**
- 2F-P&ID-I-1301
- 2F-P&ID-I-1302
- 2F-P&ID-I-1303
- 2F-P&ID-I-1304
- 2F-P&ID-I-1305
- 2F-P&ID-I-1306
- 2F-P&ID-I-1307
- 2F-P&ID-I-1308
- 2F-P&ID-I-1309
- 2F-P&ID-I-1310
- 2F-P&ID-I-1311
- 2F-P&ID-I-1312
- 2F-P&ID-I-1313
- 2F-P&ID-I-1314
- 2F-P&ID-I-1315
- 2F-P&ID-I-1316
- 2F-P&ID-I-1317
- 2F-P&ID-I-1318
- 2F-P&ID-I-1319
- 2F-P&ID-I-1320
- 2F-P&ID-I-1321
- 2F-P&ID-I-1322
- 2F-P&ID-I-1323
- 2F-P&ID-I-1324
- 2F-P&ID-I-1325
- 2F-P&ID-I-1326
- 2F-P&ID-I-1327
- 2F-P&ID-I-1328
- 2F-P&ID-I-1329
- 2F-P&ID-I-1330
- 2F-P&ID-I-1331
- 2F-P&ID-I-1332
- 2F-P&ID-I-1333
- 2F-P&ID-I-1334
- 2F-P&ID-I-1335
- 2F-P&ID-I-1336
- 2F-P&ID-I-1337
- 2F-P&ID-I-1338
- 2F-P&ID-I-1339
- 2F-P&ID-I-1340
- 2F-P&ID-I-1401
- 2F-P&ID-I-1402
- 2F-P&ID-I-8501
- 2F-P&ID-I-8502

The filtration process consists of the filter system and the backwash system. The filter system is comprised of 40 dual media (GAC/sand) filters fed from the East and West common settled water conduit. Each filter has the following equipment:

- Filter rate control valve
- Venturi flow meter on effluent line
- Turbidimeter on effluent line
- Filter inlet gate
- Filter drain gate
- Filter head loss monitor
- Filter backwash valve
- Surface sweep valve
- Level switches

The backwash system includes the following equipment:

- 3 Backwash pumps
- 1 Venturi flow meter

- 2 Backwash water holding tanks
- 2 Backwash header valves
- 2 Backwash flow meters

Filtration occurs directly after the sedimentation process and prior to discharge to the plant reservoir via the filtered water conduits.

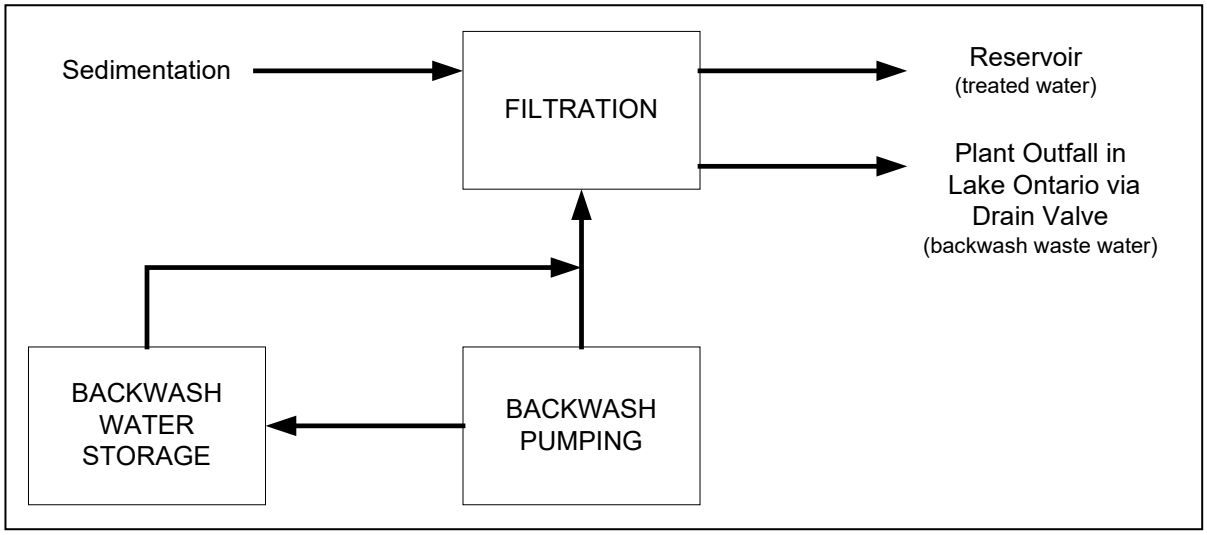


Figure 1: Filtration & Backwash Process Schematic

B. Objectives

The purpose of the filtration process at the R.C. Harris Water Filtration Plant is to remove particles from pre-treated water that have not been removed by the sedimentation process.

The quality objectives of the filter system are to consistently achieve the City of Toronto's filter effluent turbidity targets and to maximize particulate removal through this process. Filtration acts as the main removal barrier to water borne pathogens in the overall treatment process.

The objectives of the backwash system are to efficiently and effectively remove particulate matter that has been trapped in the filter during filtration, while minimizing media, sand and GAC loss and minimizing process waste production.

C. Process Control Strategy

At any given time, individual filters are:

- In-service
- Out-of-service – available for production
- Out-of-service – not available for production
- Backwashing (including filters queued for backwash)

The process control strategy for filtering is designed to evenly distribute the required plant filter flow among all in-service filters by maintaining a constant settled water conduit level or a constant master filtration rate.

At any time, a filter will be taken out of service and placed in the backwash queue if any of the following parameters are exceeded:

- Filter runtime of 96 hours
- Terminal head loss of 1.50 m

- Filter effluent turbidity > operator adjustable action level (0.15 NTU)
- Idle time exceeds 24 hours.

D. Influent Sources

The Filtration & Backwash System is fed by three (3) influent streams:

- Settled water from the Settled Water Conduits
- Potable water for backwashing
- Potable water for surface sweeps

E. Effluent Destinations

The Filtration & Backwash System feeds two (2) effluent destination:

- Filtered water to the plant Reservoir via the Filtered Water Conduits
- Backwash water to the Decant Tank(s) via the Diversion Chamber in the RMF

F. Process Equipment & Control Devices

The following table outlines the process equipment associated with the Filtration & Backwash System. Note that tags are only given for Filter #1 for brevity. All filters contain similar equipment.

Table 1: Filtration & Backwash Process Equipment

Tag No	Equipment Description	Device Operation	Control Objectives
FHA-FLT-F-0101	Filter #1	Filters Water	None
FHA-FLT-V-0101	Filter Rate Control Valve	Modulates to control effluent flow from the filter.	To evenly distribute the plant flow to each in-service filter based on the Master Filter Rate, which is the raw water divided by the number of filters in service. Hardware Interlocked with Surface Sweep Valves and Filter Backwash Valves to close when the later are open, and on UPS fault.
FHA-FLT-G-0101	Filter Inlet Gate	Opens/closes in response to control signals to control water flow into Filter	Act as a part of service mode control.
FHA-FLT-G-0102	Filter Drain Gate	Opens/closes in response to control signals to allow backwash wastewater to flow from the filter.	Act as a part of service mode control.
FHA-FLT-V-0102	Filter Backwash Valve	Opens/closes in response to control signals to control backwash flowrate.	To maintain the desired backwash flow rate. Hardwired interlock with Filter Rate Control Valves to close when the latter is open.
FHA-FLT-V-0103	Surface Sweep Valve	Opens/closes in response to control signals to control flow to surface sweeps.	On/Off control of the surface wash function. Hardware Interlocked with Filter Rate Control Valves to close when the latter is open.
FHA-BW-T-0101	Wash Water Tank #1	Stores water for backwashing	None
FHA-BW-T-0201	Wash Water Tank #2	Stores water for backwashing	None

Tag No	Equipment Description	Device Operation	Control Objectives
FHA-BW-V-0105	West Washwater header Valve	Opens/closes in response to control signals to control flow of washwater	Maintain desired flow during a backwash cycle
FHA-BW-V-0205	East Washwater header Valve		
FHA-BW-P-0501 FHA-BW-P-0601 FHA-BW-P-0701	Backwash Pump(s)	Pumps water to Wash Water Tanks	Maintain water level in Wash Water Tanks sufficient for backwash requirements.
FHA-BW-P-0503 FHA-BW-P-0603 FHA-BW-P-0703	Backwash Pump Discharge Valve	Opens/closes in response to control signals to isolate pump	Interlocked with pump control
FHA-BW-V-0001 FHA-BW-V-0002	Backwash Pump Inlet Isolation Valve	Opens/closes manually to isolate common pump header	Manually operated
FHA-BW-V-0501 FHA-BW-V-0601 FHA-BW-V-0701	Backwash Pump Suction valve	Opens/closes manually to isolate inlet to respective Backwash Pump	Manually operated
FHA-BW-V-0502 FHA-BW-V-0602 FHA-BW-V-0702	Backwash Pump Check Valve	Prevents backflow through respective Backwash pump	None

The following table outlines the control instruments associated with the Filtration & Backwash System:

Table 2: Filtration & Backwash Control Instruments

Tag No	Instrument Description	Device Operation	Control Objectives
FHA-FLT-LIT-0101	West Settled Water Conduit Level Transmitter	Continuously monitors water level in the West Settled Water Conduit	To match total filtration rate to low lift production, or total plant flow before backwashing. Compared to the West and East Settled Water Conduit set-point via PID controller to generate Master Filter Rate.
FHA-FLT-LIT-0201	East Settled Water Conduit Level Transmitter	Continuously monitors water level in the East Settled Water Conduit	
FHA-FLT-LSHL-0101	Filter Water Level Switch	Continuously monitor water level in the filter	Interlocked with filter rate control valve to take filter out-of-service if contact made
FHA-FLT-AIT-0101	Filter Effluent Turbidimeter	Continuously monitors effluent turbidity of a given filter	Signal a backwash when set point is exceeded
FHA-FLT-FIT-0101	Filter Effluent Venturi Flowmeter	Continuously monitors effluent flow from a given filter	To evenly distribute the plant flow to each in-service filter based on the Master Filter Rate divided by the number of filters in service. Compared to individual filter flow set-point via PID loop to modulate filter effluent control valve.
FHA-FLT-PDIT-0101	Filter Head Loss Transmitter	Continuously monitors head loss through a given filter	Signal a backwash when set point is exceeded
FHA-BW-FIT-0001	Wash Water Venturi Flowmeter	Monitors flow from Backwash Pumps	Trending/tracking of flow
FHA-BW-FIT-0101	West backwash Flowmeter	Monitors flow of wash water to west filters	Maintain desired flow during backwash cycles

Tag No	Instrument Description	Device Operation	Control Objectives
FHA-FLT-LIT-0101	West Settled Water Conduit Level Transmitter	Continuously monitors water level in the West Settled Water Conduit	To match total filtration rate to low lift production, or total plant flow before backwashing. Compared to the West and East Settled Water Conduit set-point via PID controller to generate Master Filter Rate.
FHA-FLT-LIT-0201	East Settled Water Conduit Level Transmitter	Continuously monitors water level in the East Settled Water Conduit	
FHA-BW-FIT-0201	East Backwash Flowmeter	Monitors flow of wash water to east filters	

9.2 CONTROL SYSTEM DESCRIPTION

A. Control Modes & Hierarchy

A.1 Hierarchal Overview

For the Filtration & Backwashing Process, 4 levels of control exist. However, depending upon the extent of complexity, some equipment may have fewer levels of control.

- Level 1: Field Device Control
- Level 2: Local / Area Control
- Level 3: RPU Control
- Level 4: SCADA Control

Level 1: A selection switch Local/Remote (L/R) is provided at the field device. By selecting L at the device, operation is disabled from any higher level. By selecting R, the device control is passed on to the next higher level.

Level 2: A selection switch Computer/Local (C/L) is provided at this level on the Local/Area Control Panel. By selecting L at this level the device is operable from the panel and operation from any higher level is disabled. By selecting C, the control is passed on to the next higher level and commands from SCADA are in effect.

Level 3: This level consists of the RPU for the process and all automated control and monitoring functionality is at this level.

Level 4: This level consists of the Supervisory Control and Data Acquisition (SCADA) work stations. These work stations are networked and placed at various locations throughout the facility. The SCADA system provides the following functionality and includes the database necessary for its support:

- Level 2 Computer / Local status
- Manual/Auto mode command
- Manual/Auto mode status

There are a total of 13 PLC's associated with the filtration process. There is a PLC dedicated to every set of four filters (1, 2, 3 & 4 / 5, 6, 7 & 8, etc.) that controls the automatic backwashing aspects of the filtration process. There is a totalizer PLC associated with totalizing values to be used for process on the other PLCs. There is a CBP PLC dedicated to calculating the master flow set point based on the current settled water conduit level. The filter 17-20 PLC is designated as the master PLC and is backed up by the filter 21-24 PLC in case of failure. The master PLC handles backwash queuing and automatic filter start-up/shut-down operation. There is one master CBP PLC working with two Indicator/Controllers to control the master filter rates based on the raw water flow and the settled water conduit levels. The master CBP PLC will automatically calculate the flow rates and send that information to the Master Filter PLCs via the SCADA network. In the case that the Master CBP PLC is not operational, the

Indicator/Controllers can be used to manually enter a flow signal to be sent out to all of the east or west filter PLCs. This flow would require manual calculations to be done by operations. Additionally the backwash pumping system has a PLC of its own. The system can be operated manually or automatically in SCADA mode.

The backwash pumps and associated discharge valves both have Local/Remote switches. In Local, this equipment can be operated locally and manually. In Remote, control of this equipment is passed up to a higher level of control.

A.2 Process Control Modes

The Control Modes for the Filtration & Backwash Process are as follows:

Local Manual (LM): This mode is available at Level 1 and 2.

Level 1:
- H/O/A switch on the LCP/actuator for a given valve is set to H
- L/R switch on the ACP for a given backwash pump is set to L
- L/R switch on the LCP/actuator for a given backwash discharge valve is set to L

It is recommended that operation in FIELD/MANUAL only be used in emergency situations as its inherent limitations in overall monitoring makes operating awkward and possibly unsafe. A maintenance test can also be performed with a push-button from the switchgear when withdrawn in the test position. Control circuitry is applied and main power disconnected. All interlocks are bypassed.

The Suction Valve must be opened and Discharge Valve must be closed for a Backwash Pump start command. Automatic start and stop of the backwash pumps can only be achieved with the hardwired emergency backup washwater tank level transmitters.

Filter valves are opened/closed manually by the operator at the device. Backwash pumps are started/stopped locally. There is an interlock on the backwash pump start command that opens the respective discharge valve. However, the discharge valve can be manually adjusted locally if necessary.

Level 2:
- H/O/A switch on the LCPs/actuators for all filter valves are set to A
- ACP/PLC switch on the PLC panel is set to ACP

Filter valves are opened/closed manually at the ACP. The filter rate valve is controlled via the Indicator/Controller by inputting the desired valve position. Backwash sequencing cannot be achieved automatically in this mode.

To operate the backwash pumps in this mode:

- H/O/A switches on the LCP for all the backwash pumps are set to A
- L/R switch on the ACP is set to L

Automatic start and stop of the backwash pumps can only be achieved with the hardwired emergency backup washwater tank level transmitters.

Computer Manual (CM): This mode is available at Level 4. SCADA manual control is typically available at the area operator workstation and central operator station.

- H/O/A switches on the LCPs/actuators for all filter valves is set to A
- ACP/PLC switch on the PLC panel is set to PLC
- SCADA/MANUAL is selected at an HMI

The filtration control mode for each of the filters to be operated in this mode must be selected as SCADA/MANUAL at the SCADA view node. Filter valves are opened/closed manually at the SCADA HMI. The filter rate valve is

controlled via the SCADA HMI by inputting the desired valve position (in per cent). Backwash sequencing cannot be achieved automatically in this mode.

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP can be either L or A

Automatic start and stop of the backwash pumps can only be achieved with the CBP L/A Switch in Auto or by the hardwired emergency washwater tank level transmitters.

Computer Auto (CA): This mode is available at Level 4. The devices are set to automatic mode at area operator workstation or the central operator station.

SCADA/AUTO:

- H/O/A switch on the LCPs/actuators for all filter valves is set to A
- ACP/PLC switch on the PLC panel is set to PLC
- L/R switch on the ACP for a given backwash discharge valve is set to R
- Filter has flow >25 L/s and SCADA HMI indicates "Filtering"
- SCADA/AUTO is selected at an HMI

The filtration control mode for each of the filters to be operated in this mode must be selected as SCADA/AUTO at the SCADA HMI. In other words, it is possible to operate some filters in another mode, while operating the majority in SCADA/AUTO. Filter valves are opened/closed automatically by the PLC. The filter rate valve is controlled automatically based on an operator entered flow set point on the SCADA HMI. A flow set point is entered in the rate control valve popup to automatically control the rate valve position and maintain the desired flow.

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP is set to A

SCADA/MASTER:

- H/O/A switch on the LCPs/actuators for all filter valves is set to A
- ACP/PLC switch on the PLC panel is set to PLC
- L/R switch for a given backwash pump is set to R
- L/R switch on the LCP for a given backwash discharge valve is set to R
- SCADA/MASTER is selected at an HMI

In SCADA/MASTER mode, the “START” button on the Filter Control popup may be pressed if the Filter is “IDLE” or “OUT OF SERVICE”. The Filter will be considered “FILTERING” once a filter flow rate of 25 L/s or greater has been achieved. The filtration control mode for each of the filters to be operated in this mode must be selected as SCADA/MASTER at the SCADA view node. In other words, it is possible to operate some filters in another mode, while operating the majority in SCADA/MASTER. Filter valves are opened/closed automatically by the PLC. The filter rate valve is controlled automatically based on the Master Flow Rate set point received from the Master PLC.

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP is set to A

All of the backwash pumps to be operated in this mode must be set to Computer-Auto to automatically start and stop based one operator wash water tank set points. The pumps will start in a staggered fashion (20 seconds apart).

CBP/LOCAL:

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP is set to L

Pumps in this mode are started with a spring return switch.

The following table identifies the control modes and their hierarchy level for the equipment in the Filtration & Backwash Process:

Table 3: Filtration & Backwash Control Modes & Hierarchy

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Master Filter Rate Control Valve(s) #1 - 4 FHA-FLT-V-0101 FHA-FLT-V-0201 FHA-FLT-V-0301 FHA-FLT-V-0401	L/R at Valve	None	RPU-1721	Status monitoring and control
Master Filter Rate Control Valve(s) #5 - 8 FHA-FLT-V-0501 FHA-FLT-V-0601 FHA-FLT-V-0701 FHA-FLT-V-0801	L/R at Valve	None	RPU-1722	Status monitoring and control
Master Filter Rate Control Valve(s) #9 - 12 FHA-FLT-V-0901 FHA-FLT-V-1001 FHA-FLT-V-1101 FHA-FLT-V-1201	L/R at Valve	None	RPU-1723	Status monitoring and control
Master Filter Rate Control Valve(s) #13 - 16 FHA-FLT-V-1301 FHA-FLT-V-1401 FHA-FLT-V-1501 FHA-FLT-V-1601	L/R at Valve	None	RPU-1724	Status monitoring and control
Master Filter Rate Control Valve(s) #17 - 20 FHA-FLT-V-1701 FHA-FLT-V-1801 FHA-FLT-V-1901 FHA-FLT-V-2001	L/R at Valve	None	RPU-1822	Status monitoring and control
Master Filter Rate Control Valve(s) #21 - 24 FHA-FLT-V-2101 FHA-FLT-V-2201 FHA-FLT-V-2301 FHA-FLT-V-2401	L/R at Valve	None	RPU-1823	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Master Filter Rate Control Valve(s) #25 - 28 FHA-FLT-V-2501 FHA-FLT-V-2601 FHA-FLT-V-2701 FHA-FLT-V-2801	L/R at Valve	None	RPU-1621	Status monitoring and control
Master Filter Rate Control Valve(s) #29 - 32 FHA-FLT-V-2901 FHA-FLT-V-3001 FHA-FLT-V-3101 FHA-FLT-V-3201	L/R at Valve	None	RPU-1622	Status monitoring and control
Master Filter Rate Control Valve(s) #33 - 36 FHA-FLT-V-3301 FHA-FLT-V-3401 FHA-FLT-V-3501 FHA-FLT-V-3601	L/R at Valve	None	RPU-1623	Status monitoring and control
Master Filter Rate Control Valve(s) #37 - 40 FHA-FLT-V-3701 FHA-FLT-V-3801 FHA-FLT-V-3901 FHA-FLT-V-4001	L/R at Valve	None	RPU-1624	Status monitoring and control
Filter Inlet Gate(s) #1 - 4 FHA-FLT-G-0101 FHA-FLT-G-0201 FHA-FLT-G-0301 FHA-FLT-G-0401	L/R at Gate	Respective Filter Console	RPU-1721	Status monitoring and control
Filter Inlet Gate(s) #5 - 8 FHA-FLT-G-0501 FHA-FLT-G-0601 FHA-FLT-G-0701 FHA-FLT-G-0801	L/R at Gate	Respective Filter Console	RPU-1722	Status monitoring and control
Filter Inlet Gate(s) #9 - 12 FHA-FLT-G-0901 FHA-FLT-G-1001 FHA-FLT-G-1101 FHA-FLT-G-1201	L/R at Gate	Respective Filter Console	RPU-1723	Status monitoring and control
Filter Inlet Gate(s) #13 - 16 FHA-FLT-G-1301 FHA-FLT-G-1401 FHA-FLT-G-1501 FHA-FLT-G-1601	L/R at Gate	Respective Filter Console	RPU-1724	Status monitoring and control
Filter Inlet Gate(s) #17 - 20 FHA-FLT-G-1701 FHA-FLT-G-1801 FHA-FLT-G-1901 FHA-FLT-G-2001	L/R at Gate	Respective Filter Console	RPU-1822	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Filter Inlet Gate(s) #21 - 24 FHA-FLT-G-2101 FHA-FLT-G-2201 FHA-FLT-G-2301 FHA-FLT-G-2401	L/R at Gate	Respective Filter Console	RPU-1823	Status monitoring and control
Filter Inlet Gate(s) #25 - 28 FHA-FLT-G-2501 FHA-FLT-G-2601 FHA-FLT-G-2701 FHA-FLT-G-2801	L/R at Gate	Respective Filter Console	RPU-1621	Status monitoring and control
Filter Inlet Gate(s) #29 - 32 FHA-FLT-G-2901 FHA-FLT-G-3001 FHA-FLT-G-3101 FHA-FLT-G-3201	L/R at Gate	Respective Filter Console	RPU-1622	Status monitoring and control
Filter Inlet Gate(s) #33 - 36 FHA-FLT-G-3301 FHA-FLT-G-3401 FHA-FLT-G-3501 FHA-FLT-G-3601	L/R at Gate	Respective Filter Console	RPU-1623	Status monitoring and control
Filter Inlet Gate(s) #37 - 40 FHA-FLT-G-3701 FHA-FLT-G-3801 FHA-FLT-G-3901 FHA-FLT-G-4001	L/R at Gate	Respective Filter Console	RPU-1624	Status monitoring and control
Filter Drain Gate(s) #1 - 4 FHA-FLT-G-0102 FHA-FLT-G-0202 FHA-FLT-G-0302 FHA-FLT-G-0402	L/R at Gate	Respective Filter Console	RPU-1721	Status monitoring and control
Filter Drain Gate(s) #5 - 8 FHA-FLT-G-0502 FHA-FLT-G-0602 FHA-FLT-G-0702 FHA-FLT-G-0802	L/R at Gate	Respective Filter Console	RPU-1722	Status monitoring and control
Filter Drain Gate(s) #9 - 12 FHA-FLT-G-0902 FHA-FLT-G-1002 FHA-FLT-G-1102 FHA-FLT-G-1202	L/R at Gate	Respective Filter Console	RPU-1723	Status monitoring and control
Filter Drain Gate(s) #13 - 16 FHA-FLT-G-1302 FHA-FLT-G-1402 FHA-FLT-G-1502 FHA-FLT-G-1602	L/R at Gate	Respective Filter Console	RPU-1724	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Filter Drain Gate(s) #17 - 20 FHA-FLT-G-1702 FHA-FLT-G-1802 FHA-FLT-G-1902 FHA-FLT-G-2002	L/R at Gate	Respective Filter Console	RPU-1822	Status monitoring and control
Filter Drain Gate(s) #21 - 24 FHA-FLT-G-2102 FHA-FLT-G-2202 FHA-FLT-G-2302 FHA-FLT-G-2402	L/R at Gate	Respective Filter Console	RPU-1823	Status monitoring and control
Filter Drain Gate(s) #25 - 28 FHA-FLT-G-2502 FHA-FLT-G-2602 FHA-FLT-G-2702 FHA-FLT-G-2802	L/R at Gate	Respective Filter Console	RPU-1621	Status monitoring and control
Filter Drain Gate(s) #29 - 32 FHA-FLT-G-2902 FHA-FLT-G-3002 FHA-FLT-G-3102 FHA-FLT-G-3202	L/R at Gate	Respective Filter Console	RPU-1622	Status monitoring and control
Filter Drain Gate(s) #33 - 36 FHA-FLT-G-3302 FHA-FLT-G-3402 FHA-FLT-G-3502 FHA-FLT-G-3602	L/R at Gate	Respective Filter Console	RPU-1623	Status monitoring and control
Filter Drain Gate(s) #37 - 40 FHA-FLT-G-3702 FHA-FLT-G-3802 FHA-FLT-G-3902 FHA-FLT-G-4002	L/R at Gate	Respective Filter Console	RPU-1624	Status monitoring and control
Backwash Valve(s) #1 - 4 FHA-FLT-V-0102 FHA-FLT-V-0202 FHA-FLT-V-0302 FHA-FLT-V-0402	L/R at Valve	Respective Filter Console	RPU-1721	Status monitoring and control
Backwash Valve(s) #5 - 8 FHA-FLT-V-0502 FHA-FLT-V-0602 FHA-FLT-V-0702 FHA-FLT-V-0802	L/R at Valve	Respective Filter Console	RPU-1722	Status monitoring and control
Backwash Valve(s) #9 - 12 FHA-FLT-V-0902 FHA-FLT-V-1002 FHA-FLT-V-1102 FHA-FLT-V-1202	L/R at Valve	Respective Filter Console	RPU-1723	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Backwash Valve(s) #13 - 16 FHA-FLT-V-1302 FHA-FLT-V-1402 FHA-FLT-V-1502 FHA-FLT-V-1602	L/R at Valve	Respective Filter Console	RPU-1724	Status monitoring and control
Backwash Valve(s) #17 - 20 FHA-FLT-V-1702 FHA-FLT-V-1802 FHA-FLT-V-1902 FHA-FLT-V-2002	L/R at Valve	Respective Filter Console	RPU-1822	Status monitoring and control
Backwash Valve(s) #21 - 24 FHA-FLT-V-2102 FHA-FLT-V-2202 FHA-FLT-V-2302 FHA-FLT-V-2402	L/R at Valve	Respective Filter Console	RPU-1823	Status monitoring and control
Backwash Valve(s) #25 - 28 FHA-FLT-V-2502 FHA-FLT-V-2602 FHA-FLT-V-2702 FHA-FLT-V-2802	L/R at Valve	Respective Filter Console	RPU-1621	Status monitoring and control
Backwash Valve(s) #29 - 32 FHA-FLT-V-2902 FHA-FLT-V-3002 FHA-FLT-V-3102 FHA-FLT-V-3202	L/R at Valve	Respective Filter Console	RPU-1622	Status monitoring and control
Backwash Valve(s) #33 - 36 FHA-FLT-V-3302 FHA-FLT-V-3402 FHA-FLT-V-3502 FHA-FLT-V-3602	L/R at Valve	Respective Filter Console	RPU-1623	Status monitoring and control
Backwash Valve(s) #37 - 40 FHA-FLT-V-3702 FHA-FLT-V-3802 FHA-FLT-V-3902 FHA-FLT-V-4002	L/R at Valve	Respective Filter Console	RPU-1624	Status monitoring and control
Surface Sweep Valve(s) #1 - 4 FHA-FLT-V-0103 FHA-FLT-V-0203 FHA-FLT-V-0303 FHA-FLT-V-0403	O/C	Respective Filter Console	RPU-1721	Status monitoring and control
Surface Sweep Valve(s) #5 - 8 FHA-FLT-V-0503 FHA-FLT-V-0603 FHA-FLT-V-0703 FHA-FLT-V-0803	O/C	Respective Filter Console	RPU-1722	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Surface Sweep Valve(s) #9 - 12 FHA-FLT-V-0903 FHA-FLT-V-1003 FHA-FLT-V-1103 FHA-FLT-V-1203	O/C	Respective Filter Console	RPU-1723	Status monitoring and control
Surface Sweep Valve(s) #13 - 16 FHA-FLT-V-1303 FHA-FLT-V-1403 FHA-FLT-V-1503 FHA-FLT-V-1603	O/C	Respective Filter Console	RPU-1724	Status monitoring and control
Surface Sweep Valve(s) #17 - 20 FHA-FLT-V-1703 FHA-FLT-V-1803 FHA-FLT-V-1903 FHA-FLT-V-2003	O/C	Respective Filter Console	RPU-1822	Status monitoring and control
Surface Sweep Valve(s) #21 - 24 FHA-FLT-V-2103 FHA-FLT-V-2203 FHA-FLT-V-2303 FHA-FLT-V-2403	O/C	Respective Filter Console	RPU-1823	Status monitoring and control
Surface Sweep Valve(s) #25 - 28 FHA-FLT-V-2503 FHA-FLT-V-2603 FHA-FLT-V-2703 FHA-FLT-V-2803	O/C	Respective Filter Console	RPU-1621	Status monitoring and control
Surface Sweep Valve(s) #29 - 32 FHA-FLT-V-2903 FHA-FLT-V-3003 FHA-FLT-V-3103 FHA-FLT-V-3203	O/C	Respective Filter Console	RPU-1622	Status monitoring and control
Surface Sweep Valve(s) #33 - 36 FHA-FLT-V-3303 FHA-FLT-V-3403 FHA-FLT-V-3503 FHA-FLT-V-3603	O/C	Respective Filter Console	RPU-1623	Status monitoring and control
Surface Sweep Valve(s) #37 - 40 FHA-FLT-V-3703 FHA-FLT-V-3803 FHA-FLT-V-3903 FHA-FLT-V-4003	O/C	Respective Filter Console	RPU-1624	Status monitoring and control
Washwater Header Valve(s) FHA-BW-V-0105 FHA-BW-V-0205	L/R at Valve	None	RPU-1223	Status monitoring and control
Backwash Pump(s) FHA-BW-P-0501 FHA-BW-P-0601 FHA-BW-P-0701	None	L/M/R at control panel in MCC	RPU-1223	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Backwash Pump Discharge Valve(s) FHA-BW-V-0503 FHA-BW-V-0603 FHA-BW-V-0703	L/R at Valve	None	RPU-1223	Status monitoring and control
Backwash Pump Suction Valve(s) FHA-BW-V-0501 FHA-BW-V-0601 FHA-BW-V-070	O/C	None	RPU-1223	Status monitoring
Backwash Pump Inlet Isolation valve(s) FHA-BW-V-0001 FHA-BW-V-0002	O/C	None	RPU-1223	Status monitoring

B. RPU Input / Output Signal List

Table 4: Filtration & Backwash RPU I/O List

I/O Tag No	Description	Type	RPU
FHA-FLT-ZIT-0101-ZI	FILTER #1 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0101-AI	FILTER #1 TURBIDITY	AI	1721
FHA-FLT-ZIT-0201-ZI	FILTER #2 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0201-AI	FILTER #2 TURBIDITY	AI	1721
FHA-FLT-ZIT-0301-ZI	FILTER #3 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0301-AI	FILTER #3 TURBIDITY	AI	1721
FHA-FLT-ZIT-0401-ZI	FILTER #4 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0401-AI	FILTER #4 TURBIDITY	AI	1721
FHA-SED-AIT-0101-AI	SEW TRB ANALYZER - WEST	AI	1721
FHA-DCL-AIT-0002B-AI	POST-SO2 CLR RESID#2B	AI	1721
FHA-DCL-AIT-0001-AI	PRE-SO2 CHLORINE RESID	AI	1721
FHA-DCL-AIT-0002A-AI	POST-SO2 CLR RESID#2A	AI	1721
FHA-TRW-AIT-0001-AI	TRW TOT CLR ANALYZER	AI	1721
FHA-TRW-AIT-0002-AI	TRW TRB ANALYZER	AI	1721
FHA-TRW-AIT-0003-AI	FLUORIDE ANALYZER	AI	1721
FHA-FLT-FIT-0101-FI	FILTER #1 FLOW	AI	1721
FHA-FLT-PDIT-0101-PDI	FILTER #1 HEAD LOSS	AI	1721
FHA-FLT-FIT-0201-FI	FILTER #2 FLOW	AI	1721
FHA-FLT-PDIT-0201-PDI	FILTER #2 HEAD LOSS	AI	1721
FHA-FLT-FIT-0301-FI	FILTER #3 FLOW	AI	1721
FHA-FLT-PDIT-0301-PDI	FILTER #3 HEAD LOSS	AI	1721
FHA-FLT-FIT-0401-FI	FILTER #4 FLOW	AI	1721
FHA-FLT-PDIT-0401-PDI	FILTER #4 HEAD LOSS	AI	1721
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1721
FHA-FLT-V-0101-ZC	FILTER #1 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-FLT-V-0201-ZC	FILTER #2 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-FLT-V-0301-ZC	FILTER #3 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-FLT-V-0401-ZC	FILTER #4 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-SPC-UPS-1721-EA	FILTERS 1-4 PLC UPS - POWER FAILURE	DI	1721
FHA-SPC-UPS-1721-EAL	FILTERS 1-4 PLC UPS - LOW BATTERY	DI	1721
FHA-SPC-UPS-1721-XA	FILTERS 1-4 PLC UPS - UPS FAILURE	DI	1721

I/O Tag No	Description	Type	RPU
FHA-SPC-RPU-1721-TAH	FILTER #1-4 PANEL SMOKE/HEAT ALARM	DI	1721
FHA-FLT-G-0101-YN	FILTER #1 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0101-YA	FILTER #1 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0101-ZH	FILTER #1 INLET GATE OPENED	DI	1721
FHA-FLT-G-0101-ZL	FILTER #1 INLET GATE CLOSED	DI	1721
vFHA-FLT-G-0102-YN	FILTER #1 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0102-YA	FILTER #1 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0102-ZH	FILTER #1 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0102-ZL	FILTER #1 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0101-YN	FILTER #1 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0101-YA	FILTER #1 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0101-ZH	FILTER #1 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0101-ZL	FILTER #1 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0102-YN	FILTER #1 BACKWASH VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0102-YA	FILTER #1 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0102-ZH	FILTER #1 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0102-ZL	FILTER #1 BACKWASH VALVE CLOSED	DI	1721
FHA-FLT-V-0103-YN	FILTER #1 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0103-YA	FILTER #1 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0103-ZH	FILTER #1 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0103-ZL	FILTER #1 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-G-0201-YN	FILTER #2 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0201-YA	FILTER #2 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0201-ZH	FILTER #2 INLET GATE OPENED	DI	1721
FHA-FLT-G-0201-ZL	FILTER #2 INLET GATE CLOSED	DI	1721
FHA-FLT-G-0202-YN	FILTER #2 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0202-YA	FILTER #2 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0202-ZH	FILTER #2 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0202-ZL	FILTER #2 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0201-YN	FILTER #2 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0201-YA	FILTER #2 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0201-ZH	FILTER #2 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0201-ZL	FILTER #2 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0202-YN	FILTER #2 BACKWASH VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0202-YA	FILTER #2 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0202-ZH	FILTER #2 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0202-ZL	FILTER #2 BACKWASH VALVE CLOSED	DI	1721

I/O Tag No	Description	Type	RPU
FHA-FLT-V-0203-YN	FILTER #2 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0203-YA	FILTER #2 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0203-ZH	FILTER #2 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0203-ZL	FILTER #2 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-G-0301-YN	FILTER #3 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0301-YA	FILTER #3 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0301-ZH	FILTER #3 INLET GATE OPENED	DI	1721
FHA-FLT-G-0301-ZL	FILTER #3 INLET GATE CLOSED	DI	1721
FHA-FLT-G-0302-YN	FILTER #3 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0302-YA	FILTER #3 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0302-ZH	FILTER #3 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0302-ZL	FILTER #3 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0301-YN	FILTER #3 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0301-YA	FILTER #3 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0301-ZH	FILTER #3 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0301-ZL	FILTER #3 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0302-YN	FILTER #3 BACKWASH VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0302-YA	FILTER #3 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0302-ZH	FILTER #3 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0302-ZL	FILTER #3 BACKWASH VALVE CLOSED	DI	1721
FHA-FLT-V-0303-YN	FILTER #3 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0303-YA	FILTER #3 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0303-ZH	FILTER #3 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0303-ZL	FILTER #3 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-G-0401-YN	FILTER #4 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0401-YA	FILTER #4 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0401-ZH	FILTER #4 INLET GATE OPENED	DI	1721
FHA-FLT-G-0401-ZL	FILTER #4 INLET GATE CLOSED	DI	1721
FHA-FLT-G-0402-YN	FILTER #4 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0402-YA	FILTER #4 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0402-ZH	FILTER #4 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0402-ZL	FILTER #4 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0401-YN	FILTER #4 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0401-YA	FILTER #4 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0401-ZH	FILTER #4 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0401-ZL	FILTER #4 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0402-YN	FILTER #4 BACKWASH VALVE COMPUTER MODE	DI	1721

I/O Tag No	Description	Type	RPU
FHA-FLT-V-0402-YA	FILTER #4 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0402-ZH	FILTER #4 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0402-ZL	FILTER #4 BACKWASH VALVE CLOSED	DI	1721
FHA-FLT-V-0403-YN	FILTER #4 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0403-YA	FILTER #4 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0403-ZH	FILTER #4 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0403-ZL	FILTER #4 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-HS-0101-ZL	FILTER #1 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-HS-0201-ZL	FILTER #2 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-HS-0301-ZL	FILTER #3 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-HS-0401-ZL	FILTER #4 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-AIT-0101-YA	FILTER #1EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-AIT-0201-YA	FILTER #2 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-AIT-0301-YA	FILTER #3 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-AIT-0401-YA	FILTER #4 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-LSHL-0101-LAH	FILTER #1 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0101-LAL	FILTER #1 LO LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0201-LAH	FILTER #2 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0201-LAL	FILTER #2 LO LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0301-LAH	FILTER #3 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0301-LAL	FILTER #3 LO LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0401-LAH	FILTER #4 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0401-LAL	FILTER #4 LO LEVEL SWITCH	DI	1721
FHA-SED-P-0101-YN	SEW SAMPLE PUMP - WEST COMPUTER MODE	DI	1721
FHA-SED-P-0101-MN	SEW SAMPLE PUMP - WEST RUNNING	DI	1721
FHA-SED-V-0102-YN	SEW SMP PUMP SUCT VLV-W COMPUTER MODE	DI	1721
FHA-SED-V-0102-YA	SEW SMP PUMP SUCT VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0102-ZH	SEW SMP PUMP SUCT VLV-W OPENED	DI	1721
FHA-SED-V-0102-ZL	SEW SMP PUMP SUCT VLV-W CLOSED	DI	1721
FHA-SED-V-0109-YN	SEW SMP PUMP TRB VLV-W COMPUTER MODE	DI	1721
FHA-SED-V-0109-YA	SEW SMP PUMP TRB VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0109-ZH	SEW SMP PUMP TRB VLV-W OPENED	DI	1721
FHA-SED-V-0109-ZL	SEW SMP PUMP TRB VLV-W CLOSED	DI	1721
FHA-SED-V-0110-YN	SEW SUCT FLUSH VLV-W COMPUTER MODE	DI	1721
FHA-SED-V-0110-YA	SEW SUCT FLUSH VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0110-ZH	SEW SUCT FLUSH VLV-W OPENED	DI	1721
FHA-SED-V-0110-ZL	SEW SUCT FLUSH VLV-W CLOSED	DI	1721
FHA-SED-V-0111-YN	SEW DISCH FLUSH VLV-W COMPUTER MODE	DI	1721

I/O Tag No	Description	Type	RPU
FHA-SED-V-0111-YA	SEW DISCH FLUSH VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0111-ZH	SEW DISCH FLUSH VLV-W OPENED	DI	1721
FHA-SED-V-0111-ZL	SEW DISCH FLUSH VLV-W CLOSED	DI	1721
FHA-SED-FSL-0101-FAL	SEW SMP PUMP-WEST FLOW LOW ALARM	DI	1721
FHA-SED-FSL-0102-FAL	SEW TRB ANALYZER-WEST FLOW LOW ALARM	DI	1721
FHA-SED-AIT-0101-YA	SEW TRB ANALYZER - WEST INSTRUMENT FAULT	DI	1721
FHA-DCL-V-0013-YN	BFR-SO2 SMP DRAIN VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0013-YA	BFR-SO2 SMP DRAIN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0013-ZH	BFR-SO2 SMP DRAIN VLV OPENED	DI	1721
FHA-DCL-V-0013-ZL	BFR-SO2 SMP DRAIN VLV CLOSED	DI	1721
FHA-DCL-V-0014-YN	BFR-SO2 SMP FLUSH VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0014-YA	BFR-SO2 SMP FLUSH VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0014-ZH	BFR-SO2 SMP FLUSH VLV OPENED	DI	1721
FHA-DCL-V-0014-ZL	BFR-SO2 SMP FLUSH VLV CLOSED	DI	1721
FHA-DCL-V-0015-YN	BFR-SO2 TRB INLET VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0015-YA	BFR-SO2 TRB INLET VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0015-ZH	BFR-SO2 TRB INLET VLV OPENED	DI	1721
FHA-DCL-V-0015-ZL	BFR-SO2 TRB INLET VLV CLOSED	DI	1721
FHA-DCL-V-0016-YN	BFR-SO2 LAB SAMPLE VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0016-YA	BFR-SO2 LAB SAMPLE VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0016-ZH	BFR-SO2 LAB SAMPLE VLV OPENED	DI	1721
FHA-DCL-V-0016-ZL	BFR-SO2 LAB SAMPLE VLV CLOSED	DI	1721
FHA-DCL-P-0001A-YN	BFR-SO2 SMP PUMP P-0001A COMPUTER MODE	DI	1721
FHA-DCL-P-0001A-MN	BFR-SO2 SMP PUMP P-0001A RUNNING	DI	1721
FHA-DCL-P-0001B-YN	BFR-SO2 SMP PUMP P-0001B COMPUTER MODE	DI	1721
FHA-DCL-P-0001B-MN	BFR-SO2 SMP PUMP P-0001B RUNNING	DI	1721
FHA-DCL-AIT-0001-YA	BFR-SO2 CLR RESID ANALYZER INSTRUMENT FAULT	DI	1721
FHA-DCL-FSL-0001A-FAL	BFR-SO2 SMP PUMP P-0001A FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0001B-FAL	BFR-SO2 SMP PUMP P-0001B FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0002-FAL	BFR-SO2 CLR RESID ANALYZER FLOW LOW ALARM	DI	1721
FHA-DCL-V-0026-YN	AFT-SO2 SMP FLUSH VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0026-YA	AFT-SO2 SMP FLUSH VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0026-ZH	AFT-SO2 SMP FLUSH VLV OPENED	DI	1721
FHA-DCL-V-0026-ZL	AFT-SO2 SMP FLUSH VLV CLOSED	DI	1721
FHA-DCL-V-0027-YN	AFT-SO2 SMP DRAIN VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0027-YA	AFT-SO2 SMP DRAIN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0027-ZH	AFT-SO2 SMP DRAIN VLV OPENED	DI	1721
FHA-DCL-V-0027-ZL	AFT-SO2 SMP DRAIN VLV CLOSED	DI	1721
FHA-DCL-V-0028-YN	AFT-SO2 ANALYZER ISLN VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0028-YA	AFT-SO2 ANALYZER ISLN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721

I/O Tag No	Description	Type	RPU
FHA-DCL-V-0028-ZH	AFT-SO2 ANALYZER ISLN VLV OPENED	DI	1721
FHA-DCL-V-0028-ZL	AFT-SO2 ANALYZER ISLN VLV CLOSED	DI	1721
FHA-DCL-V-0030-YN	AFT-SO2 LAB SAMPLE VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0030-YA	AFT-SO2 LAB SAMPLE VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0030-ZH	AFT-SO2 LAB SAMPLE VLV OPENED	DI	1721
FHA-DCL-V-0030-ZL	AFT-SO2 LAB SAMPLE VLV CLOSED	DI	1721
FHA-DCL-P-0002A-YN	AFT-SO2 SMP PUMP P-0002A COMPUTER MODE	DI	1721
FHA-DCL-P-0002A-MN	AFT-SO2 SMP PUMP P-0002A RUNNING	DI	1721
FHA-DCL-P-0002B-YN	AFT-SO2 SMP PUMP P-0002B COMPUTER MODE	DI	1721
FHA-DCL-P-0002B-MN	AFT-SO2 SMP PUMP P-0002B RUNNING	DI	1721
FHA-DCL-FSL-0003A-FAL	AFT-SO2 SMP PUMP P-0002A FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0003B-FAL	AFT-SO2 SMP PUMP P-0002B FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0004A-FAL	AFT-SO2 CLR ANALYZER 2A FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0004B-FAL	AFT-SO2 CLR ANALYZER 2B FLOW LOW ALARM	DI	1721
FHA-DCL-AIT-0002A-YA	AFT-SO2 CLR RESID ANALYZE2A INSTRUMENT FAULT	DI	1721
FHA-DCL-AIT-0002B-YA	AFT-SO2 CLR RESID ANALYZE2B INSTRUMENT FAULT	DI	1721
FHA-TRW-V-0010-YN	TRW LAB ISLN VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0010-YA	TRW LAB ISLN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0010-ZH	TRW LAB ISLN VLV OPENED	DI	1721
FHA-TRW-V-0010-ZL	TRW LAB ISLN VLV CLOSED	DI	1721
FHA-TRW-V-0013-YN	ANALYZER ISOLATION VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0013-YA	ANALYZER ISOLATION VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0013-ZH	ANALYZER ISOLATION VLV OPENED	DI	1721
FHA-TRW-V-0013-ZL	ANALYZER ISOLATION VLV CLOSED	DI	1721
FHA-TRW-V-0017-YN	TRW DRAIN VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0017-YA	TRW DRAIN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0017-ZH	TRW DRAIN VLV OPENED	DI	1721
FHA-TRW-V-0017-ZL	TRW DRAIN VLV CLOSED	DI	1721
FHA-TRW-V-0018-YN	TRW SMP FLUSH VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0018-YA	TRW SMP FLUSH VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0018-ZH	TRW SMP FLUSH VLV OPENED	DI	1721
FHA-TRW-V-0018-ZL	TRW SMP FLUSH VLV CLOSED	DI	1721
FHA-TRW-P-0002A-YN	TRW SMP PUMP P-0002A COMPUTER MODE	DI	1721
FHA-TRW-P-0002A-MN	TRW SMP PUMP P-0002A RUNNING	DI	1721
FHA-TRW-P-0002B-YN	TRW SMP PUMP P-0002B COMPUTER MODE	DI	1721
FHA-TRW-P-0002B-MN	TRW SMP PUMP P-0002B RUNNING	DI	1721
FHA-TRW-FSL-0001A-FAL	TRW SMP PUMP P-0002A FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0001B-FAL	TRW SMP PUMP P-0002B FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0002-FAL	CLR ANALYZER OUTLET#1 FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0003-FAL	TRB ANALYZER OUTLET#1 FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0004-FAL	FLORIDE ANALYZER FLOW LOW ALARM	DI	1721
FHA-TRW-AIT-0001-YA	TRW TOT CLR ANALYZER INSTRUMENT FAULT	DI	1721

I/O Tag No	Description	Type	RPU
FHA-TRW-AIT-0002-YA	TRW TRB ANALYZER INSTRUMENT FAULT	DI	1721
FHA-TRW-AIT-0003-YA	FLUORIDE ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-G-0101-VH	FILTER #1 INLET GATE OPEN	DO	1721
FHA-FLT-G-0101-VL	FILTER #1 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0102-VH	FILTER #1 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0102-VL	FILTER #1 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0102-VH	FILTER #1 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0102-VL	FILTER #1 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0103-VH	FILTER #1 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0103-VL	FILTER #1 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-FLT-G-0201-VH	FILTER #2 INLET GATE OPEN	DO	1721
FHA-FLT-G-0201-VL	FILTER #2 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0202-VH	FILTER #2 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0202-VL	FILTER #2 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0202-VH	FILTER #2 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0202-VL	FILTER #2 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0203-VH	FILTER #2 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0203-VL	FILTER #2 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-FLT-G-0301-VH	FILTER #3 INLET GATE OPEN	DO	1721
FHA-FLT-G-0301-VL	FILTER #3 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0302-VH	FILTER #3 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0302-VL	FILTER #3 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0302-VH	FILTER #3 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0302-VL	FILTER #3 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0303-VH	FILTER #3 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0303-VL	FILTER #3 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-FLT-G-0401-VH	FILTER #4 INLET GATE OPEN	DO	1721
FHA-FLT-G-0401-VL	FILTER #4 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0402-VH	FILTER #4 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0402-VL	FILTER #4 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0402-VH	FILTER #4 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0402-VL	FILTER #4 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0403-VH	FILTER #4 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0403-VL	FILTER #4 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-SED-V-0102-VH	SEW SMP PUMP SUCT VLV-W OPEN	DO	1721
FHA-SED-V-0102-VL	SEW SMP PUMP SUCT VLV-W CLOSE	DO	1721
FHA-SED-V-0109-VH	SEW SMP PUMP TRB VLV-W OPEN	DO	1721
FHA-SED-V-0109-VL	SEW SMP PUMP TRB VLV-W CLOSE	DO	1721
FHA-SED-V-0110-VH	SEW SUCT FLUSH VLV-W OPEN	DO	1721
FHA-SED-V-0110-VL	SEW SUCT FLUSH VLV-W CLOSE	DO	1721
FHA-SED-V-0111-VH	SEW DISCH FLUSH VLV-W OPEN	DO	1721
FHA-SED-V-0111-VL	SEW DISCH FLUSH VLV-W CLOSE	DO	1721
FHA-SED-P-0101-MH	SEW SAMPLE PUMP - WEST START COMMAND	DO	1721
FHA-SED-P-0101-MB	SEW SAMPLE PUMP - WEST STOP COMMAND	DO	1721
FHA-DCL-V-0013-VH	BFR-SO2 SMP DRAIN VLV OPEN	DO	1721
FHA-DCL-V-0013-VL	BFR-SO2 SMP DRAIN VLV CLOSE	DO	1721
FHA-DCL-V-0014-VH	BFR-SO2 SMP FLUSH VLV OPEN	DO	1721

I/O Tag No	Description	Type	RPU
FHA-DCL-V-0014-VL	BFR-SO2 SMP FLUSH VLV CLOSE	DO	1721
FHA-DCL-V-0015-VH	BFR-SO2 TRB INLET VLV OPEN	DO	1721
FHA-DCL-V-0015-VL	BFR-SO2 TRB INLET VLV CLOSE	DO	1721
FHA-DCL-V-0016-VH	BFR-SO2 LAB SAMPLE VLV OPEN	DO	1721
FHA-DCL-V-0016-VL	BFR-SO2 LAB SAMPLE VLV CLOSE	DO	1721
FHA-DCL-P-0001A-MH	BFR-SO2 SMP PUMP P-0001A START COMMAND	DO	1721
FHA-DCL-P-0001A-MB	BFR-SO2 SMP PUMP P-0001A STOP COMMAND	DO	1721
FHA-DCL-P-0001B-MH	BFR-SO2 SMP PUMP P-0001B START COMMAND	DO	1721
FHA-DCL-P-0001B-MB	BFR-SO2 SMP PUMP P-0001B STOP COMMAND	DO	1721
FHA-DCL-V-0026-VH	AFT-SO2 SMP FLUSH VLV OPEN	DO	1721
FHA-DCL-V-0026-VL	AFT-SO2 SMP FLUSH VLV CLOSE	DO	1721
FHA-DCL-V-0027-VH	AFT-SO2 SMP DRAIN VLV OPEN	DO	1721
FHA-DCL-V-0027-VL	AFT-SO2 SMP DRAIN VLV CLOSE	DO	1721
FHA-DCL-V-0028-VH	AFT-SO2 ANALYZER ISLN VLV OPEN	DO	1721
FHA-DCL-V-0028-VL	AFT-SO2 ANALYZER ISLN VLV CLOSE	DO	1721
FHA-DCL-V-0030-VH	AFT-SO2 LAB SAMPLE VLV OPEN	DO	1721
FHA-DCL-V-0030-VL	AFT-SO2 LAB SAMPLE VLV CLOSE	DO	1721
FHA-DCL-P-0002A-MH	AFT-SO2 SMP PUMP P-0002A START COMMAND	DO	1721
FHA-DCL-P-0002A-MB	AFT-SO2 SMP PUMP P-0002A STOP COMMAND	DO	1721
FHA-DCL-P-0002B-MH	AFT-SO2 SMP PUMP P-0002B START COMMAND	DO	1721
FHA-DCL-P-0002B-MB	AFT-SO2 SMP PUMP P-0002B STOP COMMAND	DO	1721
FHA-TRW-V-0009A-VH	PUMP P-0002A DISCH VLV OPEN	DO	1721
FHA-TRW-V-0009A-VL	PUMP P-0002A DISCH VLV CLOSE	DO	1721
FHA-TRW-V-0010-VH	PUMP P-0002B LAB VLV OPEN	DO	1721
FHA-TRW-V-0010-VL	PUMP P-0002B LAB VLV CLOSE	DO	1721
FHA-TRW-V-0013-VH	ANALYZER ISOLATION VLV OPEN	DO	1721
FHA-TRW-V-0013-VL	ANALYZER ISOLATION VLV CLOSE	DO	1721
FHA-TRW-V-0017-VH	TRW DRAIN VLV OPEN	DO	1721
FHA-TRW-V-0017-VL	TRW DRAIN VLV CLOSE	DO	1721
FHA-TRW-V-0018-VH	TRW SMP FLUSH VLV OPEN	DO	1721
FHA-TRW-V-0018-VL	TRW SMP FLUSH VLV CLOSE	DO	1721
FHA-TRW-P-0002A-MH	TRW SMP PUMP P-0002A START COMMAND	DO	1721
FHA-TRW-P-0002A-MB	TRW SMP PUMP P-0002A STOP COMMAND	DO	1721
FHA-TRW-P-0002B-MH	TRW SMP PUMP P-0002B START COMMAND	DO	1721
FHA-TRW-P-0002B-MB	TRW SMP PUMP P-0002B STOP COMMAND	DO	1721
FHA-DCL-AIT-0002A-DUTY	AFT-SO2 CLR RESID ANALYZER 2A-2B CONTROL/REFERENCE SELECTION	AI	1721
FHA-FLT-ZIT-0501-ZI	FILTER #5 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0501-AI	FILTER #5 TURBIDITY	AI	1722
FHA-FLT-ZIT-0601-ZI	FILTER #6 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0601-AI	FILTER #6 TURBIDITY	AI	1722
FHA-FLT-ZIT-0701-ZI	FILTER #7 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0701-AI	FILTER #7 TURBIDITY	AI	1722
FHA-FLT-ZIT-0801-ZI	FILTER #8 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0801-AI	FILTER #8 TURBIDITY	AI	1722
FHA-FLT-FIT-0501-FT	FILTER #5 FLOW	AI	1722
FHA-FLT-PDIT-0501-PDI	FILTER #5 HEAD LOSS	AI	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-FIT-0601-FT	FILTER #6 FLOW	AI	1722
FHA-FLT-PDIT-0601-PDI	FILTER #6 HEAD LOSS	AI	1722
FHA-FLT-FIT-0701-FT	FILTER #7 FLOW	AI	1722
FHA-FLT-PDIT-0701-PDI	FILTER #7 HEAD LOSS	AI	1722
FHA-FLT-FIT-0801-FT	FILTER #8 FLOW	AI	1722
FHA-FLT-PDIT-0801-PDI	FILTER #8 HEAD LOSS	AI	1722
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1722
FHA-FLT-V-0501-ZC	FILTER #5 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-FLT-V-0601-ZC	FILTER #6 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-FLT-V-0701-ZC	FILTER #7 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-FLT-V-0801-ZC	FILTER #8 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-SPC-UPS-1722-EA	FILTERS 5-8 PLC UPS - POWER FAILURE	DI	1722
FHA-SPC-UPS-1722-EAL	FILTERS 5-8 PLC UPS - LOW BATTERY	DI	1722
FHA-SPC-UPS-1722-XA	FILTERS 5-8 PLC UPS - UPS FAILURE	DI	1722
FHA-SPC-RPU-1722-TAH	FILTER #5-8 PANEL SMOKE/HEAT ALARM	DI	1722
FHA-FLT-G-0501-YN	FILTER #5 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0501-YA	FILTER #5 INLET GATE NOT AVAILABLE	DI	1722
FHA-FLT-G-0501-ZH	FILTER #5 INLET GATE OPENED	DI	1722
FHA-FLT-G-0501-ZL	FILTER #5 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0502-YN	FILTER #5 DRAIN GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0502-YA	FILTER #5 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0502-ZH	FILTER #5 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0502-ZL	FILTER #5 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0501-YN	FILTER #5 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0501-YA	FILTER #5 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE	DI	1722
FHA-FLT-V-0501-ZH	FILTER #5 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0501-ZL	FILTER #5 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0502-YN	FILTER #5 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0502-YA	FILTER #5 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0502-ZH	FILTER #5 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0502-ZL	FILTER #5 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0503-YN	FILTER #5 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0503-YA	FILTER #5 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0503-ZH	FILTER #5 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0503-ZL	FILTER #5 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-G-0601-YN	FILTER #6 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0601-YA	FILTER #6 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0601-ZH	FILTER #6 INLET GATE OPENED	DI	1722
FHA-FLT-G-0601-ZL	FILTER #6 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0602-YN	FILTER #6 DRAIN GATE COMPUTER MODE	DI	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-G-0602-YA	FILTER #6 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0602-ZH	FILTER #6 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0602-ZL	FILTER #6 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0601-YN	FILTER #6 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0601-YA	FILTER #6 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0601-ZH	FILTER #6 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0601-ZL	FILTER #6 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0602-YN	FILTER #6 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0602-YA	FILTER #6 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0602-ZH	FILTER #6 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0602-ZL	FILTER #6 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0603-YN	FILTER #6 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0603-YA	FILTER #6 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0603-ZH	FILTER #6 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0603-ZL	FILTER #6 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-G-0701-YN	FILTER #7 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0701-YA	FILTER #7 INLET GATE NOT AVAILABLE	DI	1722
FHA-FLT-G-0701-ZH	FILTER #7 INLET GATE OPENED	DI	1722
FHA-FLT-G-0701-ZL	FILTER #7 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0702-YN	FILTER #7 DRAIN GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0702-YA	FILTER #7 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0702-ZH	FILTER #7 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0702-ZL	FILTER #7 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0701-YN	FILTER #7 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0701-YA	FILTER #7 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0701-ZH	FILTER #7 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0701-ZL	FILTER #7 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0702-YN	FILTER #7 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0702-YA	FILTER #7 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0702-ZH	FILTER #7 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0702-ZL	FILTER #7 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0703-YN	FILTER #7 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0703-YA	FILTER #7 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0703-ZH	FILTER #7 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0703-ZL	FILTER #7 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-G-0801-YN	FILTER #8 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0801-YA	FILTER #8 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-G-0801-ZH	FILTER #8 INLET GATE OPENED	DI	1722
FHA-FLT-G-0801-ZL	FILTER #8 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0802-YN	FILTER #8 DRAIN GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0802-YA	FILTER #8 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0802-ZH	FILTER #8 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0802-ZL	FILTER #8 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0801-YN	FILTER #8 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0801-YA	FILTER #8 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0801-ZH	FILTER #8 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0801-ZL	FILTER #8 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0802-YN	FILTER #8 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0802-YA	FILTER #8 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0802-ZH	FILTER #8 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0802-ZL	FILTER #8 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0803-YN	FILTER #8 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0803-YA	FILTER #8 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0803-ZH	FILTER #8 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0803-ZL	FILTER #8 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-HS-0501-ZL	FILTER #5 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-HS-0601-ZL	FILTER #6 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-HS-0701-ZL	FILTER #7 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-HS-0801-ZL	FILTER #8 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-AIT-0501-YA	FILTER #5 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-AIT-0601-YA	FILTER #6 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-AIT-0701-YA	FILTER #7 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-AIT-0801-YA	FILTER #8 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-LSHL-0501-LAH	FILTER #5 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0501-LAL	FILTER #5 LO LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0601-LAH	FILTER #6 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0601-LAL	FILTER #6 LO LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0701-LAH	FILTER #7 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0701-LAL	FILTER #7 LO LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0801-LAH	FILTER #8 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0801-LAL	FILTER #8 LO LEVEL SWITCH	DI	1722
FHA-FLT-G-0501-VH	FILTER #5 INLET GATE OPEN	DO	1722
FHA-FLT-G-0501-VL	FILTER #5 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0502-VH	FILTER #5 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0502-VL	FILTER #5 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0502-VH	FILTER #5 BACKWASH VALVE OPEN	DO	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-V-0502-VL	FILTER #5 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0503-VH	FILTER #5 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0503-VL	FILTER #5 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-G-0601-VH	FILTER #6 INLET GATE OPEN	DO	1722
FHA-FLT-G-0601-VL	FILTER #6 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0602-VH	FILTER #6 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0602-VL	FILTER #6 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0602-VH	FILTER #6 BACKWASH VALVE OPEN	DO	1722
FHA-FLT-V-0602-VL	FILTER #6 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0603-VH	FILTER #6 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0603-VL	FILTER #6 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-G-0701-VH	FILTER #7 INLET GATE OPEN	DO	1722
FHA-FLT-G-0701-VL	FILTER #7 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0702-VH	FILTER #7 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0702-VL	FILTER #7 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0702-VH	FILTER #7 BACKWASH VALVE OPEN	DO	1722
FHA-FLT-V-0702-VL	FILTER #7 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0703-VH	FILTER #7 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0703-VL	FILTER #7 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-G-0801-VH	FILTER #8 INLET GATE OPEN	DO	1722
FHA-FLT-G-0801-VL	FILTER #8 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0802-VH	FILTER #8 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0802-VL	FILTER #8 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0802-VH	FILTER #8 BACKWASH VALVE OPEN	DO	1722
FHA-FLT-V-0802-VL	FILTER #8 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0803-VH	FILTER #8 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0803-VL	FILTER #8 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-ZIT-0901-ZI	FILTER #9 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-0901-AI	FILTER #9 TURBIDITY	AI	1723
FHA-FLT-ZIT-1001-ZI	FILTER #10 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-1001-AI	FILTER #10 TURBIDITY	AI	1723
FHA-FLT-ZIT-1101-ZI	FILTER #11 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-1101-AI	FILTER #11 TURBIDITY	AI	1723
FHA-FLT-ZIT-1201-ZI	FILTER #12 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-1201-AI	FILTER #12 TURBIDITY	AI	1723
FHA-FLT-FIT-0901-FT	FILTER #9 FLOW	AI	1723
FHA-FLT-PDIT-0901-PDI	FILTER #9 HEAD LOSS	AI	1723
FHA-FLT-FIT-1001-FT	FILTER #10 FLOW	AI	1723
FHA-FLT-PDIT-1001-PDI	FILTER #10 HEAD LOSS	AI	1723
FHA-FLT-FIT-1101-FT	FILTER #11 FLOW	AI	1723
FHA-FLT-PDIT-1101-PDI	FILTER #11 HEAD LOSS	AI	1723
FHA-FLT-FIT-1201-FT	FILTER #12 FLOW	AI	1723
FHA-FLT-PDIT-1201-PDI	FILTER #12 HEAD LOSS	AI	1723
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1723
FHA-FLT-V-0901-ZC	FILTER #9 RATE CONTROL VALVE POSITION SETPOINT	AO	1723
FHA-FLT-V-1001-ZC	FILTER #10 RATE CONTROL VALVE POSITION SETPOINT	AO	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1101-ZC	FILTER #11 RATE CONTROL VALVE POSITION SETPOINT	AO	1723
FHA-FLT-V-1201-ZC	FILTER #12 RATE CONTROL VALVE POSITION SETPOINT	AO	1723
FHA-SPC-UPS-1723-EA	FILTERS 9-12 PLC UPS - POWER FAILURE	DI	1723
FHA-SPC-UPS-1723-EAL	FILTERS 9-12 PLC UPS - LOW BATTERY	DI	1723
FHA-SPC-UPS-1723-XA	FILTERS 9-12 PLC UPS - UPS FAILURE	DI	1723
FHA-SPC-RPU-1723-TAH	FILTER #9-12 PANEL SMOKE/HEAT ALARM	DI	1723
FHA-FLT-G-0901-YN	FILTER #9 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-0901-YA	FILTER #9 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-0901-ZH	FILTER #9 INLET GATE OPENED	DI	1723
FHA-FLT-G-0901-ZL	FILTER #9 INLET GATE CLOSED	DI	1723
FHA-FLT-G-0902-YN	FILTER #9 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-0902-YA	FILTER #9 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-0902-ZH	FILTER #9 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-0902-ZL	FILTER #9 DRAIN GATE CLOSED	DI	1723
FHA-FLT-V-0901-YN	FILTER #9 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-0901-YA	FILTER #9 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-0901-ZH	FILTER #9 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-0901-ZL	FILTER #9 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-0902-YN	FILTER #9 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-0902-YA	FILTER #9 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-0902-ZH	FILTER #9 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-0902-ZL	FILTER #9 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-0903-YN	FILTER #9 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-0903-YA	FILTER #9 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-0903-ZH	FILTER #9 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-0903-ZL	FILTER #9 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-G-1001-YN	FILTER #10 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1001-YA	FILTER #10 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1001-ZH	FILTER #10 INLET GATE OPENED	DI	1723
FHA-FLT-G-1001-ZL	FILTER #10 INLET GATE CLOSED	DI	1723
FHA-FLT-G-1002-YN	FILTER #10 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1002-YA	FILTER #10 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1002-ZH	FILTER #10 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-1002-ZL	FILTER #10 DRAIN GATE CLOSED	DI	1723
FHA-FLT-V-1001-YN	FILTER #10 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1001-YA	FILTER #10 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1001-ZH	FILTER #10 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-1001-ZL	FILTER #10 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-1002-YN	FILTER #10 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1002-YA	FILTER #10 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1002-ZH	FILTER #10 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-1002-ZL	FILTER #10 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-1003-YN	FILTER #10 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1003-YA	FILTER #10 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1003-ZH	FILTER #10 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-1003-ZL	FILTER #10 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-G-1101-YN	FILTER #11 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1101-YA	FILTER #11 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1101-ZH	FILTER #11 INLET GATE OPENED	DI	1723
FHA-FLT-G-1101-ZL	FILTER #11 INLET GATE CLOSED	DI	1723
FHA-FLT-G-1102-YN	FILTER #11 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1102-YA	FILTER #11 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1102-ZH	FILTER #11 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-1102-ZL	FILTER #11 DRAIN GATE CLOSED	DI	1723
FHA-FLT-V-1101-YN	FILTER #11 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1101-YA	FILTER #11 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1101-ZH	FILTER #11 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-1101-ZL	FILTER #11 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-1102-YN	FILTER #11 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1102-YA	FILTER #11 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1102-ZH	FILTER #11 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-1102-ZL	FILTER #11 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-1103-YN	FILTER #11 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1103-YA	FILTER #11 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1103-ZH	FILTER #11 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-1103-ZL	FILTER #11 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-G-1201-YN	FILTER #12 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1201-YA	FILTER #12 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1201-ZH	FILTER #12 INLET GATE OPENED	DI	1723
FHA-FLT-G-1201-ZL	FILTER #12 INLET GATE CLOSED	DI	1723
FHA-FLT-G-1202-YN	FILTER #12 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1202-YA	FILTER #12 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1202-ZH	FILTER #12 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-1202-ZL	FILTER #12 DRAIN GATE CLOSED	DI	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1201-YN	FILTER #12 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1201-YA	FILTER #12 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1201-ZH	FILTER #12 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-1201-ZL	FILTER #12 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-1202-YN	FILTER #12 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1202-YA	FILTER #12 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1202-ZH	FILTER #12 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-1202-ZL	FILTER #12 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-1203-YN	FILTER #12 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1203-YA	FILTER #12 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1203-ZH	FILTER #12 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-1203-ZL	FILTER #12 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-HS-0901-ZL	FILTER #9 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-HS-1001-ZL	FILTER #10 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-HS-1101-ZL	FILTER #11 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-HS-1201-ZL	FILTER #12 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-AIT-0901-YA	FILTER #9 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-AIT-1001-YA	FILTER #10 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-AIT-1101-YA	FILTER #11 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-AIT-1201-YA	FILTER #12 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-LSHL-0901-LAH	FILTER #9 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-0901-LAL	FILTER #9 LO LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1001-LAH	FILTER #10 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1001-LAL	FILTER #10 LO LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1101-LAH	FILTER #11 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1101-LAL	FILTER #11 LO LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1201-LAH	FILTER #12 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1201-LAL	FILTER #12 LO LEVEL SWITCH	DI	1723
FHA-FLT-G-0901-VH	FILTER #9 INLET GATE OPEN	DO	1723
FHA-FLT-G-0901-VL	FILTER #9 INLET GATE CLOSE	DO	1723
FHA-FLT-G-0902-VH	FILTER #9 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-0902-VL	FILTER #9 DRAIN GATE CLOSE	DO	1723
FHA-FLT-V-0902-VH	FILTER #9 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-0902-VL	FILTER #9 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-0903-VH	FILTER #9 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-0903-VL	FILTER #9 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-G-1001-VH	FILTER #10 INLET GATE OPEN	DO	1723
FHA-FLT-G-1001-VL	FILTER #10 INLET GATE CLOSE	DO	1723
FHA-FLT-G-1002-VH	FILTER #10 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-1002-VL	FILTER #10 DRAIN GATE CLOSE	DO	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1002-VH	FILTER #10 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-1002-VL	FILTER #10 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-1003-VH	FILTER #10 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-1003-VL	FILTER #10 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-G-1101-VH	FILTER #11 INLET GATE OPEN	DO	1723
FHA-FLT-G-1101-VL	FILTER #11 INLET GATE CLOSE	DO	1723
FHA-FLT-G-1102-VH	FILTER #11 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-1102-VL	FILTER #11 DRAIN GATE CLOSE	DO	1723
FHA-FLT-V-1102-VH	FILTER #11 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-1102-VL	FILTER #11 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-1103-VH	FILTER #11 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-1103-VL	FILTER #11 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-G-1201-VH	FILTER #12 INLET GATE OPEN	DO	1723
FHA-FLT-G-1201-VL	FILTER #12 INLET GATE CLOSE	DO	1723
FHA-FLT-G-1202-VH	FILTER #12 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-1202-VL	FILTER #12 DRAIN GATE CLOSE	DO	1723
FHA-FLT-V-1202-VH	FILTER #12 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-1202-VL	FILTER #12 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-1203-VH	FILTER #12 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-1203-VL	FILTER #12 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-ZIT-1301-ZI	FILTER #13 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1301-AI	FILTER #13 TURBIDITY	AI	1724
FHA-FLT-ZIT-1401-ZI	FILTER #14 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1401-AI	FILTER #14 TURBIDITY	AI	1724
FHA-FLT-ZIT-1501-ZI	FILTER #15 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1501-AI	FILTER #15 TURBIDITY	AI	1724
FHA-FLT-ZIT-1601-ZI	FILTER #16 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1601-AI	FILTER #16 TURBIDITY	AI	1724
FHA-FLT-AIT-4101-AI	W FILTER TRB ANALYZER	AI	1724
FHA-FLT-AIT-4102-AI	W FLE RESID CLR ANALYZER	AI	1724
FHA-FLT-FIT-1301-FT	FILTER #13 FLOW	AI	1724
FHA-FLT-PDIT-1301-PDI	FILTER #13 HEAD LOSS	AI	1724
FHA-FLT-FIT-1401-FT	FILTER #14 FLOW	AI	1724
FHA-FLT-PDIT-1401-PDI	FILTER #14 HEAD LOSS	AI	1724
FHA-FLT-FIT-1501-FT	FILTER #15 FLOW	AI	1724
FHA-FLT-PDIT-1501-PDI	FILTER #15 HEAD LOSS	AI	1724
FHA-FLT-FIT-1601-FT	FILTER #16 FLOW	AI	1724
FHA-FLT-PDIT-1601-PDI	FILTER #16 HEAD LOSS	AI	1724
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1724
FHA-FLT-V-1301-ZC	FILTER #13 RATE CONTROL VALVE POSITION SETPOINT	AO	1724
FHA-FLT-V-1401-ZC	FILTER #14 RATE CONTROL VALVE POSITION SETPOINT	AO	1724
FHA-FLT-V-1501-ZC	FILTER #15 RATE CONTROL VALVE POSITION SETPOINT	AO	1724
FHA-FLT-V-1601-ZC	FILTER #16 RATE CONTROL VALVE POSITION SETPOINT	AO	1724

I/O Tag No	Description	Type	RPU
FHA-SPC-UPS-1724-EA	FILTERS 13-16 PLC UPS - POWER FAILURE	DI	1724
FHA-SPC-UPS-1724-EAL	FILTERS 13-16 PLC UPS - LOW BATTERY	DI	1724
FHA-SPC-UPS-1724-XA	FILTERS 13-16 PLC UPS - UPS FAILURE	DI	1724
FHA-SPC-RPU-1724-TAH	FILTER #13-16 PANEL SMOKE/HEAT ALARM	DI	1724
FHA-FLT-G-1301-YN	FILTER #13 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1301-YA	FILTER #13 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1301-ZH	FILTER #13 INLET GATE OPENED	DI	1724
FHA-FLT-G-1301-ZL	FILTER #13 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1302-YN	FILTER #13 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1302-YA	FILTER #13 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1302-ZH	FILTER #13 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1302-ZL	FILTER #13 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1301-YN	FILTER #13 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1301-YA	FILTER #13 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1301-ZH	FILTER #13 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1301-ZL	FILTER #13 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1302-YN	FILTER #13 BACKWASH VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1302-YA	FILTER #13 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1302-ZH	FILTER #13 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1302-ZL	FILTER #13 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1303-YN	FILTER #13 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1303-YA	FILTER #13 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1303-ZH	FILTER #13 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1303-ZL	FILTER #13 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-G-1401-YN	FILTER #14 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1401-YA	FILTER #14 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1401-ZH	FILTER #14 INLET GATE OPENED	DI	1724
FHA-FLT-G-1401-ZL	FILTER #14 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1402-YN	FILTER #14 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1402-YA	FILTER #14 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1402-ZH	FILTER #14 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1402-ZL	FILTER #14 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1401-YN	FILTER #14 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1401-YA	FILTER #14 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1401-ZH	FILTER #14 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1401-ZL	FILTER #14 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1402-YN	FILTER #14 BACKWASH VALVE COMPUTER MODE	DI	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1402-YA	FILTER #14 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1402-ZH	FILTER #14 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1402-ZL	FILTER #14 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1403-YN	FILTER #14 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1403-YA	FILTER #14 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1403-ZH	FILTER #14 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1403-ZL	FILTER #14 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-G-1501-YN	FILTER #15 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1501-YA	FILTER #15 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1501-ZH	FILTER #15 INLET GATE OPENED	DI	1724
FHA-FLT-G-1501-ZL	FILTER #15 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1502-YN	FILTER #15 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1502-YA	FILTER #15 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1502-ZH	FILTER #15 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1502-ZL	FILTER #15 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1501-YN	FILTER #15 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1501-YA	FILTER #15 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1501-ZH	FILTER #15 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1501-ZL	FILTER #15 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1502-YN	FILTER #15 BACKWASH VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1502-YA	FILTER #15 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1502-ZH	FILTER #15 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1502-ZL	FILTER #15 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1503-YN	FILTER #15 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1503-YA	FILTER #15 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1503-ZH	FILTER #15 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1503-ZL	FILTER #15 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-G-1601-YN	FILTER #16 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1601-YA	FILTER #16 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1601-ZH	FILTER #16 INLET GATE OPENED	DI	1724
FHA-FLT-G-1601-ZL	FILTER #16 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1602-YN	FILTER #16 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1602-YA	FILTER #16 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1602-ZH	FILTER #16 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1602-ZL	FILTER #16 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1601-YN	FILTER #16 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1601-YA	FILTER #16 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1601-ZH	FILTER #16 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1601-ZL	FILTER #16 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1602-YN	FILTER #16 BACKWASH VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1602-YA	FILTER #16 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1602-ZH	FILTER #16 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1602-ZL	FILTER #16 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1603-YN	FILTER #16 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1603-YA	FILTER #16 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1603-ZH	FILTER #16 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1603-ZL	FILTER #16 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-HS-1301-ZL	FILTER #13 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-HS-1401-ZL	FILTER #14 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-HS-1501-ZL	FILTER #15 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-HS-1601-ZL	FILTER #16 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-AIT-1301-YA	FILTER #13 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-AIT-1401-YA	FILTER #14 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-AIT-1501-YA	FILTER #15 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-AIT-1601-YA	FILTER #16 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-LSHL-1301-LAH	FILTER #13 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1301-LAL	FILTER #13 LO LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1401-LAH	FILTER #14 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1401-LAL	FILTER #14 LO LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1501-LAH	FILTER #15 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1501-LAL	FILTER #15 LO LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1601-LAH	FILTER #16 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1601-LAL	FILTER #16 LO LEVEL SWITCH	DI	1724
FHA-FLT-P-4101-YN	W FILTER CMPST SMP PUMP COMPUTER MODE	DI	1724
FHA-FLT-P-4101-MN	W FILTER CMPST SMP PUMP RUNNING	DI	1724
FHA-FLT-FSL-4101-FAL	W FILTER CMPST SMP PUMP FLOW LOW ALARM	DI	1724
FHA-FLT-FSL-4102-FAL	W FILTER TRB ANALYZER FLOW LOW ALARM	DI	1724
FHA-FLT-FSL-4103-FAL	W FLE RESID CLR ANALYZER FLOW LOW ALARM	DI	1724
FHA-FLT-AIT-4101-YA	W FILTER TRB ANALYZER LOSS OF SIGNAL SIGNAL (N/A - DISABLED IN SOFTWARE LOGIC)	DI	1724
FHA-FLT-AIT-4102-YA	W FLE RESID CLR ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-V-4108-YN	WEST ANALYZER ISLN VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4108-YA	WEST ANALYZER ISLN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4108-ZH	WEST ANALYZER ISLN VLV OPENED	DI	1724
FHA-FLT-V-4108-ZL	WEST ANALYZER ISLN VLV CLOSED	DI	1724
FHA-FLT-V-4109-YN	WEST BACKFLUSH VLV COMPUTER MODE	DI	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-4109-YA	WEST BACKFLUSH VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4109-ZH	WEST BACKFLUSH VLV OPENED	DI	1724
FHA-FLT-V-4109-ZL	WEST BACKFLUSH VLV CLOSED	DI	1724
FHA-FLT-V-4110-YN	WEST DRAIN VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4110-YA	WEST DRAIN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4110-ZH	WEST DRAIN VLV OPENED	DI	1724
FHA-FLT-V-4110-ZL	WEST DRAIN VLV CLOSED	DI	1724
FHA-FLT-V-4106-YN	WEST LAB ISLN VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4106-YA	WEST LAB ISLN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4106-ZH	WEST LAB ISLN VLV OPENED	DI	1724
FHA-FLT-V-4106-ZL	WEST LAB ISLN VLV CLOSED	DI	1724
FHA-FLT-V-4111-YN	WEST SUCT FLUSH VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4111-YA	WEST SUCT FLUSH VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4111-ZH	WEST SUCT FLUSH VLV OPENED	DI	1724
FHA-FLT-V-4111-ZL	WEST SUCT FLUSH VLV CLOSED	DI	1724
FHA-FLT-G-1301-VH	FILTER #13 INLET GATE OPEN	DO	1724
FHA-FLT-G-1301-VL	FILTER #13 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1302-VH	FILTER #13 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1302-VL	FILTER #13 DRAIN GATE CLOSE	DO	1724
FHA-FLT-V-1302-VH	FILTER #13 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1302-VL	FILTER #13 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1303-VH	FILTER #13 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1303-VL	FILTER #13 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-G-1401-VH	FILTER #14 INLET GATE OPEN	DO	1724
FHA-FLT-G-1401-VL	FILTER #14 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1402-VH	FILTER #14 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1402-VL	FILTER #14 DRAIN GATE CLOSE	DO	1724
FHA-FLT-V-1402-VH	FILTER #14 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1402-VL	FILTER #14 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1403-VH	FILTER #14 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1403-VL	FILTER #14 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-G-1501-VH	FILTER #15 INLET GATE OPEN	DO	1724
FHA-FLT-G-1501-VL	FILTER #15 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1502-VH	FILTER #15 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1502-VL	FILTER #15 DRAIN GATE CLOSE	DO	1724
FHA-FLT-V-1502-VH	FILTER #15 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1502-VL	FILTER #15 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1503-VH	FILTER #15 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1503-VL	FILTER #15 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-G-1601-VH	FILTER #16 INLET GATE OPEN	DO	1724
FHA-FLT-G-1601-VL	FILTER #16 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1602-VH	FILTER #16 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1602-VL	FILTER #16 DRAIN GATE CLOSE	DO	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1602-VH	FILTER #16 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1602-VL	FILTER #16 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1603-VH	FILTER #16 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1603-VL	FILTER #16 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-P-4101-MH	W FILTER CMPST SMP PUMP START COMMAND	DO	1724
FHA-FLT-P-4101-MB	W FILTER CMPST SMP PUMP STOP COMMAND	DO	1724
FHA-FLT-V-4108-VH	WEST ANALYZER ISLN VLV OPEN	DO	1724
FHA-FLT-V-4108-VL	WEST ANALYZER ISLN VLV CLOSE	DO	1724
FHA-FLT-V-4109-VH	WEST BACKFLUSH VLV OPEN	DO	1724
FHA-FLT-V-4109-VL	WEST BACKFLUSH VLV CLOSE	DO	1724
FHA-FLT-V-4110-VH	WEST DRAIN VLV OPEN	DO	1724
FHA-FLT-V-4110-VL	WEST DRAIN VLV CLOSE	DO	1724
FHA-FLT-V-4106-VH	WEST LAB ISLN VLV OPEN	DO	1724
FHA-FLT-V-4106-VL	WEST LAB ISLN VLV CLOSE	DO	1724
FHA-FLT-V-4111-VH	WEST SUCT FLUSH VLV OPEN	DO	1724
FHA-FLT-V-4111-VL	WEST SUCT FLUSH VLV CLOSE	DO	1724
FHA-FLT-AIT-1701-AI	FILTER #17 TURBIDITY	AI	1822
FHA-FLT-ZIT-1701-ZI	FILTER #17 RATE CONT VLV POSITION	AI	1822
FHA-FLT-AIT-1801-AI	FILTER #18 TURBIDITY	AI	1822
FHA-FLT-ZIT-1801-ZI	FILTER #18 RATE CONT VLV POSITION	AI	1822
FHA-FLT-AIT-1901-AI	FILTER #19 TURBIDITY	AI	1822
FHA-FLT-ZIT-1901-ZI	FILTER #19 RATE CONT VLV POSITION	AI	1822
FHA-FLT-AIT-2001-AI	FILTER #20 TURBIDITY	AI	1822
FHA-FLT-ZIT-2001-ZI	FILTER #20 RATE CONT VLV POSITION	AI	1822
FHA-BW-ZIT-0105-ZI	WEST WW RATE CONT VLV POSITION	AI	1822
FHA-CLB-AIT-0002-AI	FILTER CMPST TRB ANALYZER	AI	1822
FHA-CLB-AIT-0004-AI	AFTER POST CHLOR RESIDUAL #2	AI	1822
FHA-FLT-FIT-0001-FI	WEST FILTERS TOTAL FLOW	AI	1822
FHA-TRW-LIT-0001-LI	RESERVOIR LEVEL	AI	1822
FHA-CLB-AIT-0003-AI	AFTER POST CHLOR RESIDUAL #1	AI	1822
FHA-FLT-FIT-1701-FT	FILTER #17 FLOW	AI	1822
FHA-FLT-PDIT-1701-PDI	FILTER #17 HEAD LOSS	AI	1822
FHA-FLT-FIT-1801-FT	FILTER #18 FLOW	AI	1822
FHA-FLT-PDIT-1801-PDI	FILTER #18 HEAD LOSS	AI	1822
FHA-FLT-FIT-1901-FT	FILTER #19 FLOW	AI	1822
FHA-FLT-PDIT-1901-PDI	FILTER #19 HEAD LOSS	AI	1822
FHA-FLT-FIT-2001-FT	FILTER #20 FLOW	AI	1822
FHA-FLT-PDIT-2001-PDI	FILTER #20 HEAD LOSS	AI	1822
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1822
FHA-FLT-V-1701-ZC	FILTER #17 RATE CONTROL VALVE POSITION SETPOINT	AO	1822
FHA-FLT-V-1801-ZC	FILTER #18 RATE CONTROL VALVE POSITION SETPOINT	AO	1822
FHA-FLT-V-1901-ZC	FILTER #19 RATE CONTROL VALVE POSITION SETPOINT	AO	1822
FHA-FLT-V-2001-ZC	FILTER #20 RATE CONTROL VALVE POSITION SETPOINT	AO	1822

I/O Tag No	Description	Type	RPU
FHA-BW-V-0105-VC	WEST WW CTRL VLV PID{CV}CONTROL VARIABLE-OUTPUT	AO	1822
FHA-SPC-UPS-1822-EA	FILTERS 17-20 PLC UPS - POWER FAILURE	DI	1822
FHA-SPC-UPS-1822-EAL	FILTERS 17-20 PLC UPS - LOW BATTERY	DI	1822
FHA-SPC-UPS-1822-XA	FILTERS 17-20 PLC UPS - UPS FAILURE	DI	1822
FHA-SPC-UPS-1811-EA	WEST FILTRATION COMPUTER UPS - POWER FAILURE	DI	1822
FHA-SPC-UPS-1811-EAL	WEST FILTRATION COMPUTER UPS - LOW BATTERY	DI	1822
FHA-SPC-UPS-1811-XA	WEST FILTRATION COMPUTER UPS - UPS FAILURE	DI	1822
FHA-SPC-RPU-1822-TAH	FILTER #17-20 PANEL SMOKE/HEAT ALARM	DI	1822
FHA-FLT-G-1701-YN	FILTER #17 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1701-YA	FILTER #17 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1701-ZH	FILTER #17 INLET GATE OPENED	DI	1822
FHA-FLT-G-1701-ZL	FILTER #17 INLET GATE CLOSED	DI	1822
FHA-FLT-G-1702-YN	FILTER #17 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1702-YA	FILTER #17 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1702-ZH	FILTER #17 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-1702-ZL	FILTER #17 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-1701-YN	FILTER #17 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1701-YA	FILTER #17 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1701-ZH	FILTER #17 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-1701-ZL	FILTER #17 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-1702-YN	FILTER #17 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1702-YA	FILTER #17 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1702-ZH	FILTER #17 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-1702-ZL	FILTER #17 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-1703-YN	FILTER #17 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1703-YA	FILTER #17 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1703-ZH	FILTER #17 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-1703-ZL	FILTER #17 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-G-1801-YN	FILTER #18 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1801-YA	FILTER #18 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1801-ZH	FILTER #18 INLET GATE OPENED	DI	1822
FHA-FLT-G-1801-ZL	FILTER #18 INLET GATE CLOSED	DI	1822
FHA-FLT-G-1802-YN	FILTER #18 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1802-YA	FILTER #18 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1802-ZH	FILTER #18 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-1802-ZL	FILTER #18 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-1801-YN	FILTER #18 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1801-YA	FILTER #18 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1801-ZH	FILTER #18 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-1801-ZL	FILTER #18 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-1802-YN	FILTER #18 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1802-YA	FILTER #18 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1802-ZH	FILTER #18 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-1802-ZL	FILTER #18 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-1803-YN	FILTER #18 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1803-YA	FILTER #18 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1803-ZH	FILTER #18 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-1803-ZL	FILTER #18 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-G-1901-YN	FILTER #19 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1901-YA	FILTER #19 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1901-ZH	FILTER #19 INLET GATE OPENED	DI	1822
FHA-FLT-G-1901-ZL	FILTER #19 INLET GATE CLOSED	DI	1822
FHA-FLT-G-1902-YN	FILTER #19 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1902-YA	FILTER #19 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1902-ZH	FILTER #19 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-1902-ZL	FILTER #19 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-1901-YN	FILTER #19 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1901-YA	FILTER #19 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1901-ZH	FILTER #19 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-1901-ZL	FILTER #19 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-1902-YN	FILTER #19 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1902-YA	FILTER #19 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1902-ZH	FILTER #19 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-1902-ZL	FILTER #19 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-1903-YN	FILTER #19 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1903-YA	FILTER #19 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1903-ZH	FILTER #19 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-1903-ZL	FILTER #19 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-G-2001-YN	FILTER #20 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-2001-YA	FILTER #20 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-2001-ZH	FILTER #20 INLET GATE OPENED	DI	1822
FHA-FLT-G-2001-ZL	FILTER #20 INLET GATE CLOSED	DI	1822
FHA-FLT-G-2002-YN	FILTER #20 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-2002-YA	FILTER #20 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822

I/O Tag No	Description	Type	RPU
FHA-FLT-G-2002-ZH	FILTER #20 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-2002-ZL	FILTER #20 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-2001-YN	FILTER #20 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-2001-YA	FILTER #20 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-2001-ZH	FILTER #20 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-2001-ZL	FILTER #20 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-2002-YN	FILTER #20 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-2002-YA	FILTER #20 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-2002-ZH	FILTER #20 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-2002-ZL	FILTER #20 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-2003-YN	FILTER #20 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-2003-YA	FILTER #20 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-2003-ZH	FILTER #20 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-2003-ZL	FILTER #20 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-HS-1701-ZL	FILTER #17 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-HS-1801-ZL	FILTER #18 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-HS-1901-ZL	FILTER #19 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-HS-2001-ZL	FILTER #20 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-AIT-1701-YA	FILTER #17 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-AIT-1801-YA	FILTER #18 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-AIT-1901-YA	FILTER #19 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-AIT-2001-YA	FILTER #20 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-LSHL-1701-LAH	FILTER #17 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1701-LAL	FILTER #17 LO LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1801-LAH	FILTER #18 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1801-LAL	FILTER #18 LO LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1901-LAH	FILTER #19 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1901-LAL	FILTER #19 LO LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-2001-LAH	FILTER #20 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-2001-LAL	FILTER #20 LO LEVEL SWITCH	DI	1822
FHA-BW-V-0105-YN	WEST WW CTRL VLV COMPUTER MODE	DI	1822
FHA-BW-V-0105-YA	WEST WW CTRL VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-BW-V-0105-ZH	WEST WW CTRL VLV OPENED	DI	1822
FHA-BW-V-0105-ZL	WEST WW CTRL VLV CLOSED	DI	1822
FHA-FLT-LIT-0101-YA	WEST SEW CONDUIT LEVEL LOSS OF SIGNAL	DI	1822
FHA-CLB-AIT-0002-YA	FILTER CMPST TRB ANALYZER INSTRUMENT FAULT	DI	1822
FHA-CLB-AIT-0003-YA	AFT POST CLR ANALYZER#1 INSTRUMENT FAULT	DI	1822
FHA-CLB-AIT-0004-YA	AFT POST CLR ANALYZER#2 INSTRUMENT FAULT	DI	1822
FHA-CLB-FSL-0001-FAL	POST CLR SMP PUMP LOW FLOW ALARM	DI	1822

I/O Tag No	Description	Type	RPU
FHA-CLB-FSL-0003-FAL	POST CLR TRB ANALYZER LOW FLOW ALARM	DI	1822
FHA-CLB-FSL-0004-FAL	AFT POST CLR ANALYZER#1 LOW FLOW ALARM	DI	1822
FHA-CLB-FSL-0005-FAL	AFT POST CLR ANALYZER#2 LOW FLOW ALARM	DI	1822
FHA-CLB-P-0001A-YN	AFTER POST SMP PUMP#1A COMPUTER MODE	DI	1822
FHA-CLB-P-0001A-MN	AFTER POST SMP PUMP#1A RUNNING	DI	1822
FHA-CLB-V-0012-YN	SMP PUMP DRAIN VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0012-YA	SMP PUMP DRAIN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-CLB-V-0012-ZH	SMP PUMP DRAIN VLV OPENED	DI	1822
FHA-CLB-V-0012-ZL	SMP PUMP DRAIN VLV CLOSED	DI	1822
FHA-CLB-V-0013-YN	BACKFLUSH VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0013-YA	BACKFLUSH VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-CLB-V-0013-ZH	BACKFLUSH VLV OPENED	DI	1822
FHA-CLB-V-0013-ZL	BACKFLUSH VLV CLOSED	DI	1822
FHA-CLB-P-0001B-YN	AFTER POST SMP PUMP#1B COMPUTER MODE	DI	1822
FHA-CLB-P-0001B-MN	AFTER POST SMP PUMP#1B RUNNING	DI	1822
FHA-CLB-V-0014-YN	ANALYZER ISLN VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0014-YA	ANALYZER ISLN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-CLB-V-0014-ZH	ANALYZER ISLN VLV OPENED	DI	1822
FHA-CLB-V-0014-ZL	ANALYZER ISLN VLV CLOSED	DI	1822
FHA-CLB-V-0029-YN	LAB ISOLATION VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0029-YA	LAB ISOLATION VLV NOT AVAILABLE	DI	1822
FHA-CLB-V-0029-ZH	LAB ISOLATION VLV OPENED	DI	1822
FHA-CLB-V-0029-ZL	LAB ISOLATION VLV CLOSED	DI	1822
FHA-FLT-G-1701-VH	FILTER #17 INLET GATE OPEN	DO	1822
FHA-FLT-G-1701-VL	FILTER #17 INLET GATE CLOSE	DO	1822
FHA-FLT-G-1702-VH	FILTER #17 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-1702-VL	FILTER #17 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-1702-VH	FILTER #17 BACKWASH VALVE OPEN	DO	1822
FHA-FLT-V-1702-VL	FILTER #17 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-1703-VH	FILTER #17 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-1703-VL	FILTER #17 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-FLT-G-1801-VH	FILTER #18 INLET GATE OPEN	DO	1822
FHA-FLT-G-1801-VL	FILTER #18 INLET GATE CLOSE	DO	1822
FHA-FLT-G-1802-VH	FILTER #18 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-1802-VL	FILTER #18 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-1802-VH	FILTER #18 BACKWASH VALVE OPEN	DO	1822
FHA-FLT-V-1802-VL	FILTER #18 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-1803-VH	FILTER #18 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-1803-VL	FILTER #18 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-FLT-G-1901-VH	FILTER #19 INLET GATE OPEN	DO	1822
FHA-FLT-G-1901-VL	FILTER #19 INLET GATE CLOSE	DO	1822
FHA-FLT-G-1902-VH	FILTER #19 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-1902-VL	FILTER #19 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-1902-VH	FILTER #19 BACKWASH VALVE OPEN	DO	1822

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1902-VL	FILTER #19 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-1903-VH	FILTER #19 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-1903-VL	FILTER #19 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-FLT-G-2001-VH	FILTER #20 INLET GATE OPEN	DO	1822
FHA-FLT-G-2001-VL	FILTER #20 INLET GATE CLOSE	DO	1822
FHA-FLT-G-2002-VH	FILTER #20 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-2002-VL	FILTER #20 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-2002-VH	FILTER #20 BACKWASH VALVE OPEN	DO	1822
FHA-FLT-V-2002-VL	FILTER #20 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-2003-VH	FILTER #20 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-2003-VL	FILTER #20 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-CLB-P-0001A-MH	AFTER POST SMP PUMP#1A START COMMAND	DO	1822
FHA-CLB-P-0001A-MB	AFTER POST SMP PUMP#1A STOP COMMAND	DO	1822
FHA-CLB-P-0001B-MH	AFTER POST SMP PUMP#1B START COMMAND	DO	1822
FHA-CLB-P-0001B-MB	AFTER POST SMP PUMP#1B STOP COMMAND	DO	1822
FHA-CLB-V-0012-VH	SMP PUMP DRAIN VLV OPEN	DO	1822
FHA-CLB-V-0012-VL	SMP PUMP DRAIN VLV CLOSE	DO	1822
FHA-CLB-V-0013-VH	BACKFLUSH VLV OPEN	DO	1822
FHA-CLB-V-0013-VL	BACKFLUSH VLV CLOSE	DO	1822
FHA-CLB-V-0014-VH	ANALYZER ISLN VLV OPEN	DO	1822
FHA-CLB-V-0014-VL	ANALYZER ISLN VLV CLOSE	DO	1822
FHA-CLB-V-0029-VH	LAB ISOLATION VLV OPEN	DO	1822
FHA-CLB-V-0029-VL	LAB ISOLATION VLV CLOSE	DO	1822
FHA-CLB-AIT-0003-DUTY	AFT POST CHLORINE ANALYZER CONTROL/REFERENCE SELECTION	DO	1822
FHA-FLT-ZIT-2101-ZI	FILTER #21 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2101-AI	FILTER #21 TURBIDITY	AI	1823
FHA-FLT-ZIT-2201-ZI	FILTER #22 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2201-AI	FILTER #22 TURBIDITY	AI	1823
FHA-FLT-ZIT-2301-ZI	FILTER #23 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2301-AI	FILTER #23 TURBIDITY	AI	1823
FHA-FLT-ZIT-2401-ZI	FILTER #24 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2401-AI	FILTER #24 TURBIDITY	AI	1823
FHA-BW-ZIT-0205-ZI	EAST WW RATE CONT VLV POSITION	AI	1823
FHA-FLT-FIT-0002-FI	EAST FILTERS TOTAL FLOW	AI	1823
FHA-FLT-FIT-2101-FT	FILTER #21 FLOW	AI	1823
FHA-FLT-PDIT-2101-PDI	FILTER #21 HEAD LOSS	AI	1823
FHA-FLT-FIT-2201-FT	FILTER #22 FLOW	AI	1823
FHA-FLT-PDIT-2201-PDI	FILTER #22 HEAD LOSS	AI	1823
FHA-FLT-FIT-2301-FT	FILTER #23 FLOW	AI	1823
FHA-FLT-PDIT-2301-PDI	FILTER #23 HEAD LOSS	AI	1823
FHA-FLT-FIT-2401-FT	FILTER #24 FLOW	AI	1823
FHA-FLT-PDIT-2401-PDI	FILTER #24 HEAD LOSS	AI	1823
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1823
FHA-FLT-V-2101-ZC	FILTER #21 RATE CONTROL VALVE POSITION SETPOINT	AO	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2201-ZC	FILTER #22 RATE CONTROL VALVE POSITION SETPOINT	AO	1823
FHA-FLT-V-2301-VC	FILTER #23 RATE CONTROL VALVE POSITION SETPOINT	AO	1823
FHA-FLT-V-2401-VC	FILTER #24 RATE CONTROL VALVE POSITION SETPOINT	AO	1823
FHA-BW-V-0205-VC	EAST WW CTRL VLV PID{CV}CONTROL VARIABLE-OUTPUT	AO	1823
FHA-SPC-UPS-1823-EA	FILTERS 21-24 PLC UPS - POWER FAILURE	DI	1823
FHA-SPC-UPS-1823-EAL	FILTERS 21-24 PLC UPS - LOW BATTERY	DI	1823
FHA-SPC-UPS-1823-XA	FILTERS 21-24 PLC UPS - UPS FAILURE	DI	1823
FHA-SPC-RPU-1823-TAH	FILTER #21-24 PANEL SMOKE/HEAT ALARM	DI	1823
FHA-FLT-G-2101-YN	FILTER #21 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2101-YA	FILTER #21 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2101-ZH	FILTER #21 INLET GATE OPENED	DI	1823
FHA-FLT-G-2101-ZL	FILTER #21 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2102-YN	FILTER #21 DRAIN GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2102-YA	FILTER #21 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2102-ZH	FILTER #21 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2102-ZL	FILTER #21 DRAIN GATE CLOSED	DI	1823
FHA-FLT-V-2101-YN	FILTER #21 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2101-YA	FILTER #21 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2101-ZH	FILTER #21 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2101-ZL	FILTER #21 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2102-YN	FILTER #21 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2102-YA	FILTER #21 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2102-ZH	FILTER #21 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2102-ZL	FILTER #21 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2103-YN	FILTER #21 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2103-YA	FILTER #21 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2103-ZH	FILTER #21 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2103-ZL	FILTER #21 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-G-2201-YN	FILTER #22 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2201-YA	FILTER #22 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2201-ZH	FILTER #22 INLET GATE OPENED	DI	1823
FHA-FLT-G-2201-ZL	FILTER #22 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2202-YN	FILTER #22 DRAIN GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2202-YA	FILTER #22 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2202-ZH	FILTER #22 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2202-ZL	FILTER #22 DRAIN GATE CLOSED	DI	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2201-YN	FILTER #22 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2201-YA	FILTER #22 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2201-ZH	FILTER #22 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2201-ZL	FILTER #22 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2202-YN	FILTER #22 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2202-YA	FILTER #22 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2202-ZH	FILTER #22 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2202-ZL	FILTER #22 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2203-YN	FILTER #22 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2203-YA	FILTER #22 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2203-ZH	FILTER #22 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2203-ZL	FILTER #22 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-G-2301-YN	FILTER #23 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2301-YA	FILTER #23 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2301-ZH	FILTER #23 INLET GATE OPENED	DI	1823
FHA-FLT-G-2301-ZL	FILTER #23 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2302-YN	FILTER #23 DRAIN GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2302-YA	FILTER #23 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2302-ZH	FILTER #23 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2302-ZL	FILTER #23 DRAIN GATE CLOSED	DI	1823
FHA-FLT-V-2301-YN	FILTER #23 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2301-YA	FILTER #23 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2301-ZH	FILTER #23 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2301-ZL	FILTER #23 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2302-YN	FILTER #23 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2302-YA	FILTER #23 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2302-ZH	FILTER #23 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2302-ZL	FILTER #23 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2303-YN	FILTER #23 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2303-YA	FILTER #23 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2303-ZH	FILTER #23 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2303-ZL	FILTER #23 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-G-2401-YN	FILTER #24 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2401-YA	FILTER #24 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2401-ZH	FILTER #24 INLET GATE OPENED	DI	1823
FHA-FLT-G-2401-ZL	FILTER #24 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2402-YN	FILTER #24 DRAIN GATE COMPUTER MODE	DI	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-G-2402-YA	FILTER #24 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2402-ZH	FILTER #24 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2402-ZL	FILTER #24 DRAIN GATE CLOSED	DI	1823
FHA-FLT-V-2401-YN	FILTER #24 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2401-YA	FILTER #24 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2401-ZH	FILTER #24 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2401-ZL	FILTER #24 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2402-YN	FILTER #24 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2402-YA	FILTER #24 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2402-ZH	FILTER #24 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2402-ZL	FILTER #24 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2403-YN	FILTER #24 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2403-YA	FILTER #24 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2403-ZH	FILTER #24 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2403-ZL	FILTER #24 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-HS-2101-ZL	FILTER #21 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-HS-2201-ZL	FILTER #22 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-HS-2301-ZL	FILTER #23 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-HS-2401-ZL	FILTER #24 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-AIT-2101-YA	FILTER #21 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1823
FHA-FLT-AIT-2201-YA	FILTER #22EFFLUENT TURBIDITY INSTRUMENT FAULT	DI	1823
FHA-FLT-AIT-2301-YA	FILTER #23 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1823
FHA-FLT-AIT-2401-YA	FILTER #24 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1823
FHA-FLT-LSHL-2101-LAH	FILTER #21 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2101-LAL	FILTER #21 LO LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2201-LAH	FILTER #22 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2201-LAL	FILTER #22 LO LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2301-LAH	FILTER #23 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2301-LAL	FILTER #23 LO LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2401-LAH	FILTER #24 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2401-LAL	FILTER #24 LO LEVEL SWITCH	DI	1823
FHA-BW-V-0205-YN	EAST WW CTRL VLV COMPUTER MODE	DI	1823
FHA-BW-V-0205-YA	EAST WW CTRL VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-BW-V-0205-ZH	EAST WW CTRL VLV OPENED	DI	1823
FHA-BW-V-0205-ZL	EAST WW CTRL VLV CLOSED	DI	1823
FHA-FLT-LIT-0201-YA	EAST SEW CONDUIT LEVEL LOSS OF SIGNAL	DI	1823
FHA-FLT-V-2109-ZH	FILTER #21 EFFLUENT G VALVE OPENED	DI	1823
FHA-FLT-V-2109-ZL	FILTER #21 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-V-2209-ZH	FILTER #22 EFFLUENT G VALVE OPENED	DI	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2209-ZL	FILTER #22 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-V-2309-ZH	FILTER #23 EFFLUENT G VALVE OPENED	DI	1823
FHA-FLT-V-2309-ZL	FILTER #23 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-V-2409-ZH	FILTER #24 EFFLUENT G VALVE OPENED	DI	1823
FHA-FLT-V-2409-ZL	FILTER #24 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-G-2101-VH	FILTER #21 INLET GATE OPEN	DO	1823
FHA-FLT-G-2101-VL	FILTER #21 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2102-VH	FILTER #21 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2102-VL	FILTER #21 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2102-VH	FILTER #21 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2102-VL	FILTER #21 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2103-VH	FILTER #21 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2103-VL	FILTER #21 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-G-2201-VH	FILTER #22 INLET GATE OPEN	DO	1823
FHA-FLT-G-2201-VL	FILTER #22 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2202-VH	FILTER #22 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2202-VL	FILTER #22 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2202-VH	FILTER #22 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2202-VL	FILTER #22 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2203-VH	FILTER #22 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2203-VL	FILTER #22 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-G-2301-VH	FILTER #23 INLET GATE OPEN	DO	1823
FHA-FLT-G-2301-VL	FILTER #23 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2302-VH	FILTER #23 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2302-VL	FILTER #23 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2302-VH	FILTER #23 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2302-VL	FILTER #23 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2303-VH	FILTER #23 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2303-VL	FILTER #23 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-G-2401-VH	FILTER #24 INLET GATE OPEN	DO	1823
FHA-FLT-G-2401-VL	FILTER #24 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2402-VH	FILTER #24 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2402-VL	FILTER #24 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2402-VH	FILTER #24 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2402-VL	FILTER #24 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2403-VH	FILTER #24 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2403-VL	FILTER #24 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-ZIT-2501-ZI	FILTER #25 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2501-AI	FILTER #25 TURBIDITY	AI	1621
FHA-FLT-ZIT-2601-ZI	FILTER #26 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2601-AI	FILTER #26 TURBIDITY	AI	1621
FHA-FLT-ZIT-2701-ZI	FILTER #27 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2701-AI	FILTER #27 TURBIDITY	AI	1621
FHA-FLT-ZIT-2801-ZI	FILTER #28 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2801-AI	FILTER #28 TURBIDITY	AI	1621
FHA-FLT-AIT-4201-AI	E FILTER TRB ANALYZER	AI	1621
FHA-FLT-AIT-4202-AI	E FLE RESID CLR ANALYZER	AI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-FIT-2501-FT	FILTER #25 FLOW	AI	1621
FHA-FLT-PDIT-2501-PDI	FILTER #25 HEAD LOSS	AI	1621
FHA-FLT-FIT-2601-FT	FILTER #26 FLOW	AI	1621
FHA-FLT-PDIT-2601-PDI	FILTER #26 HEAD LOSS	IA	1621
FHA-FLT-FIT-2701-FT	FILTER #27 FLOW	AI	1621
FHA-FLT-PDIT-2701-PDI	FILTER #27 HEAD LOSS	AI	1621
FHA-FLT-FIT-2801-FT	FILTER #28 FLOW	AI	1621
FHA-FLT-PDIT-2801-PDI	FILTER #28 HEAD LOSS	AI	1621
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1621
FHA-FLT-V-2501-ZC	FILTER #25 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-FLT-V-2601-ZC	FILTER #26 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-FLT-V-2701-VC	FILTER #27 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-FLT-V-2801-VC	FILTER #28 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-SPC-UPS-1621-EA	FILTERS 25-28 PLC UPS - POWER FAILURE	DI	1621
FHA-SPC-UPS-1621-EAL	FILTERS 25-28 PLC UPS - LOW BATTERY	DI	1621
FHA-SPC-UPS-1621-XA	FILTERS 25-28 PLC UPS - UPS FAILURE	DI	1621
FHA-SPC-UPS-1611-EA	EAST FILTRATION COMPUTER UPS - POWER FAILURE	DI	1621
FHA-SPC-UPS-1611-EAL	EAST FILTRATION COMPUTER UPS - LOW BATTERY	DI	1621
FHA-SPC-UPS-1611-XA	EAST FILTRATION COMPUTER UPS - UPS FAILURE	DI	1621
FHA-SPC-RPU-1621-TAH	FILTER #25-28 PANEL SMOKE/HEAT ALARM	DI	1621
FHA-FLT-G-2501-YN	FILTER #25 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2501-YA	FILTER #25 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2501-ZH	FILTER #25 INLET GATE OPENED	DI	1621
FHA-FLT-G-2501-ZL	FILTER #25 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2502-YN	FILTER #25 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2502-YA	FILTER #25 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2502-ZH	FILTER #25 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2502-ZL	FILTER #25 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2501-YN	FILTER #25 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2501-YA	FILTER #25 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2501-ZH	FILTER #25 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2501-ZL	FILTER #25 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2502-YN	FILTER #25 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2502-YA	FILTER #25 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2502-ZH	FILTER #25 BACKWASH VALVE OPENED	DI	1621
FHA-FLT-V-2502-ZL	FILTER #25 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2503-YN	FILTER #25 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2503-YA	FILTER #25 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2503-ZH	FILTER #25 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2503-ZL	FILTER #25 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-G-2601-YN	FILTER #26 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2601-YA	FILTER #26 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2601-ZH	FILTER #26 INLET GATE OPENED	DI	1621
FHA-FLT-G-2601-ZL	FILTER #26 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2602-YN	FILTER #26 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2602-YA	FILTER #26 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2602-ZH	FILTER #26 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2602-ZL	FILTER #26 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2601-YN	FILTER #26 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2601-YA	FILTER #26 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2601-ZH	FILTER #26 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2601-ZL	FILTER #26 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2602-YN	FILTER #26 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2602-YA	FILTER #26 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2602-ZH	FILTER #26 BACKWASH VALVE OPENED	DI	1621
FHA-FLT-V-2602-ZL	FILTER #26 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2603-YN	FILTER #26 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2603-YA	FILTER #26 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2603-ZH	FILTER #26 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2603-ZL	FILTER #26 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-G-2701-YN	FILTER #27 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2701-YA	FILTER #27 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2701-ZH	FILTER #27 INLET GATE OPENED	DI	1621
FHA-FLT-G-2701-ZL	FILTER #27 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2702-YN	FILTER #27 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2702-YA	FILTER #27 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2702-ZH	FILTER #27 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2702-ZL	FILTER #27 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2701-YN	FILTER #27 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2701-YA	FILTER #27 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2701-ZH	FILTER #27 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2701-ZL	FILTER #27 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2702-YN	FILTER #27 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2702-YA	FILTER #27 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2702-ZH	FILTER #27 BACKWASH VALVE OPENED	DI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2702-ZL	FILTER #27 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2703-YN	FILTER #27 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2703-YA	FILTER #27 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2703-ZH	FILTER #27 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2703-ZL	FILTER #27 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-G-2801-YN	FILTER #28 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2801-YA	FILTER #28 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2801-ZH	FILTER #28 INLET GATE OPENED	DI	1621
FHA-FLT-G-2801-ZL	FILTER #28 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2802-YN	FILTER #28 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2802-YA	FILTER #28 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2802-ZH	FILTER #28 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2802-ZL	FILTER #28 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2801-YN	FILTER #28 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2801-YA	FILTER #28 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2801-ZH	FILTER #28 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2801-ZL	FILTER #28 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2802-YN	FILTER #28 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2802-YA	FILTER #28 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2802-ZH	FILTER #28 BACKWASH VALVE OPENED	DI	1621
FHA-FLT-V-2802-ZL	FILTER #28 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2803-YN	FILTER #28 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2803-YA	FILTER #28 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2803-ZH	FILTER #28 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2803-ZL	FILTER #28 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-HS-2501-ZL	FILTER #25 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-HS-2601-ZL	FILTER #26 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-HS-2701-ZL	FILTER #27 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-HS-2801-ZL	FILTER #28 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-AIT-2501-YA	FILTER #25 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-AIT-2601-YA	FILTER #26 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-AIT-2701-YA	FILTER #27 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-AIT-2801-YA	FILTER #28 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-LSHL-2501-LAH	FILTER #25 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2501-LAL	FILTER #25 LO LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2601-LAH	FILTER #26 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2601-LAL	FILTER #26 LO LEVEL SWITCH	DI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-LSHL-2701-LAH	FILTER #27 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2701-LAL	FILTER #27 LO LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2801-LAH	FILTER #28 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2801-LAL	FILTER #28 LO LEVEL SWITCH	DI	1621
FHA-FLT-V-2509-ZH	FILTER #25 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2509-ZL	FILTER #25 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-V-2609-ZH	FILTER #26 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2609-ZL	FILTER #26 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-V-2709-ZH	FILTER #27 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2709-ZL	FILTER #27 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-V-2809-ZH	FILTER #28 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2809-ZL	FILTER #28 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-AIT-4201-YA	FILTER TRB ANALYZER LOSS OF SIGNAL (N/A – DISABLED IN SOFTWARE LOGIC)	DI	1621
FHA-FLT-AIT-4202-YA	E FLE RESID CLR ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-FSL-4201-FAL	E FILTER CMPST SMP PUMP FLOW LOW ALARM	DI	1621
FHA-FLT-FSL-4202-FAL	E FILTER TRB ANALYZER FLOW LOW ALARM	DI	1621
FHA-FLT-FSL-4203-FAL	E FLE RESID CLR ANALYZER FLOW LOW ALARM	DI	1621
FHA-FLT-P-4201-YN	E FILTER CMPST SMP PUMP COMPUTER MODE	DI	1621
FHA-FLT-P-4201-MN	E FILTER CMPST SMP PUMP RUNNING	DI	1621
FHA-FLT-V-4208-YN	EAST ANALYZER ISLN VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4208-YA	EAST ANALYZER ISLN VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4208-ZH	EAST ANALYZER ISLN VALVE OPENED	DI	1621
FHA-FLT-V-4208-ZL	EAST ANALYZER ISLN VALVE CLOSED	DI	1621
FHA-FLT-V-4209-YN	EAST BACKFLUSH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4209-YA	EAST BACKFLUSH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4209-ZH	EAST BACKFLUSH VALVE OPENED	DI	1621
FHA-FLT-V-4209-ZL	EAST BACKFLUSH VALVE CLOSED	DI	1621
FHA-FLT-V-4210-YN	EAST DRAIN VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4210-YA	EAST DRAIN VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4210-ZH	EAST DRAIN VALVE OPENED	DI	1621
FHA-FLT-V-4210-ZL	EAST DRAIN VALVE CLOSED	DI	1621
FHA-FLT-V-4206-YN	EAST LAB ISLN VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4206-YA	EAST LAB ISLN VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4206-ZH	EAST LAB ISLN VALVE OPENED	DI	1621
FHA-FLT-V-4206-ZL	EAST LAB ISLN VALVE CLOSED	DI	1621
FHA-FLT-V-4211-YN	EAST SUCT FLUSH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4211-YA	EAST SUCT FLUSH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4211-ZH	EAST SUCT FLUSH VALVE OPENED	DI	1621
FHA-FLT-V-4211-ZL	EAST SUCT FLUSH VALVE CLOSED	DI	1621
FHA-FLT-G-2501-VH	FILTER #25 INLET GATE OPEN	DO	1621
FHA-FLT-G-2501-VL	FILTER #25 INLET GATE CLOSE	DO	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-G-2502-VH	FILTER #25 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2502-VL	FILTER #25 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2502-VH	FILTER #25 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2502-VL	FILTER #25 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2503-VH	FILTER #25 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2503-VL	FILTER #25 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-G-2601-VH	FILTER #26 INLET GATE OPEN	DO	1621
FHA-FLT-G-2601-VL	FILTER #26 INLET GATE CLOSE	DO	1621
FHA-FLT-G-2602-VH	FILTER #26 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2602-VL	FILTER #26 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2602-VH	FILTER #26 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2602-VL	FILTER #26 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2603-VH	FILTER #26 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2603-VL	FILTER #26 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-G-2701-VH	FILTER #27 INLET GATE OPEN	DO	1621
FHA-FLT-G-2701-VL	FILTER #27 INLET GATE CLOSE	DO	1621
FHA-FLT-G-2702-VH	FILTER #27 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2702-VL	FILTER #27 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2702-VH	FILTER #27 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2702-VL	FILTER #27 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2703-VH	FILTER #27 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2703-VL	FILTER #27 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-G-2801-VH	FILTER #28 INLET GATE OPEN	DO	1621
FHA-FLT-G-2801-VL	FILTER #28 INLET GATE CLOSE	DO	1621
FHA-FLT-G-2802-VH	FILTER #28 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2802-VL	FILTER #28 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2802-VH	FILTER #28 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2802-VL	FILTER #28 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2803-VH	FILTER #28 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2803-VL	FILTER #28 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-P-4201-MH	E FILTER CMPST SMP PUMP START COMMAND	DO	1621
FHA-FLT-P-4201-MB	E FILTER CMPST SMP PUMP STOP COMMAND	DO	1621
FHA-FLT-V-4208-VH	EAST ANALYZER ISLN VALVE OPEN	DO	1621
FHA-FLT-V-4208-VL	EAST ANALYZER ISLN VALVE CLOSE	DO	1621
FHA-FLT-V-4209-VH	EAST BACKFLUSH VALVE OPEN	DO	1621
FHA-FLT-V-4209-VL	EAST BACKFLUSH VALVE CLOSE	DO	1621
FHA-FLT-V-4210-VH	EAST DRAIN VALVE OPEN	DO	1621
FHA-FLT-V-4210-VL	EAST DRAIN VALVE CLOSE	DO	1621
FHA-FLT-V-4206-VH	EAST LAB ISLN VALVE OPEN	DO	1621
FHA-FLT-V-4206-VL	EAST LAB ISLN VALVE CLOSE	DO	1621
FHA-FLT-V-4211-VH	EAST SUCT FLUSH VALVE OPEN	DO	1621
FHA-FLT-V-4211-VL	EAST SUCT FLUSH VALVE CLOSE	DO	1621
FHA-FLT-ZIT-2901-ZI	FILTER #29 RATE CONT VLV POSITION	AI	1622
FHA-FLT-AIT-2901-AI	FILTER #29 TURBIDITY	AI	1622
FHA-FLT-ZIT-3001-ZI	FILTER #30 RATE CONT VLV POSITION	AI	1622
FHA-FLT-AIT-3001-AI	FILTER #30 TURBIDITY	AI	1622
FHA-FLT-ZIT-3101-ZI	FILTER #31 RATE CONT VLV POSITION	AI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-AIT-3101-AI	FILTER #31 TURBIDITY	AI	1622
FHA-FLT-ZIT-3201-ZI	FILTER #32 RATE CONT VLV POSITION	AI	1622
FHA-FLT-AIT-3201-AI	FILTER #32 TURBIDITY	AI	1622
FHA-FLT-FIT-2901-FT	FILTER #29 FLOW	AI	1622
FHA-FLT-PDIT-2901-PDI	FILTER #29 HEAD LOSS	AI	1622
FHA-FLT-FIT-3001-FT	FILTER #30 FLOW	AI	1622
FHA-FLT-PDIT-3001-PDI	FILTER #30 HEAD LOSS	AI	1622
FHA-FLT-FIT-3101-FT	FILTER #31 FLOW	AI	1622
FHA-FLT-PDIT-3101-PDI	FILTER #31 HEAD LOSS	AI	1622
FHA-FLT-FIT-3201-FT	FILTER #32 FLOW	AI	1622
FHA-FLT-PDIT-3201-PDI	FILTER #32 HEAD LOSS	AI	1622
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1622
FHA-FLT-V-2901-ZC	FILTER #29 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-FLT-V-3001-ZC	FILTER #30 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-FLT-V-3101-VC	FILTER #31 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-FLT-V-3201-VC	FILTER #32 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-SPC-UPS-1622-EA	FILTERS 29-32 PLC UPS - POWER FAILURE	DI	1622
FHA-SPC-UPS-1622-EAL	FILTERS 29-32 PLC UPS - LOW BATTERY	DI	1622
FHA-SPC-UPS-1622-XA	FILTERS 29-32 PLC UPS - UPS FAILURE	DI	1622
FHA-SPC-RPU-1622-TAH	FILTER #29-32 PANEL SMOKE/HEAT ALARM	DI	1622
FHA-FLT-G-2901-YN	FILTER #29 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-2901-YA	FILTER #29 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-2901-ZH	FILTER #29 INLET GATE OPENED	DI	1622
FHA-FLT-G-2901-ZL	FILTER #29 INLET GATE CLOSED	DI	1622
FHA-FLT-G-2902-YN	FILTER #29 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-2902-YA	FILTER #29 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-2902-ZH	FILTER #29 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-2902-ZL	FILTER #29 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-2901-YN	FILTER #29 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-2901-YA	FILTER #29 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-2901-ZH	FILTER #29 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-2901-ZL	FILTER #29 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-2902-YN	FILTER #29 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-2902-YA	FILTER #29 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-2902-ZH	FILTER #29 BACKWASH VALVE OPENED	DI	1622
FHA-FLT-V-2902-ZL	FILTER #29 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-2903-YN	FILTER #29 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-2903-YA	FILTER #29 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2903-ZH	FILTER #29 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-2903-ZL	FILTER #29 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-G-3001-YN	FILTER #30 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3001-YA	FILTER #30 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3001-ZH	FILTER #30 INLET GATE OPENED	DI	1622
FHA-FLT-G-3001-ZL	FILTER #30 INLET GATE CLOSED	DI	1622
FHA-FLT-G-3002-YN	FILTER #30 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3002-YA	FILTER #30 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3002-ZH	FILTER #30 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-3002-ZL	FILTER #30 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-3001-YN	FILTER #30 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3001-YA	FILTER #30 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3001-ZH	FILTER #30 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-3001-ZL	FILTER #30 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-3002-YN	FILTER #30 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3002-YA	FILTER #30 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3002-ZH	FILTER #30 BACKWASH VALVE OPENED	DI	1622
FHA-FLT-V-3002-ZL	FILTER #30 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-3003-YN	FILTER #30 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3003-YA	FILTER #30 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3003-ZH	FILTER #30 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-3003-ZL	FILTER #30 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-G-3101-YN	FILTER #31 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3101-YA	FILTER #31 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3101-ZH	FILTER #31 INLET GATE OPENED	DI	1622
FHA-FLT-G-3101-ZL	FILTER #31 INLET GATE CLOSED	DI	1622
FHA-FLT-G-3102-YN	FILTER #31 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3102-YA	FILTER #31 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3102-ZH	FILTER #31 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-3102-ZL	FILTER #31 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-3101-YN	FILTER #31 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3101-YA	FILTER #31 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3101-ZH	FILTER #31 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-3101-ZL	FILTER #31 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-3102-YN	FILTER #31 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3102-YA	FILTER #31 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3102-ZH	FILTER #31 BACKWASH VALVE OPENED	DI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3102-ZL	FILTER #31 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-3103-YN	FILTER #31 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3103-YA	FILTER #31 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3103-ZH	FILTER #31 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-3103-ZL	FILTER #31 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-G-3201-YN	FILTER #32 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3201-YA	FILTER #32 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3201-ZH	FILTER #32 INLET GATE OPENED	DI	1622
FHA-FLT-G-3201-ZL	FILTER #32 INLET GATE CLOSED	DI	1622
FHA-FLT-G-3202-YN	FILTER #32 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3202-YA	FILTER #32 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3202-ZH	FILTER #32 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-3202-ZL	FILTER #32 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-3201-YN	FILTER #32 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3201-YA	FILTER #32 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3201-ZH	FILTER #32 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-3201-ZL	FILTER #32 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-3202-YN	FILTER #32 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3202-YA	FILTER #32 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3202-ZH	FILTER #32 BACKWASH VALVE OPENED	DI	1622
FHA-FLT-V-3202-ZL	FILTER #32 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-3203-YN	FILTER #32 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3203-YA	FILTER #32 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3203-ZH	FILTER #32 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-3203-ZL	FILTER #32 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-HS-2901-ZL	FILTER #29 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-HS-3001-ZL	FILTER #30 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-HS-3101-ZL	FILTER #31 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-HS-3201-ZL	FILTER #32 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-AIT-2901-YA	FILTER #29 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-AIT-3001-YA	FILTER #30 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-AIT-3101-YA	FILTER #31 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-AIT-3201-YA	FILTER #32 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-LSHL-2901-LAH	FILTER #29 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-2901-LAL	FILTER #29 LO LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3001-LAH	FILTER #30 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3001-LAL	FILTER #30 LO LEVEL SWITCH	DI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-LSHL-3101-LAH	FILTER #31 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3101-LAL	FILTER #31 LO LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3201-LAH	FILTER #32 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3201-LAL	FILTER #32 LO LEVEL SWITCH	DI	1622
FHA-FLT-V-2909-ZH	FILTER #29 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-2909-ZL	FILTER #29 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-V-3009-ZH	FILTER #30 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-3009-ZL	FILTER #30 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-V-3109-ZH	FILTER #31 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-3109-ZL	FILTER #31 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-V-3209-ZH	FILTER #32 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-3209-ZL	FILTER #32 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-G-2901-VH	FILTER #29 INLET GATE OPEN	DO	1622
FHA-FLT-G-2901-VL	FILTER #29 INLET GATE CLOSE	DO	1622
FHA-FLT-G-2902-VH	FILTER #29 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-2902-VL	FILTER #29 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-2902-VH	FILTER #29 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-2902-VL	FILTER #29 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-2903-VH	FILTER #29 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-2903-VL	FILTER #29 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-G-3001-VH	FILTER #30 INLET GATE OPEN	DO	1622
FHA-FLT-G-3001-VL	FILTER #30 INLET GATE CLOSE	DO	1622
FHA-FLT-G-3002-VH	FILTER #30 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-3002-VL	FILTER #30 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-3002-VH	FILTER #30 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-3002-VL	FILTER #30 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-3003-VH	FILTER #30 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-3003-VL	FILTER #30 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-G-3101-VH	FILTER #31 INLET GATE OPEN	DO	1622
FHA-FLT-G-3101-VL	FILTER #31 INLET GATE CLOSE	DO	1622
FHA-FLT-G-3102-VH	FILTER #31 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-3102-VL	FILTER #31 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-3102-VH	FILTER #31 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-3102-VL	FILTER #31 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-3103-VH	FILTER #31 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-3103-VL	FILTER #31 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-G-3201-VH	FILTER #32 INLET GATE OPEN	DO	1622
FHA-FLT-G-3201-VL	FILTER #32 INLET GATE CLOSE	DO	1622
FHA-FLT-G-3202-VH	FILTER #32 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-3202-VL	FILTER #32 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-3202-VH	FILTER #32 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-3202-VL	FILTER #32 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-3203-VH	FILTER #32 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-3203-VL	FILTER #32 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-ZIT-3301-ZI	FILTER #33 RATE CONT VLV POSITION	AI	1623
FHA-FLT-AIT-3301-AI	FILTER #33 TURBIDITY	AI	1623
FHA-FLT-ZIT-3401-ZI	FILTER #34 RATE CONT VLV POSITION	AI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-AIT-3401-AI	FILTER #34 TURBIDITY	AI	1623
FHA-FLT-ZIT-3501-ZI	FILTER #35 RATE CONT VLV POSITION	AI	1623
FHA-FLT-AIT-3501-AI	FILTER #35 TURBIDITY	AI	1623
FHA-FLT-ZIT-3601-ZI	FILTER #36 RATE CONT VLV POSITION	AI	1623
FHA-FLT-AIT-3601-AI	FILTER #36 TURBIDITY	AI	1623
FHA-FLT-FIT-3301-FT	FILTER #33 FLOW	AI	1623
FHA-FLT-PDIT-3301-PDI	FILTER #33 HEAD LOSS	AI	1623
FHA-FLT-FIT-3401-FT	FILTER #34 FLOW	AI	1623
FHA-FLT-PDIT-3401-PDI	FILTER #34 HEAD LOSS	AI	1623
FHA-FLT-FIT-3501-FT	FILTER #35 FLOW	AI	1623
FHA-FLT-PDIT-3501-PDI	FILTER #35 HEAD LOSS	AI	1623
FHA-FLT-FIT-3601-FT	FILTER #36 FLOW	AI	1623
FHA-FLT-PDIT-3601-PDI	FILTER #36 HEAD LOSS	AI	1623
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1623
FHA-FLT-V-3301-ZC	FILTER #33 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-FLT-V-3401-ZC	FILTER #34 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-FLT-V-3501-ZC	FILTER #35 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-FLT-V-3601-ZC	FILTER #36 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-SPC-UPS-1623-EA	FILTERS 33-36 PLC UPS - POWER FAILURE	DI	1623
FHA-SPC-UPS-1623-EAL	FILTERS 33-36 PLC UPS - LOW BATTERY	DI	1623
FHA-SPC-UPS-1623-XA	FILTERS 33-36 PLC UPS - UPS FAILURE	DI	1623
FHA-SPC-RPU-1623-TAH	FILTER #33-36 PANEL SMOKE/HEAT ALARM	DI	1623
FHA-FLT-G-3301-YN	FILTER #33 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3301-YA	FILTER #33 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3301-ZH	FILTER #33 INLET GATE OPENED	DI	1623
FHA-FLT-G-3301-ZL	FILTER #33 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3302-YN	FILTER #33 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3302-YA	FILTER #33 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3302-ZH	FILTER #33 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3302-ZL	FILTER #33 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3301-YN	FILTER #33 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3301-YA	FILTER #33 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3301-ZH	FILTER #33 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3301-ZL	FILTER #33 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3302-YN	FILTER #33 BACKWASH VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3302-YA	FILTER #33 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3302-ZH	FILTER #33 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3302-ZL	FILTER #33 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3303-YN	FILTER #33 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3303-YA	FILTER #33 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3303-ZH	FILTER #33 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3303-ZL	FILTER #33 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-G-3401-YN	FILTER #34 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3401-YA	FILTER #34 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3401-ZH	FILTER #34 INLET GATE OPENED	DI	1623
FHA-FLT-G-3401-ZL	FILTER #34 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3402-YN	FILTER #34 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3402-YA	FILTER #34 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3402-ZH	FILTER #34 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3402-ZL	FILTER #34 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3401-YN	FILTER #34 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3401-YA	FILTER #34 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3401-ZH	FILTER #34 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3401-ZL	FILTER #34 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3402-YN	FILTER #34 BACKWASH VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3402-YA	FILTER #34 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3402-ZH	FILTER #34 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3402-ZL	FILTER #34 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3403-YN	FILTER #34 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3403-YA	FILTER #34 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3403-ZH	FILTER #34 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3403-ZL	FILTER #34 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-G-3501-YN	FILTER #35 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3501-YA	FILTER #35 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3501-ZH	FILTER #35 INLET GATE OPENED	DI	1623
FHA-FLT-G-3501-ZL	FILTER #35 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3502-YN	FILTER #35 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3502-YA	FILTER #35 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3502-ZH	FILTER #35 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3502-ZL	FILTER #35 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3501-YN	FILTER #35 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3501-YA	FILTER #35 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3501-ZH	FILTER #35 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3501-ZL	FILTER #35 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3502-YN	FILTER #35 BACKWASH VALVE COMPUTER MODE	DI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3502-YA	FILTER #35 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3502-ZH	FILTER #35 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3502-ZL	FILTER #35 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3503-YN	FILTER #35 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3503-YA	FILTER #35 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3503-ZH	FILTER #35 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3503-ZL	FILTER #35 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-G-3601-YN	FILTER #36 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3601-YA	FILTER #36 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3601-ZH	FILTER #36 INLET GATE OPENED	DI	1623
FHA-FLT-G-3601-ZL	FILTER #36 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3602-YN	FILTER #36 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3602-YA	FILTER #36 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3602-ZH	FILTER #36 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3602-ZL	FILTER #36 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3601-YN	FILTER #36 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3601-YA	FILTER #36 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3601-ZH	FILTER #36 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3601-ZL	FILTER #36 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3602-YN	FILTER #36 BACKWASH VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3602-YA	FILTER #36 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3602-ZH	FILTER #36 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3602-ZL	FILTER #36 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3603-YN	FILTER #36 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3603-YA	FILTER #36 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3603-ZH	FILTER #36 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3603-ZL	FILTER #36 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-HS-3301-ZL	FILTER #33 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-HS-3401-ZL	FILTER #34 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-HS-3501-ZL	FILTER #35 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-HS-3601-ZL	FILTER #36 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-AIT-3301-YA	FILTER #33 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-AIT-3401-YA	FILTER #33 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-AIT-3501-YA	FILTER #35 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-AIT-3601-YA	FILTER #36 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-LSHL-3301-LAH	FILTER #33 HI LEVEL SWITCH	DI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-LSHL-3301-LAL	FILTER #33 LO LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3401-LAH	FILTER #34 HI LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3401-LAL	FILTER #34 LO LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3501-LAH	FILTER #35 HI LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3501-LAL	FILTER #35 LO LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3601-LAH	FILTER #36 HI LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3601-LAL	FILTER #36 LO LEVEL SWITCH	DI	1623
FHA-FLT-V-3309-ZH	FILTER #33 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3309-ZL	FILTER #33 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-V-3409-ZH	FILTER #34 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3409-ZL	FILTER #34 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-V-3509-ZH	FILTER #35 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3509-ZL	FILTER #35 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-V-3609-ZH	FILTER #36 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3609-ZL	FILTER #36 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-G-3301-VH	FILTER #33 INLET GATE OPEN	DO	1623
FHA-FLT-G-3301-VL	FILTER #33 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3302-VH	FILTER #33 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3302-VL	FILTER #33 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3302-VH	FILTER #33 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3302-VL	FILTER #33 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3303-VH	FILTER #33 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3303-VL	FILTER #33 SURFACE SWEEP VALVE CLOSE	DO	1623
FHA-FLT-G-3401-VH	FILTER #34 INLET GATE OPEN	DO	1623
FHA-FLT-G-3401-VL	FILTER #34 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3402-VH	FILTER #34 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3402-VL	FILTER #34 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3402-VH	FILTER #34 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3402-VL	FILTER #34 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3403-VH	FILTER #34 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3403-VL	FILTER #34 SURFACE SWEEP VALVE CLOSE	DO	1623
FHA-FLT-G-3501-VH	FILTER #35 INLET GATE OPEN	DO	1623
FHA-FLT-G-3501-VL	FILTER #35 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3502-VH	FILTER #35 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3502-VL	FILTER #35 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3502-VH	FILTER #35 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3502-VL	FILTER #35 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3503-VH	FILTER #35 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3503-VL	FILTER #35 SURFACE SWEEP VALVE CLOSE	DO	1623
FHA-FLT-G-3601-VH	FILTER #36 INLET GATE OPEN	DO	1623
FHA-FLT-G-3601-VL	FILTER #36 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3602-VH	FILTER #36 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3602-VL	FILTER #36 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3602-VH	FILTER #36 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3602-VL	FILTER #36 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3603-VH	FILTER #36 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3603-VL	FILTER #36 SURFACE SWEEP VALVE CLOSE	DO	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-ZIT-3701-ZI	FILTER #37 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-3701-AI	FILTER #37 TURBIDITY	AI	1624
FHA-FLT-ZIT-3801-ZI	FILTER #38 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-3801-AI	FILTER #38 TURBIDITY	AI	1624
FHA-FLT-ZIT-3901-ZI	FILTER #39 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-3901-AI	FILTER #39 TURBIDITY	AI	1624
FHA-FLT-ZIT-4001-ZI	FILTER #40 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-4001-AI	FILTER #40 TURBIDITY	AI	1624
FHA-SED-AIT-0201-AI	E SEW TRB ANALYZER	AI	1624
FHA-FLT-FIT-3701-FT	FILTER #37 FLOW	AI	1624
FHA-FLT-PDIT-3701-PDI	FILTER #37 HEAD LOSS	AI	1624
FHA-FLT-FIT-3801-FT	FILTER #38 FLOW	AI	1624
FHA-FLT-PDIT-3801-PDI	FILTER #38 HEAD LOSS	AI	1624
FHA-FLT-FIT-3901-FT	FILTER #39 FLOW	AI	1624
FHA-FLT-PDIT-3901-PDI	FILTER #39 HEAD LOSS	AI	1624
FHA-FLT-FIT-4001-FT	FILTER #40 FLOW	AI	1624
FHA-FLT-PDIT-4001-PDI	FILTER #40 HEAD LOSS	AI	1624
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1624
FHA-FLT-V-3701-ZC	FILTER #37 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-FLT-V-3801-ZC	FILTER #38 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-FLT-V-3901-ZC	FILTER #39 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-FLT-V-4001-ZC	FILTER #40 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-SPC-UPS-1624-EA	FILTERS 37-40 PLC UPS - POWER FAILURE	DI	1624
FHA-SPC-UPS-1624-EAL	FILTERS 37-40 PLC UPS - LOW BATTERY	DI	1624
FHA-SPC-UPS-1624-XA	FILTERS 37-40 PLC UPS - UPS FAILURE	DI	1624
FHA-SPC-RPU-1624-TAH	FILTER #37-40 PANEL SMOKE/HEAT ALARM	DI	1624
FHA-FLT-G-3701-YN	FILTER #37 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3701-YA	FILTER #37 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3701-ZH	FILTER #37 INLET GATE OPENED	DI	1624
FHA-FLT-G-3701-ZL	FILTER #37 INLET GATE CLOSED	DI	1624
FHA-FLT-G-3702-YN	FILTER #37 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3702-YA	FILTER #37 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3702-ZH	FILTER #37 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-3702-ZL	FILTER #37 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-3701-YN	FILTER #37 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3701-YA	FILTER #37 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3701-ZH	FILTER #37 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-3701-ZL	FILTER #37 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-3702-YN	FILTER #37 BACKWASH VALVE COMPUTER MODE	DI	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3702-YA	FILTER #37 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3702-ZH	FILTER #37 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-3702-ZL	FILTER #37 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-3703-YN	FILTER #37 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3703-YA	FILTER #37 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3703-ZH	FILTER #37 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-3703-ZL	FILTER #37 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-G-3801-YN	FILTER #38 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3801-YA	FILTER #38 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3801-ZH	FILTER #38 INLET GATE OPENED	DI	1624
FHA-FLT-G-3801-ZL	FILTER #38 INLET GATE CLOSED	DI	1624
FHA-FLT-G-3802-YN	FILTER #38 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3802-YA	FILTER #38 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3802-ZH	FILTER #38 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-3802-ZL	FILTER #38 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-3801-YN	FILTER #38 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3801-YA	FILTER #38 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3801-ZH	FILTER #38 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-3801-ZL	FILTER #38 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-3802-YN	FILTER #38 BACKWASH VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3802-YA	FILTER #38 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3802-ZH	FILTER #38 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-3802-ZL	FILTER #38 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-3803-YN	FILTER #38 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3803-YA	FILTER #38 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3803-ZH	FILTER #38 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-3803-ZL	FILTER #38 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-G-3901-YN	FILTER #39 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3901-YA	FILTER #39 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3901-ZH	FILTER #39 INLET GATE OPENED	DI	1624
FHA-FLT-G-3901-ZL	FILTER #39 INLET GATE CLOSED	DI	1624
FHA-FLT-G-3902-YN	FILTER #39 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3902-YA	FILTER #39 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3902-ZH	FILTER #39 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-3902-ZL	FILTER #39 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-3901-YN	FILTER #39 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3901-YA	FILTER #39 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3901-ZH	FILTER #39 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-3901-ZL	FILTER #39 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-3902-YN	FILTER #39 BACKWASH VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3902-YA	FILTER #39 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3902-ZH	FILTER #39 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-3902-ZL	FILTER #39 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-3903-YN	FILTER #39 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3903-YA	FILTER #39 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3903-ZH	FILTER #39 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-3903-ZL	FILTER #39 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-G-4001-YN	FILTER #40 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-4001-YA	FILTER #40 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-4001-ZH	FILTER #40 INLET GATE OPENED	DI	1624
FHA-FLT-G-4001-ZL	FILTER #40 INLET GATE CLOSED	DI	1624
FHA-FLT-G-4002-YN	FILTER #40 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-4002-YA	FILTER #40 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-4002-ZH	FILTER #40 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-4002-ZL	FILTER #40 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-4001-YN	FILTER #40 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-4001-YA	FILTER #40 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-4001-ZH	FILTER #40 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-4001-ZL	FILTER #40 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-4002-YN	FILTER #40 BACKWASH VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-4002-YA	FILTER #40 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-4002-ZH	FILTER #40 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-4002-ZL	FILTER #40 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-4003-YN	FILTER #40 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-4003-YA	FILTER #40 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-4003-ZH	FILTER #40 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-4003-ZL	FILTER #40 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-HS-3701-ZL	FILTER #37 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-HS-3801-ZL	FILTER #38 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-HS-3901-ZL	FILTER #39 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-HS-4001-ZL	FILTER #40 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-AIT-3701-YA	FILTER #37 EFFLUENT TURBIDITY ANALYZER ISNTRUMENT FAULT	DI	1624
FHA-FLT-AIT-3801-YA	FILTER #38 EFFLUENT TURBIDITY ANALYZER ISNTRUMENT FAULT	DI	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-AIT-3901-YA	FILTER #39 EFFLUENT TURBIDITY ANALYZER ISNTRUMENT FAULT	DI	1624
FHA-FLT-AIT-4001-YA	FILTER #40 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1624
FHA-FLT-LSHL-3701-LAH	FILTER #37 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3701-LAL	FILTER #37 LO LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3801-LAH	FILTER #38 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3801-LAL	FILTER #38 LO LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3901-LAH	FILTER #39 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3901-LAL	FILTER #39 LO LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-4001-LAH	FILTER #40 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-4001-LAL	FILTER #40 LO LEVEL SWITCH	DI	1624
FHA-SED-P-0201-YN	SEW SAMPLE PUMP - EAST COMPUTER MODE	DI	1624
FHA-SED-P-0201-MN	SEW SAMPLE PUMP - EAST RUNNING	DI	1624
FHA-SED-V-0202-YN	SEW SMP PUMP SUCT VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0202-YA	SEW SMP PUMP SUCT VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0202-ZH	SEW SMP PUMP SUCT VLV-E OPENED	DI	1624
FHA-SED-V-0202-ZL	SEW SMP PUMP SUCT VLV-E CLOSED	DI	1624
FHA-SED-V-0209-YN	SEW SMP PUMP TRB VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0209-YA	SEW SMP PUMP TRB VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0209-ZH	SEW SMP PUMP TRB VLV-E OPENED	DI	1624
FHA-SED-V-0209-ZL	SEW SMP PUMP TRB VLV-E CLOSED	DI	1624
FHA-SED-V-0210-YN	SEW SUCT FLUSH VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0210-YA	SEW SUCT FLUSH VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0210-ZH	SEW SUCT FLUSH VLV-E OPENED	DI	1624
FHA-SED-V-0210-ZL	SEW SUCT FLUSH VLV-E CLOSED	DI	1624
FHA-SED-V-0211-YN	SEW DISCH FLUSH VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0211-YA	SEW DISCH FLUSH VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0211-ZH	SEW DISCH FLUSH VLV-E OPENED	DI	1624
FHA-SED-V-0211-ZL	SEW DISCH FLUSH VLV-E CLOSED	DI	1624
FHA-FLT-V-3709-ZH	FILTER #37 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-3709-ZL	FILTER #37 EFFLUENT G VALVE CLOSED	DI	1624
FHA-FLT-V-3809-ZH	FILTER #38 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-3809-ZL	FILTER #38 EFFLUENT G VALVE CLOSED	DI	1624
FHA-FLT-V-3909-ZH	FILTER #39 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-3909-ZL	FILTER #39 EFFLUENT G VALVE CLOSED	DI	1624
FHA-FLT-V-4009-ZH	FILTER #40 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-4009-ZL	FILTER #40 EFFLUENT G VALVE CLOSED	DI	1624
FHA-SED-FSL-0201-FAL	E SEW SMP PUMP P-0201 FLOW LOW ALARM	DI	1624
FHA-SED-FSL-0202-FAL	E SEW TRB ANALYZER FLOW LOW ALARM	DI	1624
FHA-SED-AIT-0201-YA	E SEW TRB ANALYZER INSTRUMENT FAULT	DI	1624
FHA-FLT-G-3701-VH	FILTER #37 INLET GATE OPEN	DO	1624
FHA-FLT-G-3701-VL	FILTER #37 INLET GATE CLOSE	DO	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-G-3702-VH	FILTER #37 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-3702-VL	FILTER #37 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-3702-VH	FILTER #37 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-3702-VL	FILTER #37 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-3703-VH	FILTER #37 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-3703-VL	FILTER #37 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-FLT-G-3801-VH	FILTER #38 INLET GATE OPEN	DO	1624
FHA-FLT-G-3801-VL	FILTER #38 INLET GATE CLOSE	DO	1624
FHA-FLT-G-3802-VH	FILTER #38 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-3802-VL	FILTER #38 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-3802-VH	FILTER #38 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-3802-VL	FILTER #38 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-3803-VH	FILTER #38 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-3803-VL	FILTER #38 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-FLT-G-3901-VH	FILTER #39 INLET GATE OPEN	DO	1624
FHA-FLT-G-3901-VL	FILTER #39 INLET GATE CLOSE	DO	1624
FHA-FLT-G-3902-VH	FILTER #39 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-3902-VL	FILTER #39 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-3902-VH	FILTER #39 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-3902-VL	FILTER #39 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-3903-VH	FILTER #39 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-3903-VL	FILTER #39 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-FLT-G-4001-VH	FILTER #40 INLET GATE OPEN	DO	1624
FHA-FLT-G-4001-VL	FILTER #40 INLET GATE CLOSE	DO	1624
FHA-FLT-G-4002-VH	FILTER #40 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-4002-VL	FILTER #40 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-4002-VH	FILTER #40 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-4002-VL	FILTER #40 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-4003-VH	FILTER #40 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-4003-VL	FILTER #40 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-SED-P-0201-MH	E SEW SMP PUMP P-0201 START COMMAND	DO	1624
FHA-SED-P-0201-MB	E SEW SMP PUMP P-0201 STOP COMMAND	DO	1624
FHA-SED-V-0202-VH	E SEW SUCT FLUSH VLV OPEN	DO	1624
FHA-SED-V-0202-VL	E SEW SUCT FLUSH VLV CLOSE	DO	1624
FHA-SED-V-0209-VH	E SEW ANALYZER ISLN VLV OPEN	DO	1624
FHA-SED-V-0209-VL	E SEW ANALYZER ISLN VLV CLOSE	DO	1624
FHA-SED-V-0210-VH	E SEW LAB ISLN VLV OPEN	DO	1624
FHA-SED-V-0210-VL	E SEW LAB ISLN VLV CLOSE	DO	1624
FHA-SED-V-0211-VH	E SEW BACKFLUSH VLV OPEN	DO	1624
FHA-SED-V-0211-VL	E SEW BACKFLUSH VLV CLOSE	DO	1624
FHA-BW-FIT-0001-FI	BACKWASH FLOW	AI	1223
FHA-SPC-UPS-1223-EA	BACKWASH PUMPS PLC UPS - POWER FAILURE	DI	1223
FHA-SPC-UPS-1223-EAL	BACKWASH PUMPS PLC UPS - LOW BATTERY	DI	1223
FHA-SPC-UPS-1223-XA	BACKWASH PUMPS PLC UPS - UPS FAILURE	DI	1223
FHA-SPC-UPS-1211-EA	SWITCHGEAR ROOM COMPUTER UPS - POWER FAILURE	DI	1223
FHA-SPC-UPS-1211-EAL	SWITCHGEAR ROOM COMPUTER UPS - LOW BATTERY	DI	1223

I/O Tag No	Description	Type	RPU
FHA-SPC-UPS-1211-XA	SWITCHGEAR ROOM COMPUTER UPS - UPS FAILURE	ID	1223
FHA-SPC-RPU-1223-TAH	PANEL SMOKE/HEAT ALM	DI	1223
FHA-BW-P-0501-YN	BACKWASH PUMP 5 COMPUTER MODE	DI	1223
FHA-BW-P-0501-YA	BACKWASH PUMP 5 NOT AVAILABLE– MULTILIN R6 FAULT	DI	1223
FHA-BW-P-0501-MN	BACKWASH PUMP 5 RUNNING	DI	1223
FHA-BW-V-0501-ZH	BACKWASH PUMP 5 INLET VALVE OPENED	DI	1223
FHA-BW-V-0501-ZL	BACKWASH PUMP 5 INLET VALVE CLOSED	DI	1223
FHA-BW-V-0503-ZH	BACKWASH PUMP 5 DISCH VALVE OPENED	DI	1223
FHA-BW-V-0503-ZL	BACKWASH PUMP 5 DISCH VALVE CLOSED	DI	1223
FHA-BW-FIT-0001-YA	BACKWASH FLOW LOSS OF SIGNAL	DI	1223
FHA-BW-P-0701-YN	BACKWASH PUMP 7 COMPUTER MODE	DI	1223
FHA-BW-P-0701-YA	BACKWASH PUMP 7 NOT AVAILABLE– MULTILIN R6 FAULT	DI	1223
FHA-BW-P-0701-MN	BACKWASH PUMP 7 RUNNING	DI	1223
FHA-BW-P-0601-YN	BACKWASH PUMP 6 COMPUTER MODE	DI	1223
FHA-BW-P-0601-YA	BACKWASH PUMP 6 NOT AVAILABLE– MULTILIN R6 FAULT	DI	1223
FHA-BW-P-0601-MN	BACKWASH PUMP 6 RUNNING	DI	1223
FHA-BW-V-0601-ZH	BACKWASH PUMP 6 INLET VALVE OPENED	DI	1223
FHA-BW-V-0601-ZL	BACKWASH PUMP 6 INLET VALVE CLOSED	DI	1223
FHA-BW-V-0603-ZH	BACKWASH PUMP 6 DISCH VALVE OPENED	DI	1223
FHA-BW-V-0603-ZL	BACKWASH PUMP 6 DISCH VALVE CLOSED	DI	1223
FHA-BW-V-0001-ZH	BACKWASH HEADER VALVE - WEST OPENED	DI	1223
FHA-BW-V-0001-ZL	BACKWASH HEADER VALVE - WEST CLOSED	DI	1223
FHA-BW-V-0002-ZH	BACKWASH HEADER VALVE - EAST OPENED	DI	1223
FHA-BW-V-0002-ZL	BACKWASH HEADER VALVE - EAST CLOSED	DI	1223
FHA-BW-V-0701-ZH	BACKWASH PUMP 7 INLET VALVE OPENED	DI	1223
FHA-BW-V-0701-ZL	BACKWASH PUMP 7 INLET VALVE CLOSED	DI	1223
FHA-BW-V-0703-ZH	BACKWASH PUMP 7 DISCH VALVE OPENED	DI	1223
FHA-BW-V-0703-ZL	BACKWASH PUMP 7 DISCH VALVE CLOSED	DI	1223
FHA-SAN-P-0101-MN	DEWATERING PUMP#1 RUNNING	DI	1223
FHA-SAN-P-0101-XA	DEWATERING PUMP#1 GENERAL ALARM	DI	1223
FHA-SAN-P-0201-MN	DEWATERING PUMP#2 RUNNING	DI	1223
FHA-SAN-P-0201-XA	DEWATERING PUMP#2 GENERAL ALARM	DI	1223
FHA-SAN-LSHH-0001-LAH	SAN WET WELL LEVEL HIGH HIGH ALARM	DI	1223
FHA-AUX-C-0201-MN	COMPRESSOR#1A RUNNING	DI	1223
FHA-AUX-C-0201-YA	COMPRESSOR#1A GENERAL ALARM	DI	1223
FHA-AUX-C-0202-MN	COMPRESSOR#1B RUNNING	DI	1223
FHA-AUX-C-0202-YA	COMPRESSOR#1B GENERAL ALARM	DI	1223
FHA-AUX-D-0201-MN	AIR DRYER#1 RUNNING	DI	1223
FHA-AUX-D-0201-YA	AIR DRYER#1 GENERAL ALARM	DI	1223
FHA-AUX-D-0202-MN	AIR DRYER#2 RUNNING	DI	1223
FHA-AUX-D-0202-YA	AIR DRYER#2 GENERAL ALARM	DI	1223
FHA-BW-P-0501-MH	BACKWASH PUMP 5 START COMMAND	DO	1223
FHA-BW-P-0501-MB	BACKWASH PUMP 5 STOP COMMAND	DO	1223
FHA-BW-P-0601-MH	BACKWASH PUMP 6 START COMMAND	DO	1223

I/O Tag No	Description	Type	RPU
FHA-BW-P-0601-MB	BACKWASH PUMP 6 STOP COMMAND	DO	1223
FHA-BW-P-0701-MH	BACKWASH PUMP 7 START COMMAND	DO	1223
FHA-BW-P-0701-MB	BACKWASH PUMP 7 STOP COMMAND	DO	1223

C. Control Logic

C.1 Normal Operation

C.1.1 Control Mode Management

The Filter PLC confirms which automatic mode is selected at the HMI, SCADA/MANUAL, SCADA/AUTO or SCADA/MASTER.

If SCADA/MANUAL is selected at the HMI – filter rate valve position is set for manual manipulation of the filter rate valve at the SCADA HMI.

If SCADA/AUTO mode has been selected on the HMI. The Filter PLC looks at the operator adjustable flow set point entered on the SCADA HMI and controls the 4-20ma position signal to the valve to maintain the desired flow.

If SCADA/MASTER mode has been selected on the HMI. The Filter PLC looks at the Master Filter Rate set point which is calculated by the Master Filter PLC. The Master Filter PLC will maintain the settled conduit level based on an operator adjustable level set point from the HMI and calculate the flow rate set point for each filter by dividing the total required flow by the number of filters in service. Total number of filters in service is determined based on each filter being in SCADA/MASTER mode. Each PLC that is in Master will receive the Master Flow Rate set point and control the 4-20ma position signal to the valve to maintain the desired flow.

C.1.2 Filtering

The normal mode of operation for each filter is SCADA/MASTER mode. In this mode, each of the filter PLCs receives a master flow rate set point from the master filter PLC. The calculation for this set point is based on the settled water conduit level and is described in equation (2).

When the master flow rate PLC determines how much flow is required to maintain the settled water conduit level, it will count the number of filters in master mode and split the total flow required between those filters. The calculation to determine this base flow rate is:

$$\boldsymbol{Q_F = \frac{Q_T - Q_{NM}}{n_F}} \quad \textbf{(2)}$$

Where:

Q_F = Individual filter flowrate (L/s)

Q_T = Master total filtration flow (L/s)

Q_{NM} = Total flow of filters not in SCADA/MASTER mode (L/s)

n_F = Number of filters in SCADA/MASTER mode

The master rate flow set point is sent through the network from the master flow rate PLC to the individual PLCs. As a backup, a 4-20mA signal is hardwired from the master flow rate PLC to the individual PLCs with this same set point.

An automatic switchover is triggered if the network fails. The individual PLCs use the master flow rate set point to modulate the rate control valve using a PID loop. A 4-20mA signal is sent to the valve actuator to open and close the valve to maintain the required flow.

The master filter PLC conditions the master rate set point using one of three methods, depending on the settled water level as described below.

The settled water conduits (east and west) level set points are entered at one of the HMI view nodes and is transmitted to the master flow rate PLC in the CBP. This set point is compared to the actual settled water conduit levels. The absolute value of this comparison is used to determine which of three signal condition methods is used to condition the master filtration rate set point.

Level 1 – Absolute value of settled water level set point minus the actual settled water level is less than Settled Water Band 1 (set to 0.02m). There is no further conditioning and the master filtration rate set point is transmitted to all the individual filter PLCs and Indicator/Controller.

Level 2 – Absolute value of a settled water level set point minus the actual settled water level is less than Settled Water Band 2 (set to 0.045m), but greater than or equal to Settled Water Band 1.

The above result is then divided by Settled Water Band 2. The result becomes the input value (in %) for the Lookup Table. The output is called the Index Value.

The master PLCs use a look-up table to condition the master filtration rate set point. The conditioned master filtration rate set point is transmitted to the respective east or west individual filtration PLCs and Indicator/Controller.

Level 3 – Absolute value of a settled water level set point minus the actual settled water level is greater than or equal to the Settled Water Band 2. The master PLCs use a PID control loop to compare the actual settled water level with the settled water level set point. The output of this PID loop becomes the master filtration rate set point and is transmitted to the respective east or west individual filtration PLCs and Indicator/Controller.

Settings for Level 1 and Level 2 of this control logic will be based on an empirically derived look-up table. A preliminary table is presented as follows. Note that fine-tuning during final implementation may be required:

Table 5: Filtration & Backwash Master Rate Control Correction Preliminary Lookup Table

INPUT (%)	OUTPUT (L/s)
0.0	0.0
10.0	14.0
20.0	25.5
30.0	36.0
40.0	44.5
50.0	51.5
60.0	58
70.0	63
80.0	67.5
90.0	71.5
100.0	75.0655

Where the input represents the % of deviation between the Level Deviation (in meters) and Settled Water Band 2 (set to 0.045m). The output is the correction of the master filtration rate set point (in L/s).

If the raw Level Deviation (PV (Level) – SV (Set point)) is positive, Base Flow – Index Value becomes the raw Master Flow Rate Set point.

If the raw Level Deviation (PV (Level) – SV (Set point)) is negative, Base Flow + Index Value becomes the raw Master Flow Rate Set point.

No adjustments are made if the level is within 0.5% of the set point.

Each filter PLC checks for control mode and if the filter is in service, uses a PID loop to compare the actual filtration rate to the conditioned master filtration rate set point. The output of this PID loop drives the filter rate valve.

C.1.3 Number of Filters In-Service & Sequencing

Filters are brought into or taken out of service based on the Individual Filter Rate. If the Rate of Production per filter drops below a predetermined action rate, two filters are taken out-of-service. If the Rate of Production per filter rises above a predetermined action rate, two filters are brought into service.

Filter run time is tracked for every filter which is either in-service, or out-of-service available. Run time is only incremented while the filter is in service. Run time is reset to zero after a backwash.

Filter idle time is tracked for every filter which is out-of-service.

If a filter is required to be brought into service, it will be the filter with the highest idle time. In the future, if a filter-to-waste cycle is implemented, then a filter will be conditioned prior to returning it to service. This means that a filter-to-waste cycle will be completed.

Whenever a filter is required to be taken out-of-service, it will be the filter with the highest run time. The filter will then be placed in the backwash queue so it will be washed prior to being available again for service.

Any leakage of a filter that is out of service, is monitored based on the reading of the filter's effluent flow meter. "Filter Out of Service Leak" alarm is generated if the detected flow is 0.2-5% of the full range (1-25 L./s).

C.1.4 Backwashing

At any time, a filter will be taken out of service and placed in the backwash queue if any of the following parameters are exceeded:

- Filter runtime of 96 hours
- Terminal head loss of 1.5 m
- Filter effluent turbidity > action level (traditionally 0.15 NTU, recommend 0.2 NTU)
- Idle time exceeds 24 hours.

Additionally, the operator is able to manually select a filter to be backwashed if necessary. The selected filter will be 'forced' to the front of the backwash queue. Note that only one filter can be backwashed at a time.

Backwash water is stored in two elevated storage tanks, which ride hydraulically on the backwash headers. The operator can select which tank level is to be used for controlling the backwash pumps. When the level in the selected tank drops below an action level, all available backwash pumps are started in a staggered fashion (20 seconds apart) to draw water from the treated water suction channel to fill the tanks.

When in SCADA/AUTO mode, the pumps will automatically start and stop based on the tank level. Additionally, an operator adjustable, hardwired backup is provided to automatically start and stop the pumps.

The supervisor is able to enable / disable surface sweeps from the SCADA HMI.

The backwash sequence consists of:

1. The filter being assigned first in the backwash queue

2. Filter level draw-down
3. Low wash for an adjustable duration (traditionally 2 minutes) at an adjustable low wash rate (traditionally 1000 L/s – to be verified in final design) with surface sweeps for a duration which is also adjustable
4. High wash for an adjustable duration (traditionally 5 minutes) at an adjustable high wash rate (traditionally 2500 L/s – to be verified in final design)
5. Settling period of 15 minutes
6. The filter is assigned as out-of-service, available
7. The filter run-time is reset to zero
8. The filter idle time is reset to zero and begins incrementing until the filter is returned to service.

Temperature variations cause expansion/contraction of the GAC. To prevent overflow and loss of GAC during periods of low temperature, the process will have flexibility to adjust backwash flow rates based on the water temperature.

Once a filter has completed the backwash cycle, it is classified as an available filter. Backwashing will only be performed when power is available to maintain the facility power demand below a target criterion (refer to section Interlocks Contained in Software for more details).

Backwash flow rate set point is maintained by adjusting the backwash header valves for all filters except 19, 20, 21 and 22, where the flow rate set point is maintained by filter valve position. The backwash flow is monitored by the flow meters FHA-FLT-FIT-0101 and FHA-FLT-FIT-0201 for the west and east filters respectively. Based on the flow rate set point, a backwash header valve is modulated to achieve the desired flow rate.

The following outlines the valve operation sequence during an automatic backwash cycle:

1. Close filter inlet gate
2. Lower level in filter to trough level
3. Close filter effluent gate
4. Open filter drain valve
5. Open surface sweep valve
6. Open backwash valve to low setting
7. Close surface sweep valve
8. Adjust backwash valve to high setting
9. Close backwash valve
10. Close filter drain valve
11. Open filter inlet gate slowly (10% until filter full – this will need empirical verification to be done in final design)
12. Wait for Settling period

C.2 Fault Response

C.2.1 Filter Master Rate PLC Failure - Master Flow Rate Setpoint

A failure of the master PLC is detected through the absence of a 'heartbeat' signal from the SCADA system. Win 911 pages out the alarm indicating the failure. The master flow rate calculation is no longer available from the master filter PLC. The individual PLCs will maintain the last master flow rate set point provided prior to the network failure.

Using the Indicator/Manual set point device on the CBP the individual filters can still operate in SCADA/MASTER mode. The CBP/PLC selector switch will be switched to the CBP position. Using the level signal and flow signals which are displayed on the Indicator/Manual set point device, an Operator can calculate the desired master flow rate and enter it on the device. A 4-20mA signal is sent to all the individual filter PLCs and used to modulate the rate control valve.

C.2.2 Filter Master Rate PLC Failure - Backwashing

The individual filter PLCs can still run the automatic backwash sequencing while the master PLC is in failure however they will not automatically be put into a cue to perform a backwash. Each backwash would need to be triggered manually from the SCADA system and then the individual filter PLC will take over and perform the sequence.

C.2.3 Master Filter PLC Failure - Master Flow Rate Setpoint

The Master Filter PLCs are housed in RPU-1822 and RPU-1823. RPU-1822 also controls Filters 17-20 and *RPU*-1823 controls Filters 21-23. SCADA control of the associated filters will be lost in the event of a Master Filter PLC failure.

A failure of these master PLCs is detected through the absence of a 'heartbeat' signal from the SCADA system. Win 911 pages out the alarm indicating the failure. The master flow rate calculation is available from the filter master rate PLC.

During the failure of the Master Filter PLCs, Filters may not be brought into or taken out of service from the SCADA system.

C.2.4 Master Filter PLC Failure - Backwashing

The individual filter PLCs can still run the automatic backwash sequencing if the master PLC fails during the wash however they will not automatically be put into a cue to perform a backwash. During the failure of the Master Filter PLCs (RPU-1822 and RPU-1823) backwashing of a filter may only be completed by the operator manually (from SCADA (if not aforementioned filters in above section), ACP or Field) opening and closing associated backwash and filter valves and running the backwash pumps.

C.2.5 Individual Filter PLC Failure

A failure of an individual filter PLC is detected through the absence of a 'heartbeat' signal from the SCADA system. Win 911 pages out the alarm indicating the failure. The automated backwashing functions and filter rate control functions for the associated filters are no longer available. Backwashing becomes a manual process from the filter ACP and filter rate flow control becomes a manual process from the Indicator/Manual Setpoint device located on the ACP.

The ACP/PLC selector switch will be switched to ACP allowing a valve position set point to be entered into the Indicator/Manual Setpoint device. This set point will be sent via a 4-20mA signal to the rate control valve actuator.

Table 6: Filtration & Backwash Fault response

Equipment Name / Tag No	Fault Condition	Response
Filter Rate Control Valve(s) FHA-FLT-V-0101 (note 1)	Power failure	• Close Filter Rate Control Valve

Note(s):

1. Tag provided for Filter #1; typical of all other filters.

C.2.6 Software Interlocks

Table 7: Filtration & Backwash Software Interlocks

Equipment Name / Tag No	Type of Interlock	Description of Conditions
Backwash Valve(s) FHA-FLT-V-0102 (note 1)	NO OPEN	• Power demand above target criteria
Filter Inlet Valve(s)	Open 10%	• Filter not full, 100% open when full

Equipment Name / Tag No	Type of Interlock	Description of Conditions
FHA-FLT-G-0101 (note 1)		

Note(s):

1. Tag provided for Filter #1; typical of all other filters.

C.2.7 Hardwired Interlocks

Table 8: Filtration & Backwash Hardwired Interlocks

Equipment Name / Tag No	Type of Interlock	Description of Conditions
Backwash Valve(s) FHA-FLT-V-0102 (note 1)	NO OPEN	• FHA-FLT-V-0101 is open
Surface Sweep Valve(s) FHA-FLT-V-0103 (note 1)	NO OPEN	• FHA-FLT-V-0101 is open
Filter Drain Valve FHA-FLT-G-0102 (note 1)	NO OPEN	• FLT-G-0101 is open
Filter FHA-FLT-F-0101 (note 1)	Force Out of Service	• FHA-FLT-LSHL-0101 triggered low level
Backwash Pump FHA-BW-P-0501	NO START	• FHA-BW-V-0501 is closed • FHA-BW-V-0503 is open
	NO STOP	• FHA-BW-V-0503 is open
Backwash Pump FHA-BW-P-0601	NO START	• FHA-BW-V-0601 is closed • FHA-BW-V-0603 is open
	NO STOP	• FHA-BW-V-0603 is open
Backwash Pump FHA-BW-P-0701	NO START	• FHA-BW-V-0701 is closed • FHA-BW-V-0703 is open
	NO STOP	• BW-V-0703 is open

Note(s):

1. Tag provided for Filter #1; typical of all other filters

C.2.8 Power Supply Failure

The main 600VAC power at the MCC (THR-ELS-MCC-0440) is fed from two different sources, herein referred to as Source A and Source B. A Tie Breaker switches between the two sources of power supplying power to the main bus. Source A, Source B, and the Tie Breaker are monitored for proper operation by a hardwired relay system in the Filter CV Shutoff Control Panel (FLT-CP-0007). A fault in the system will close the filter rate control valves in the east and west galleries. The filter rate control valves are commanded to close under the following conditions:

1. Power failure of either Source A or Source B power and failure of the Tie Breaker to switchover
2. Power failure of both Source A and Source B power.

Upon restoration of power and normal operation the Filter rate control valves will resume operation based on PID setpoint from the PLC.

Table 9: Filtration & Backwash Power Failure Fault response

Equipment Name / Tag No	Fault Condition	Response
Filter CV Shutdown Control Panel FLT-CP-0007	Source A Power failure and Tie Breaker fail to switchover	• Close all Filter Rate Control Valves in east and west galleries
Filter CV Shutdown Control Panel FLT-CP-0007	Source B Power failure and Tie Breaker fail to switchover	• Close all Filter Rate Control Valves in east and west galleries
Filter CV Shutdown Control Panel FLT-CP-0007	Source A Power failure and Source B Power failure	• Close all Filter Rate Control Valves in east and west galleries

C.3 Process Set Points

The following table outlines process set points editable in SCADA for the Filtration & Backwashing Process:

Table 10: Filtration & Backwash Process Set Points

Signal Tag No	Description	Unit	Set Point
FHA-FLT-FTM-0000-SWCW	West Settled Water Conduit Level	m	1.69
FHA-FLT-FTM-0000-SWCE	East Settled Water Conduit Level	m	1.70
FHA-FLT-FTM-0000-MNFR	Minimum Filter Rate	L/s	65
FHA-FLT-FTM-0000-MXFR	Maximum Filter rate	L/s	100
FHA-FLT-MAST-0000-RES	Reservoir Level for Backwash	m	3.60
FHA-FLT-MAST-0000-PWR	Power Peak for Backwash		0.90
FHA-BW-TSL-0001-HMD-C	Backwash Tank Pump Start Level	m	0.40
FHA-BW-TSL-0001-HMB-C	Backwash Tank Pump Stop Level	m	1.40
	Filter #1 Leak Detection	%	5.0
	Filter #1 Low Flow	L/s	1000
	Filter #1 High Flow	L/s	2000
	Filter #1 Low Position	%	31
	Filter #1 High Position	%	65
	Filter #1 Surface Sweep Time	min	4
	Filter #1 Low Wash Time	min	3
	Filter #1 High Wash Time	min	5
	Filter #1 Settling Time	min	15
	Filter #1 Head Loss Limit	m	1.50
	Filter #1 Turbidity Limit	NTU	0.15
	Filter #1 Run Time Limit	hrs	96
	Filter #1 Idle Time	hrs	24
	Filter #2 Leak Detection	%	5.0
	Filter #2 Low Flow	L/s	1000
	Filter #2 High Flow	L/s	2000
	Filter #2 Low Position	%	31
	Filter #2 High Position	%	65
	Filter #2 Surface Sweep Time	min	3
	Filter #2 Low Wash Time	min	3
	Filter #2 High Wash Time	min	5
	Filter #2 Settling Time	min	15
	Filter #2 Head Loss Limit	m	1.50
	Filter #2 Turbidity Limit	NTU	0.15
	Filter #2 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #2 Idle Time	hrs	24
	Filter #3 Leak Detection	%	5.0
	Filter #3 Low Flow	L/s	1050
	Filter #3 High Flow	L/s	2000
	Filter #3 Low Position	%	31
	Filter #3 High Position	%	65
	Filter #3 Surface Sweep Time	min	3
	Filter #3 Low Wash Time	min	3
	Filter #3 High Wash Time	min	5
	Filter #3 Settling Time	min	15
	Filter #3 Head Loss Limit	m	1.50
	Filter #3 Turbidity Limit	NTU	0.15
	Filter #3 Run Time Limit	hrs	96
	Filter #3 Idle Time	hrs	24
	Filter #4 Leak Detection	%	5.0
	Filter #4 Low Flow	L/s	1050
	Filter #4 High Flow	L/s	2000
	Filter #4 Low Position	%	31
	Filter #4 High Position	%	65
	Filter #4 Surface Sweep Time	min	3
	Filter #4 Low Wash Time	min	3
	Filter #4 High Wash Time	min	5
	Filter #4 Settling Time	min	15
	Filter #4 Head Loss Limit	m	1.50
	Filter #4 Turbidity Limit	NTU	0.15
	Filter #4 Run Time Limit	hrs	96
	Filter #4 Idle Time	hrs	24
	Filter #5 Leak Detection	%	5.0
	Filter #5 Low Flow	L/s	1100
	Filter #5 High Flow	L/s	2400
	Filter #5 Low Position	%	31
	Filter #5 High Position	%	65
	Filter #5 Surface Sweep Time	min	3
	Filter #5 Low Wash Time	min	3
	Filter #5 High Wash Time	min	5
	Filter #5 Settling Time	min	15
	Filter #5 Head Loss Limit	m	1.50
	Filter #5 Turbidity Limit	NTU	0.15
	Filter #5 Run Time Limit	hrs	96
	Filter #5 Idle Time	hrs	24
	Filter #6 Leak Detection	%	5.0
	Filter #6 Low Flow	L/s	1100
	Filter #6 High Flow	L/s	2400
	Filter #6 Low Position	%	31
	Filter #6 High Position	%	70
	Filter #6 Surface Sweep Time	min	3
	Filter #6 Low Wash Time	min	3
	Filter #6 High Wash Time	min	5
	Filter #6 Settling Time	min	15
	Filter #6 Head Loss Limit	m	1.50
	Filter #6 Turbidity Limit	NTU	0.15
	Filter #6 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #6 Idle Time	hrs	24
	Filter #7 Leak Detection	%	5.0
	Filter #7 Low Flow	L/s	1100
	Filter #7 High Flow	L/s	2400
	Filter #7 Low Position	%	31
	Filter #7 High Position	%	70
	Filter #7 Surface Sweep Time	min	3
	Filter #7 Low Wash Time	min	3
	Filter #7 High Wash Time	min	5
	Filter #7 Settling Time	min	15
	Filter #7 Head Loss Limit	m	1.50
	Filter #7 Turbidity Limit	NTU	0.15
	Filter #7 Run Time Limit	hrs	96
	Filter #7 Idle Time	hrs	24
	Filter #8 Leak Detection	%	5.0
	Filter #8 Low Flow	L/s	1100
	Filter #8 High Flow	L/s	2400
	Filter #8 Low Position	%	31
	Filter #8 High Position	%	70
	Filter #8 Surface Sweep Time	min	3
	Filter #8 Low Wash Time	min	3
	Filter #8 High Wash Time	min	5
	Filter #8 Settling Time	min	15
	Filter #8 Head Loss Limit	m	1.50
	Filter #8 Turbidity Limit	NTU	0.15
	Filter #8 Run Time Limit	hrs	96
	Filter #8 Idle Time	hrs	24
	Filter #9 Leak Detection	%	5.0
	Filter #9 Low Flow	L/s	1000
	Filter #9 High Flow	L/s	2001
	Filter #9 Low Position	%	31
	Filter #9 High Position	%	65
	Filter #9 Surface Sweep Time	min	3
	Filter #9 Low Wash Time	min	3
	Filter #9 High Wash Time	min	5
	Filter #9 Settling Time	min	15
	Filter #9 Head Loss Limit	m	1.50
	Filter #9 Turbidity Limit	NTU	0.15
	Filter #9 Run Time Limit	hrs	96
	Filter #9 Idle Time	hrs	24
	Filter #10 Leak Detection	%	5.0
	Filter #10 Low Flow	L/s	1000
	Filter #10 High Flow	L/s	2000
	Filter #10 Low Position	%	31
	Filter #10 High Position	%	65
	Filter #10 Surface Sweep Time	min	3
	Filter #10 Low Wash Time	min	3
	Filter #10 High Wash Time	min	5
	Filter #10 Settling Time	min	15
	Filter #10 Head Loss Limit	m	1.50
	Filter #10 Turbidity Limit	NTU	0.15
	Filter #10 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #10Idle Time	hrs	24
	Filter #11 Leak Detection	%	5.0
	Filter #11 Low Flow	L/s	1000
	Filter #11 High Flow	L/s	2000
	Filter #11 Low Position	%	31
	Filter #11 High Position	%	65
	Filter #11 Surface Sweep Time	min	3
	Filter #11 Low Wash Time	min	3
	Filter #11 High Wash Time	min	5
	Filter #11 Settling Time	min	15
	Filter #11 Head Loss Limit	m	1.50
	Filter #11 Turbidity Limit	NTU	0.15
	Filter #11 Run Time Limit	hrs	96
	Filter #11 Idle Time	hrs	24
	Filter #12 Leak Detection	%	5.0
	Filter #12 Low Flow	L/s	1000
	Filter #12 High Flow	L/s	2000
	Filter #12 Low Position	%	31
	Filter #12 High Position	%	65
	Filter #12 Surface Sweep Time	min	3
	Filter #12 Low Wash Time	min	3
	Filter #12 High Wash Time	min	5
	Filter #12 Settling Time	min	15
	Filter #12 Head Loss Limit	m	1.50
	Filter #12 Turbidity Limit	NTU	0.15
	Filter #12 Run Time Limit	hrs	96
	Filter #12 Idle Time	hrs	24
	Filter #13 Leak Detection	%	5.0
	Filter #13 Low Flow	L/s	1000
	Filter #13 High Flow	L/s	2000
	Filter #13 Low Position	%	31
	Filter #13 High Position	%	65
	Filter #13 Surface Sweep Time	min	3
	Filter #13 Low Wash Time	min	3
	Filter #13 High Wash Time	min	5
	Filter #13 Settling Time	min	15
	Filter #13 Head Loss Limit	m	1.50
	Filter #13 Turbidity Limit	NTU	0.15
	Filter #13 Run Time Limit	hrs	96
	Filter #13 Idle Time	hrs	24
	Filter #14 Leak Detection	%	5.0
	Filter #14 Low Flow	L/s	1000
	Filter #14 High Flow	L/s	2000
	Filter #14 Low Position	%	31
	Filter #14 High Position	%	65
	Filter #14 Surface Sweep Time	min	3
	Filter #14 Low Wash Time	min	3
	Filter #14 High Wash Time	min	5
	Filter #14 Settling Time	min	15
	Filter #14 Head Loss Limit	m	1.50
	Filter #14 Turbidity Limit	NTU	0.15
	Filter #14 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #14 Idle Time	hrs	24
	Filter #15 Leak Detection	%	5.0
	Filter #15 Low Flow	L/s	1000
	Filter #15 High Flow	L/s	2000
	Filter #15 Low Position	%	31
	Filter #15 High Position	%	65
	Filter #15 Surface Sweep Time	min	3
	Filter #15 Low Wash Time	min	3
	Filter #15 High Wash Time	min	5
	Filter #15 Settling Time	min	15
	Filter #15 Head Loss Limit	m	1.50
	Filter #15 Turbidity Limit	NTU	0.15
	Filter #15 Run Time Limit	hrs	96
	Filter #15 Idle Time	hrs	24
	Filter #16 Leak Detection	%	5.0
	Filter #16 Low Flow	L/s	1000
	Filter #16 High Flow	L/s	2000
	Filter #16 Low Position	%	31
	Filter #16 High Position	%	65
	Filter #16 Surface Sweep Time	min	3
	Filter #16 Low Wash Time	min	3
	Filter #16 High Wash Time	min	5
	Filter #16 Settling Time	min	15
	Filter #16 Head Loss Limit	m	1.50
	Filter #16 Turbidity Limit	NTU	0.15
	Filter #16 Run Time Limit	hrs	96
	Filter #16 Idle Time	hrs	24
	Filter #17 Leak Detection	%	2.1
	Filter #17 Low Flow	L/s	1050
	Filter #17 High Flow	L/s	2000
	Filter #17 Low Position	%	31
	Filter #17 High Position	%	65
	Filter #17 Surface Sweep Time	min	3
	Filter #17 Low Wash Time	min	3
	Filter #17 High Wash Time	min	5
	Filter #17 Settling Time	min	15
	Filter #17 Head Loss Limit	m	1.50
	Filter #17 Turbidity Limit	NTU	0.15
	Filter #17 Run Time Limit	hrs	96
	Filter #17 Idle Time	hrs	24
	Filter #18 Leak Detection	%	1.5
	Filter #18 Low Flow	L/s	1000
	Filter #18 High Flow	L/s	2000
	Filter #18 Low Position	%	31
	Filter #18 High Position	%	65
	Filter #18 Surface Sweep Time	min	3
	Filter #18 Low Wash Time	min	3
	Filter #18 High Wash Time	min	5
	Filter #18 Settling Time	min	15
	Filter #18 Head Loss Limit	m	1.50
	Filter #18 Turbidity Limit	NTU	0.15
	Filter #18 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #18 Idle Time	hrs	24
	Filter #19 Leak Detection	%	1.2
	Filter #19 Low Flow	L/s	1000
	Filter #19 High Flow	L/s	2000
	Filter #19 Low Position	%	31
	Filter #19 High Position	%	65
	Filter #19 Surface Sweep Time	min	3
	Filter #19 Low Wash Time	min	3
	Filter #19 High Wash Time	min	5
	Filter #19 Settling Time	min	15
	Filter #19 Head Loss Limit	m	1.50
	Filter #19 Turbidity Limit	NTU	0.15
	Filter #19 Run Time Limit	hrs	96
	Filter #19 Idle Time	hrs	24
	Filter #20 Leak Detection	%	1.7
	Filter #20 Low Flow	L/s	1000
	Filter #20 High Flow	L/s	2200
	Filter #20 Low Position	%	31
	Filter #20 High Position	%	63
	Filter #20 Surface Sweep Time	min	3
	Filter #20 Low Wash Time	min	3
	Filter #20 High Wash Time	min	5
	Filter #20 Settling Time	min	15
	Filter #20 Head Loss Limit	m	1.50
	Filter #20 Turbidity Limit	NTU	0.15
	Filter #20 Run Time Limit	hrs	96
	Filter #20 Idle Time	hrs	24
	Filter #21 Leak Detection	%	5.0
	Filter #21 Low Flow	L/s	1000
	Filter #21 High Flow	L/s	2001
	Filter #21 Low Position	%	31
	Filter #21 High Position	%	65
	Filter #21 Surface Sweep Time	min	3
	Filter #21 Low Wash Time	min	3
	Filter #21 High Wash Time	min	5
	Filter #21 Settling Time	min	15
	Filter #21 Head Loss Limit	m	1.50
	Filter #21 Turbidity Limit	NTU	0.15
	Filter #21 Run Time Limit	hrs	96
	Filter #21 Idle Time	hrs	24
	Filter #22 Leak Detection	%	5.0
	Filter #22 Low Flow	L/s	1100
	Filter #22 High Flow	L/s	2400
	Filter #22 Low Position	%	31
	Filter #22 High Position	%	70
	Filter #22 Surface Sweep Time	min	3
	Filter #22 Low Wash Time	min	3
	Filter #22 High Wash Time	min	5
	Filter #22 Settling Time	min	15
	Filter #22 Head Loss Limit	m	1.50
	Filter #22 Turbidity Limit	NTU	0.15
	Filter #22 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #22 Idle Time	hrs	24
	Filter #23 Leak Detection	%	5.0
	Filter #23 Low Flow	L/s	1000
	Filter #23 High Flow	L/s	2001
	Filter #23 Low Position	%	31
	Filter #23 High Position	%	65
	Filter #23 Surface Sweep Time	min	3
	Filter #23 Low Wash Time	min	3
	Filter #23 High Wash Time	min	5
	Filter #23 Settling Time	min	15
	Filter #23 Head Loss Limit	m	1.50
	Filter #23 Turbidity Limit	NTU	0.15
	Filter #23 Run Time Limit	hrs	96
	Filter #23 Idle Time	hrs	24
	Filter #24 Leak Detection	%	5.0
	Filter #24 Low Flow	L/s	1100
	Filter #24 High Flow	L/s	2400
	Filter #24 Low Position	%	31
	Filter #24 High Position	%	70
	Filter #24 Surface Sweep Time	min	3
	Filter #24 Low Wash Time	min	3
	Filter #24 High Wash Time	min	5
	Filter #24 Settling Time	min	15
	Filter #24 Head Loss Limit	m	1.50
	Filter #24 Turbidity Limit	NTU	0.15
	Filter #24 Run Time Limit	hrs	96
	Filter #24 Idle Time	hrs	24
	Filter #25 Leak Detection	%	2.8
	Filter #25 Low Flow	L/s	1100
	Filter #25 High Flow	L/s	2400
	Filter #25 Low Position	%	31
	Filter #25 High Position	%	70
	Filter #25 Surface Sweep Time	min	3
	Filter #25 Low Wash Time	min	3
	Filter #25 High Wash Time	min	5
	Filter #25 Settling Time	min	15
	Filter #25 Head Loss Limit	m	1.50
	Filter #25 Turbidity Limit	NTU	0.15
	Filter #25 Run Time Limit	hrs	96
	Filter #25 Idle Time	hrs	24
	Filter #26 Leak Detection	%	1.2
	Filter #26 Low Flow	L/s	1100
	Filter #26 High Flow	L/s	2400
	Filter #26 Low Position	%	31
	Filter #26 High Position	%	70
	Filter #26 Surface Sweep Time	min	3
	Filter #26 Low Wash Time	min	3
	Filter #26 High Wash Time	min	5
	Filter #26 Settling Time	min	15
	Filter #26 Head Loss Limit	m	1.50
	Filter #26 Turbidity Limit	NTU	0.15
	Filter #26 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #26 Idle Time	hrs	24
	Filter #27 Leak Detection	%	3.1
	Filter #27 Low Flow	L/s	1100
	Filter #27 High Flow	L/s	2400
	Filter #27 Low Position	%	31
	Filter #27 High Position	%	70
	Filter #27 Surface Sweep Time	min	3
	Filter #27 Low Wash Time	min	3
	Filter #27 High Wash Time	min	5
	Filter #27 Settling Time	min	15
	Filter #27 Head Loss Limit	m	1.50
	Filter #27 Turbidity Limit	NTU	0.15
	Filter #27 Run Time Limit	hrs	96
	Filter #27 Idle Time	hrs	24
	Filter #28 Leak Detection	%	3.4
	Filter #28 Low Flow	L/s	1100
	Filter #28 High Flow	L/s	2400
	Filter #28 Low Position	%	31
	Filter #28 High Position	%	70
	Filter #28 Surface Sweep Time	min	3
	Filter #28 Low Wash Time	min	3
	Filter #28 High Wash Time	min	5
	Filter #28 Settling Time	min	15
	Filter #28 Head Loss Limit	m	1.50
	Filter #28 Turbidity Limit	NTU	0.15
	Filter #28 Run Time Limit	hrs	96
	Filter #28 Idle Time	hrs	24
	Filter #29 Leak Detection	%	5.0
	Filter #29 Low Flow	L/s	1000
	Filter #29 High Flow	L/s	2001
	Filter #29 Low Position	%	31
	Filter #29 High Position	%	65
	Filter #29 Surface Sweep Time	min	3
	Filter #29 Low Wash Time	min	3
	Filter #29 High Wash Time	min	5
	Filter #29 Settling Time	min	15
	Filter #29 Head Loss Limit	m	1.50
	Filter #29 Turbidity Limit	NTU	0.15
	Filter #29 Run Time Limit	hrs	96
	Filter #29 Idle Time	hrs	24
	Filter #30 Leak Detection	%	5.0
	Filter #30 Low Flow	L/s	1100
	Filter #30 High Flow	L/s	2400
	Filter #30 Low Position	%	31
	Filter #30 High Position	%	70
	Filter #30 Surface Sweep Time	min	3
	Filter #30 Low Wash Time	min	3
	Filter #30 High Wash Time	min	5
	Filter #30 Settling Time	min	15
	Filter #30 Head Loss Limit	m	1.50
	Filter #30 Turbidity Limit	NTU	0.15
	Filter #30 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #30 Idle Time	hrs	24
	Filter #30 Leak Detection	%	5.0
	Filter #31 Low Flow	L/s	1000
	Filter #31 High Flow	L/s	2001
	Filter #31 Low Position	%	31
	Filter #31 High Position	%	65
	Filter #31 Surface Sweep Time	min	3
	Filter #31 Low Wash Time	min	3
	Filter #31 High Wash Time	min	5
	Filter #31 Settling Time	min	15
	Filter #31 Head Loss Limit	m	1.50
	Filter #31 Turbidity Limit	NTU	0.15
	Filter #31 Run Time Limit	hrs	96
	Filter #31 Idle Time	hrs	24
	Filter #32 Leak Detection	%	5.0
	Filter #32 Low Flow	L/s	1100
	Filter #32 High Flow	L/s	2400
	Filter #32 Low Position	%	31
	Filter #32 High Position	%	70
	Filter #32 Surface Sweep Time	min	3
	Filter #32 Low Wash Time	min	3
	Filter #32 High Wash Time	min	5
	Filter #32 Settling Time	min	15
	Filter #32 Head Loss Limit	m	1.50
	Filter #32 Turbidity Limit	NTU	0.15
	Filter #32 Run Time Limit	hrs	96
	Filter #32 Idle Time	hrs	24
	Filter #33 Leak Detection	%	5.0
	Filter #33 Low Flow	L/s	1000
	Filter #33 High Flow	L/s	2001
	Filter #33 Low Position	%	31
	Filter #33 High Position	%	65
	Filter #33 Surface Sweep Time	min	3
	Filter #33 Low Wash Time	min	3
	Filter #33 High Wash Time	min	5
	Filter #33 Settling Time	min	15
	Filter #33 Head Loss Limit	m	1.50
	Filter #33 Turbidity Limit	NTU	0.15
	Filter #33 Run Time Limit	hrs	96
	Filter #33 Idle Time	hrs	24
	Filter #34 Leak Detection	%	5.0
	Filter #34 Low Flow	L/s	1100
	Filter #34 High Flow	L/s	2400
	Filter #34 Low Position	%	31
	Filter #34 High Position	%	70
	Filter #34 Surface Sweep Time	min	3
	Filter #34 Low Wash Time	min	3
	Filter #34 High Wash Time	min	5
	Filter #34 Settling Time	min	15
	Filter #34 Head Loss Limit	m	1.50
	Filter #34 Turbidity Limit	NTU	0.15
	Filter #34 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #34 Idle Time	hrs	24
	Filter #35 Leak Detection	%	5.0
	Filter #35 Low Flow	L/s	1000
	Filter #35 High Flow	L/s	2000
	Filter #35 Low Position	%	31
	Filter #35 High Position	%	65
	Filter #35 Surface Sweep Time	min	3
	Filter #35 Low Wash Time	min	3
	Filter #35 High Wash Time	min	5
	Filter #35 Settling Time	min	15
	Filter #35 Head Loss Limit	m	1.50
	Filter #35 Turbidity Limit	NTU	0.15
	Filter #35 Run Time Limit	hrs	96
	Filter #35 Idle Time	hrs	24
	Filter #36 Leak Detection	%	5.0
	Filter #36 Low Flow	L/s	1100
	Filter #36 High Flow	L/s	2400
	Filter #36 Low Position	%	31
	Filter #36 High Position	%	70
	Filter #36 Surface Sweep Time	min	3
	Filter #36 Low Wash Time	min	3
	Filter #36 High Wash Time	min	5
	Filter #36 Settling Time	min	15
	Filter #36 Head Loss Limit	m	1.50
	Filter #36 Turbidity Limit	NTU	0.15
	Filter #36 Run Time Limit	hrs	96
	Filter #36 Idle Time	hrs	24
	Filter #37 Leak Detection	%	5.0
	Filter #37 Low Flow	L/s	1100
	Filter #37 High Flow	L/s	2400
	Filter #37 Low Position	%	31
	Filter #37 High Position	%	70
	Filter #37 Surface Sweep Time	min	3
	Filter #37 Low Wash Time	min	3
	Filter #37 High Wash Time	min	5
	Filter #37 Settling Time	min	15
	Filter #37 Head Loss Limit	m	1.50
	Filter #37 Turbidity Limit	NTU	0.15
	Filter #37 Run Time Limit	hrs	96
	Filter #37 Idle Time	hrs	24
	Filter #38 Leak Detection	%	5.0
	Filter #38 Low Flow	L/s	1100
	Filter #38 High Flow	L/s	2400
	Filter #38 Low Position	%	31
	Filter #38 High Position	%	70
	Filter #38 Surface Sweep Time	min	3
	Filter #38 Low Wash Time	min	3
	Filter #38 High Wash Time	min	5
	Filter #38 Settling Time	min	15
	Filter #38 Head Loss Limit	m	1.50
	Filter #38 Turbidity Limit	NTU	0.15
	Filter #38 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #38 Idle Time	hrs	24
	Filter #39 Leak Detection	%	5.0
	Filter #39 Low Flow	L/s	1100
	Filter #39 High Flow	L/s	2400
	Filter #39 Low Position	%	31
	Filter #39 High Position	%	70
	Filter #39 Surface Sweep Time	min	3
	Filter #39 Low Wash Time	min	3
	Filter #39 High Wash Time	min	5
	Filter #39 Settling Time	min	15
	Filter #39 Head Loss Limit	m	1.50
	Filter #39 Turbidity Limit	NTU	0.15
	Filter #39 Run Time Limit	hrs	96
	Filter #39 Idle Time	hrs	24
	Filter #40 Leak Detection	%	5.0
	Filter #40 Low Flow	L/s	1100
	Filter #40 High Flow	L/s	2400
	Filter #40 Low Position	%	31
	Filter #40 High Position	%	70
	Filter #40 Surface Sweep Time	min	3
	Filter #40 Low Wash Time	min	3
	Filter #40 High Wash Time	min	5
	Filter #40 Settling Time	min	15
	Filter #40 Head Loss Limit	m	1.50
	Filter #40 Turbidity Limit	NTU	0.15
	Filter #40 Run Time Limit	hrs	96
	Filter #40 Idle Time	hrs	24

C.4 Alarms

Alarms are generated by SCADA for specific events and their handling is as per Alarm Handling Standard. Virtual Alarms are monitored as available in the PCS software modules. For a complete alarm list, refer to "CSF RFI 030 Supplemental - FHA Alarm List.xlsx" contained in the Supplemental Documents folder.

The following table outlines the set points for analog alarms generated by the system for specific events detected through analog signals connected to the RPU:

Table 11: Filtration & Backwash Analog Alarms

Signal Tag No	Unit	Alarm set points				Alarm Description
		LL	L	H	HH	
Backwash Flow FHA-BW-FIT-0001-XALLC-C FHA-BW-FIT-0001-XALC-C FHA-BW-FIT-0001-XAHC-C FHA-BW-FIT-0001-XAHHC-C	L/s	98.19	194.45	1247.2	1276.6	Backwash flow low low/ low/ high/ high high
Backwash Flow West FHA-BW-FIT-0101-XALLC-C FHA-BW-FIT-0101-XALC-C FHA-BW-FIT-0101-XAHC-C FHA-BW-FIT-0101-XAHHC-C	L/s	250	500	2500	3200	Backwash flow west low low/ low/ high/ high high
Backwash Flow East FHA-BW-FIT-0201-XALLC-C	L/s	250	500	2500	3200	Backwash flow west low low/ low/ high/ high high

Signal Tag No	Unit	Alarm set points				Alarm Description
		LL	L	H	HH	
FHA-BW-FIT-0201-XALC-C FHA-BW-FIT-0201-XAHC-C FHA-BW-FIT-0201-XAHHC-C						
Backwash Tank South Level FHA-BW-LIT-0101-XALLC-C FHA-BW-LIT-0101-XALC-C FHA-BW-LIT-0101-XAHC-C FHA-BW-LIT-0101-XAHHC-C	m	0.00	0.00	1.80	2.00	South backwash tank level low low/ low/ high/ high high
Backwash Tank North Level FHA-BW-LIT-0201-XALLC-C FHA-BW-LIT-0201-XALC-C FHA-BW-LIT-0201-XAHC-C FHA-BW-LIT-0201-XAHHC-C	m	0.00	0.00	1.80	2.00	North backwash tank level low low/ low/ high/ high high
West Total Filter Flow FHA-FLT-FIT-0001-XALLC-C FHA-FLT-FIT-0001-XALC-C FHA-FLT-FIT-0001-XAHC-C FHA-FLT-FIT-0001-XAHHC-C	m^3/s	0.30	0.60	5.50	6.50	West total filter flow low low/ low/ high/ high high
East Total Filter Flow FHA-FLT-FIT-0002-XALLC-C FHA-FLT-FIT-0002-XALC-C FHA-FLT-FIT-0002-XAHC-C FHA-FLT-FIT-0002-XAHHC-C	m^3/s	0.30	1.20	5.50	6.50	East total filter flow low low/ low/ high/ high high
West Settled Water Level FHA-LIT-0101-XALLC-C FHA-LIT-0101-XALC-C FHA-LIT-0101-XAHC-C FHA-LIT-0101-XAHHC-C	m	1.20	1.30	1.85	1.95	West settled water conduit level low low/ low/ high/ high high
East Settled Water Level FHA-LIT-0101-XALLC-C FHA-LIT-0101-XALC-C FHA-LIT-0101-XAHC-C FHA-LIT-0101-XAHHC-C	m	1.20	1.30	1.85	1.95	East settled water conduit level low low/ low/ high/ high high
Filter Turbidity (Note 1)	NTU	0.01	-	0.15	0.2	Filter turbidity low low/ high/ high high
Filter Flow (Note 1)	L/s	0	50	450	500	Filter flow low low/ low/ high/ high high
Filter Head Differential (Note 1)	m	0.00	-	1.50	2.00	Filter head difference low low/ high/ high high

Note(s):

1. These set points are editable in SCADA for each individual filter. All set points are

TORONTO

SECTION 13040

EQUIPMENT AND DATA TAGGING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 This document describes the naming standard for all equipment, equipment loops, data and local area network cabling that is implemented in Toronto Water and incorporated in PCS, eOPS, POMS, WMS, LIMS and other TW software application systems, including all non- process equipment that meet the standard.`

.1 Process Control Systems (PCS)

.2 Electronic Operations Performance System (eOPS)

.3 Performance and Operations Management System (POMS)

.4 Work Management System (WMS)

.5 Laboratory Information Management System (LIMS)

.2 The purpose of this document is to establish a standard that will enable efficient management of asset related database records, information, physical equipment field tags and identification. An important part of this standard is the Toronto Water naming scheme. The naming scheme will provide a unique name (tag) for each piece of equipment, device and/or data point in order to allow flexibility in data management within Toronto Water and the identification of all equipment with a unique tag number.

.3 This document is a standard to be used by Consultants, Contractors, System Integrators and Toronto Water staff for projects that implement information systems, control systems or control system I/O's and all other plant projects that have equipment as outlined in Part 2 below.

.4 Attribute definition:

.1 Other attributes attached to a point will differ depending on partitioning of data among data tables or objects. This standard does not limit the number of attributes or the partitions of data.

.5 Terms:

.1 Terms used to describe or define attributes should follow these guidelines:

a. Only one term may be used to convey the same meaning.

b. Whenever assigning names to equipment or adding data points, terms defined in this standard must be used. This standard applies to PCS, eOPS, WMS, POMS, LIMS.

c. Use terms already in use in, Water Treatment and Supply, Wastewater Treatment, Wastewater Collection, Water Distribution, District Operations. In the case of conflict, use the term of the higher organizational level.

.6 General Facilities – Equipment and Devices:

.1 Process (with or without PCS) and non-process related equipment shall be covered under this standard including all equipment that is not part of a process system located in a facility, yard, station or any Toronto Water site. Every piece of process equipment and non-process equipment (as identified in the table under Section 2.4 in this document) shall receive a new unique tag number as per this standard unless identified in the table as “not for Contracts”.

.2 For contracts that are related to new and existing installed City equipment/devices, all equipment/devices that touch the process flow(s) covered under the contract and are shown on contract drawings shall receive a unique tag number as per this standard.

.7 Abbreviations:

.1 The use of abbreviations in text is allowed with the following restrictions:

a. Only one abbreviation may be used for a word or phrase.

b. Abbreviations defined in this standard must be used whenever the respective word or phrase is abbreviated.

.8 Equipment and Data Name Standard Change Request:

.1 In the event this standard doesn’t meet the requirements for numbering, submit a request for approval to the Toronto Water Optimized Maintenance Unit.

.9 Equipment Tag standardization:

.1 All projects and contracts are to follow the most current up to dated version of this standard. All review phases of contracts (50%, 70%, 95% etc.) shall request prior to working on the submissions a copy of the latest version of this standard and review submissions are to follow the latest version. This will ensure the most up to date standards are applied to all new areas across Toronto Water.

.2 To ensure a consistent implementation of this standard, all questions, comments and submissions for review that are covered under this standard are to be submitted to the Toronto Water Optimized Maintenance Unit.

1.2 EQUIPMENT TAG ASSIGNMENT

.1 Consultants working on PCS related projects for Toronto Water will be given access to the Toronto Water Equipment Tag Data Base known as the Enterprise Tagging Management System (ETMS). Equipment tags will be developed and checked for duplication by the Equipment Tag Designer (typically the Consultant). Once the duplication check has determined that no duplication exists, the designer will be able to immediately reserve the proposed equipment tags and a submission will be required to the Optimized Maintenance Unit and PCS Support Unit for review.

1.3 DEFINITIONS

.1 Equipment Tag:

.1 A unique identifier for a specific device/equipment (asset). The equipment tag is used to identify equipment in the field, in SCADA/HMIs' on all facility design documents and in operations and maintenance manuals.

.2 Virtual Tag:

.1 Software points that receive tag names that are not physically in the field and are used in TW applications such as PCS, WMS, eOPS and LIMS are referred to as virtual tags.

.3 Equipment Loop:

.1 Equipment Loop numbers describe a group of instruments, equipment, and so forth with a specific function. The equipment loop identification is designed into Fragment 4 as per this standard. See Section 2.6 Equipment/Loop Numbers (fragment 4) for more details.

PART 2 EQUIPMENT AND DATA NAMES

2.1 GENERAL

.1 When defining a tag for a new device, consideration must be given for the process with which the device is related. An illustration of this is a hot water pump used for digestion sludge heating. While this is a hot water pump and could be considered part of the ACC, the pump is part of the digestion process as it affects the digestion process directly. For this example the tagging should indicate DIG as opposed to ACC. Another illustration is found in the chlorine process. Piping, including valves span across multiple process areas. Although the lines may enter other process areas, they should remain tagged as part of the chlorination process.

.2 Coding System:

.1 The code consists of up to eighteen (18) characters and each section may be of an alpha-numeric combination.

.2 Dashes are included, as shown in the examples below.

.3 The basic code shall be:

AAA-	**CCC-**	**AAAA-**	**NNNN**	**A**
(1)	**(2)**	**(3)**	**(4)**	**(4A)**

Where: A Denotes Alphabetic character (letter)

N Denotes Numeric character (number)

C Denotes generic Character (either alphabetic or numeric)

.4 The different groups of characters are split into various fragments which have specific meanings. These fragments are denoted by the numbers 1 to 5 and have the following definitions:

Fragment 1	is a three-digit character representing the facility or location (site).
Fragment 2	is a two or three character code representing a process/sub-process performed within the facility or site. Water mains, reservoirs and pumping stations are classified as processes in the tag name.
Fragment 3	is a one to four-character code representing the type of equipment or instrument.
Fragment 4	is a four-character alpha/numeric code (alpha is only to be used for electrical equipment to represent existing numbering conversions that are difficult to change due to both health and safety and operational reasons) that identifies the equipment number**.** Leading zeroes are used to fill the code for numbers with less than four characters. For water mains and sewers, use the first two numbers to identify chamber/manhole numbers (i.e. all equipment in Chamber 01 will have a 01xx loop number.) For common systems, such as Plant Services (HVAC, City Water, Plant Water etc.) and Health and Safety (Exit signs, Emergency lights, Fire Extinguishers etc.) the first two digits refer to the process area. Refer to Appendix H "13040-Appendix A-common system tagging loop reservation". The list is based on process area in each facility.
Fragment 4A	is a one character alpha code to differentiate between otherwise duplicate equipment items (see example below. FCL-FLT-LIT-0012A fragment 4A is an extension of fragment 4 used only when needed for duplicate equipment). For water mains and sewers, use this fragment in conjunction with fragment 4 as part of the chamber/manhole identification (i.e. MTI chamber 17A will use loop numbers 17xxA, etc.)

.5 Example Equipment and Loop Coding:

a. The following are examples of Equipment and Loop names.

(a) THR-PRM-V-0551

(1)	**(2)**	**(3)**	**(4)**	**(4A)**
THR-	**PRM-**	**V-**	**0551**	
Humber Treatment Plant	Primary Treatment Process	Valve	No. 551	No Duplicate

(b) FHA-TRW-P-0100 (including associated equipment in the loop)

(1)	(2)	(3)	(4)	(4A)
FHA- Harris Filtration Plant	**TRW-** Treated Water Process	**P-** Pump	**0100** No. 1	No Duplicate
FHA- Harris Filtration Plant	**TRW-** Treated Water Process	**V-** Valve (Suction)	**0101** 1st Valve in loop	No Duplicate
FHA- Harris Filtration Plant	**TRW-** Treated Water Process	**V-** Valve (Check)	**0102** 2nd Valve in loop	No Duplicate
FHA- Harris Filtration Plant	**TRW-** Treated Water Process	**SWG-** Switch Gear	**0101** Switch Gear for Pump No. 1	No Duplicate

(c) TAB-STR-PSL-2332

(1)	(2)	(3)	(4)	(4A)
TAB- Ashbridges Bay Treatment Plant	**STR-** Secondary Treatment	**PSL-** Pressure Switch Low	**2332** No. 2332	No Duplicate

(d) FCL-FLT-LIT-0012A

(1)	(2)	(3)	(4)	(4A)
FCL- Clark Filtration Plant	**FLT-** Filtration Process	**LIT-** Level Indicating Transmitter	**0012** No. 12	**A** First Duplicate

(e) WTR-PEG-FIT-0324

(1)	(2)	(3)	(4)	(4A)
WTR- Water Transmission	**PEG-** Eglinton Pumping Station	**FIT-** Flow Indicating Transmitter	**0324** Loop 3 FIT 24	No Duplicate

(f) COL-MTI-G-1701A

(1)	(2)	(3)	(4)	(4A)
COL-	**MTI-**	**G-**	**1701**	**A**
WPC Collection	Mid-Toronto Interceptor	Gate	First Gate in Chamber 17A	Supplement to identify Chamber legacy number (17A)

2.2 FACILITY (SITE) CODES (FRAGMENT 1)

.1 The facility or site codes use the first character to designate the type of facility:

C - Sewerage collection system or Construction & Maintenance sites
S - Storm Water Management
F - Filtration Plant for water production
T - Treatment Plant for wastewater treatment & TWC
W - Water transmission system site
Y - Yard or Office

CODE	SITE
COL	WPC Collection System – all locations
CMS	Construction & Maintenance Site
FCL	R.L. Clark Filtration Plant
FHA	R.C. Harris Filtration Plant
FHO	F.J. Horgan Filtration Plant
FIS	Island Filtration Plant
SWM	Storm Water Management – all locations
THC	Highland Creek Treatment Plant
THR	Humber Treatment Plant
TAB	Ashbridges Bay Treatment Plant
TNT	North Toronto Treatment Plant
WTR	Water Supply – Main Transmission System – all locations
YCS	Central Services
YDA	Dee Avenue
YEC	Etobicoke Civic Center
YFI	Finch Yard
YHO	Metro Hall
YKP	Kipling Yard

CODE	SITE
YMA	Markham
YPH	Pharmacy Yard
YRC	Rockliffe Yard
YTF	Toronto Water Centre - Tiffield Road

.2 For all Equipment within the physical boundary (i.e. property line) of a treatment plant or water production plant, assign the facility code corresponding to the plant. The physical boundary of the Ashbridges Bay Treatment Plant includes the nearby raw sewage pumping stations M&T Building).

.3 For all Equipment in the sewage collection system, assign the collection system facility code (COL).

.4 For all Equipment in storm water system assign the Storm Water Management facility code (SWM)

.5 For all Equipment in the Water Supply transmission system, not located at a plant, office or yard, assign the Water Supply system facility code (WTR).

2.3 PROCESS/SUB-PROCESS CODES (FRAGMENT 2) – INCLUDES PUMPING STATIONS AND RESERVOIRS

CODE	PROCESS/SUB-PROCESS DESCRIPTION
ACC	Air Conditioning, Heating and Ventilation
AER	Aeration
AI	Instrument Air System
ALM	Alum
AM	Ammoniation
AMT	Atmosphere Monitoring
AP	Process Air System
AUX	Auxiliary System
BG	Blended/Bi (Multi) Gas e.g. Natural and Digester Gases/Natural or Digested Gas
BW	Backwash
CCS	Corrosion Control System
CG	Co-Generation
CLA	Pre-chlorination
CLB	Post-chlorination
CLC	Trim-chlorination
CL	Chlorination (use for the equipment common for more than one of CLA, CLB, CLC or DCL processes)
CSO	Combined Storm Overflow
CW	City Water System
DCL	De-chlorination
DES	Ozone Destruct
DEW	Dewatering
DIG	Digestion
DIS	Disinfection

CODE	PROCESS/SUB-PROCESS DESCRIPTION
DOZ	Disinfection Ozone
DST	Distribution (Local Distribution)
ELS	Electrical System
EPG	Electrical Power Generation
EPS	Effluent (Plant) Pumping Station (THR only)
FEQ	Fire Protection System
FL	Fluoridation
FLO	Flocculation
FLT	Filtration
FPW	Filtered Plant Water
FT	Final Tanks
GAC	Granular Activated Carbon
GAS	Administration Support
GOX	Gaseous Liquid Oxygen
GRK	Grounds - Property
HRS	Heat Recovery (Steam)
INC	Incineration
LAB	Laboratory
LOX	Liquid Oxygen
NGS	Natural Gas
NOX	Nitrogen Oxide
ITS	Information Technology Systems
MCS	Shops Mechanical / Welding
OCS	Odour Control System
ORQ	Ozone Residual Quenching
PAC	Powder Activated Carbon
PCL	Polyaluminum Chloride
PLT	Preliminary Treatment
POL	Polymer
PRM	Primary Treatment
PRS	Phosphorus Removal System
PWA	Plant Water
RSP	Raw Sewage Pumping
RW	Raw Water
SA	Service Air (Non Instrument)
SBS	Sodium Bisulfite system
SED	Sedimentation
SES	Safety & Environmental Services
SLD	Sludge Drying
SLO	Sludge Loading and Odour Control
SM	Spill Management
SPC	System Process Control
STR	Secondary Treatment
STW	Storm Water (within the Plants)
SYP	System Pressure Points
THK	Thickening Waste Activated Sludge
TPA	Telephone and Public Address System
TRW	Treated Water

CODE	PROCESS/SUB-PROCESS DESCRIPTION
VEH	Vehicles
WWW	Waste Water (Residue Management)
ZMC	Zebra Mussel Control
MTI	Mid-Toronto Interceptor
WCP	Water Circulation Program
BCV	Carlingview Blower Station
BDC	Disco Blower Station
BEB	Edenbridge Blower Station
CCC	Charles Caccia Park Storm Tank
CKW	Kenilworth Ave Storm Tank
CMC	Maclean Storm Tank
FHM	Humber Forcemain
PAB	Ashbridges Bay Plant Sewage Pumping Station (Legacy - Not to be used)
PAH	Armour Heights Pumping Station
PAT	Ashbridges Bay Plant MTI Sewage Pumping Station (Legacy-Not to be used)
PBC	Bonnycastle Sewage Pumping Station
PBF	Bluffers Park Sewage Pumping Station
PBG	Brule Gardens Sewage Pumping Station
PBL	Bloor/Islington Storm Pumping Station
PBP	Baby Point Sewage Pumping Station
PBR	Berry Road Sewage Pumping Station
PBV	Bayview Pumping Station
PBY	Brick Yard Sewage Pumping Station
PCF	Clark Sewage Pumping Station
PCH	Cherry Street Sewage Pumping Station
PCP	Copeland Sewage Pumping Station
PCU	Cumber Sewage Pumping Station
PDA	Dacotah Sewage Pumping Station (Algonquin Island PS #2)
PDG	Douglas Drive Syphon
PDU	Dunker's Storm Pumping Station
PDS	Dorset Pumping Station
PEG	Eglinton Pumping Station
PEL	Ellesmere Pumping Station
PET	Eglinton/Bellamy Storm Pumping Station
PEV	Ellis Ave Sewage Pumping Station
PEW	East Woodbridge Pumping Station
PFB	Fallingbrook Sewage Pumping Station
PFH	Fire Hall Sewage Pumping Station (Wards Island PS#4)
PFI	Fifth Street Sewage Pumping Station (Wards Island PS#8)
PFO	Fourth Street Sewage Pumping Station (Wards Island PS#9)

CODE	PROCESS/SUB-PROCESS DESCRIPTION
PGA	Grey Abby Trail Sewage Pumping Station
PGB	Governors Bridge Sewage Pumping Station
PGR	Grand River Sewage Pumping Station
PHA	Hanlan's Point Sewage Pumping Station
PHB	Humber Sewage Pumping Station
PHF	Highfield Sewage Pumping Station
PHL	High Level Pumping Station
PHP	High Park Sewage Pumping Station
PIR	Island Rd Sewage Pumping Station
PIT	Islington Storm Pumping Station
PJO	Wm.H.Johnston Pumping Station
PJS	John St Pumping Station
PKG	Kingston Sewage Pumping Station
PKL	Keele Pumping Station
PKN	Kennedy Pumping Station
PKP	Kennedy Park Sewage Pumping Station
PKS	King St Sewage Pumping Station
PLB	Long Branch Sewage Pumping Station
PLS	Lakeshore Sewage Pumping Station
PLV	Livingston Sewage Pumping Station
PLW	Lawrence Pumping Station
PMD	Midland Sewage Pumping Station
PMG	Martin Grove Storm Pumping Station
PMI	Milliken Pumping Station
PMM	Mimico Sewage Pumping Station
PMP	Mount Pleasant Sewage Pumping Station
PMR	Morrish RD Sewage Pumping Station (Decommissioned)
PMT	Military Trail Sewage Pumping Station
PMY	Maryport Sewage Pumping Station
PNO	Nottawa Sewage Pumping Station (Algonquin Island PS#3)
PNQ	North Queen Storm Pumping Station
PNT	New Toronto Sewage Pumping Station
POM	Old Mill Sewage Pumping Station
PPD	Parkdale Pumping Station
PPP	Pantry Park Sewage Pumping Station
PPU	Port Union Sewage Pumping Station
PQW	Queensway Sewage Pumping Station
PRC	Rectory Café Sewage Pumping Station (Wards Island PS #5)
PRD	Redlands Sewage Pumping Station
PRG	Ridge Valley Sewage Pumping Station
PRH	Rosehill Pumping Station
PRR	Riverside Sewage Pumping Station
PRV	Richview Pumping Station
PRX	Roxborough Sewage Pumping Station
PSA	St. Albans Pumping Station
PSB	Silverbirch Sewage Pumping Station
PSC	Scarborough Pumping Station
PSD	Spadina Sewage Pumping Station

CODE	PROCESS/SUB-PROCESS DESCRIPTION
PSH	Senior's Home Sewage Pumping Station (Wards Island PS#6)
PSI	Sixth Street Sewage Pumping Station (Wards Island PS#11)
PSK	Skydome Sewage Pumping Station
PSL	Sewells Sewage Pumping Station
PSM	Simcoe Sewage Pumping Station
PSN	Second Street Sewage Pumping Station (Wards Island PS#10)
PSP	Southport Sewage Pumping Station
PSS	Scott St Sewage Pumping Station
PST	Strachan Sewage Pumping Station
PSU	Sunnyside Sewage Pumping Station
PSW	Swansea Sewage Pumping Station
PTD	Todmorden Sewage Pumping Station
PTH	Thornhill Pumping Station
PTS	Third Street Sewage Pumping Station (Wards Island PS#12)
PVM	Valleymede Sewage Pumping Station
PWC	Wirral Court Sewage Pumping Station
PWD	Warden Storm Pumping Station
PWE	Wellington Sewage Pumping Station
PWH	Wilson Heights Sewage Pumping Station
PWI	Wilson Storm Pumping Station
PWI	Willow Avenue Sewage Pumping Station (Wards Island PS#7)
PWN	Warren Park Sewage Pumping Station
PWP	West Point Sewage Pumping Station
PWR	West Rouge Sewage Pumping Station
PWT	West Toronto Pumping Station
PWY	Wyandot Ave. Sewage Pumping Station (Algonquin Island PS#1)
RBA	Western Beaches Tunnel Aberdeen Drop Shaft
RBB	Western Beaches Tunnel Battery Pond
RBC	Western Beaches Tunnel Cowan Pond
RDD	Western Beaches Tunnel Dufferin Drop Shaft
RBG	Western Beaches Tunnel Glendale Pond
RBJ	Western Beaches Tunnel Jameson Drop Shaft
RBP	Western Beaches Tunnel Parkside Drop Shaft
RBR	Western Beaches Tunnel Remembrance Drop Shaft
RBV	Western Beaches Tunnel Roncesvalles Drop Shaft (Collection)
RBV	Bayview Reservoir (Water)
RBW	Western Beaches Tunnel Wilson Drop Shaft
RDF	Dufferin Reservoir
REG	Eglinton Reservoir
REL	Ellesmere Reservoir
REW	East Woodbridge Tank
RKL	Keele Reservoir
RLL	Leslie Tank
RLW	Lawrence Reservoir
RMA	Markham Reservoir
RMI	Milliken Reservoir
RMT	Milliken Tank

CODE	PROCESS/SUB-PROCESS DESCRIPTION
RMP	Maple Reservoir
RNM	North Markham Reservoir
RRG	Rouge Tank
RRH	Rosehill Reservoir
RRV	Richview Reservoir
RSC	Scarborough Reservoir
RST	St. Clair Reservoir
RWA	Warden Tank
RWB	Woodbridge Tank (West)
RWL	Whitlam Tank
SCW	Storm Coatsworth Road
SCH	Lake Shore/Cherry Street Blast Flocculation Facility
SDE	Storm Denison Road
SEB	Storm Earl Bales Park
SEF	Storm East Bayfront
SOS	Storm Old Sheppard Park
SSB	Storm Sherbourne Park
SST	Strachan Avenue Grade Separation-Invert Syphon
SWD	Storm West Don Lands
001 to 399	Water Mains
001-599	Storm Sewers, Sanitary Trunk Sewers, Sanitary Sewers, and Combined Trunk Sewers

.1 Process codes at plants generally correspond to geographically separate areas. For all equipment within the physical areas, buildings or rooms mainly associated with a process/sub-process, assign the corresponding process code except for the following equipment:

.2 Equipment that is normally considered part of a process/sub-process, but is located in a different process/sub-process area due to non-process considerations, should be assigned to the normal process/sub-process. For example, raw sludge pumps (which are part of the primary treatment process) could be located within the area of secondary treatment. In this case, the raw sludge pumps would be assigned the code for the primary treatment process/sub-process.

.3 Use ELS as the process code for electrical equipment that provides electrical distribution to more than one process area. Exception for Asbridges Bay (TAB): Instead of ELS uses EL1, EL2 and EL3 that represent power supply from three different sources.

.4 Water Treatment and Supply has several distribution processes that are process areas; in these cases, use the process code, e.g. Post-chlorine (CLB) is a separate process area.

2.4 EQUIPMENT CODES (FRAGMENT 3) (NOT INCLUDING INSTRUMENTS – SEE INSTRUMENT CODES TABLE)

CODE	EQUIPMENT DESCRIPTION
AC	Air Conditioner
AF	Anaerobic Filter
AFR	Arc Flash Protection Relay
AHU	Air Handling Unit
ALR	Alarm
AM	Atmosphere Monitoring
ANL	Analyser
APP	Software Applications
BAT	Battery (Bank)
BFP	Backflow Preventer
BL	Blower
BO	Boiler
BRCH	Breaching
BU	Burner
BUS	Bus bar Greater than 750 volts, used to identify Switchgear
C	Compressor
CAP	Capacitor
CB	Circuit Breaker less than 750 volts
CF	Centrifuge
CH	Chamber
CHL	Chlorinator
CI	Chiller
CL	Classifier (Grit)
CLR	Clarifier
CM	Collector Mechanism
CMP	Compactor
COM	Communications Equipment, LAN, Telephone
CP	Control Panel
CPU	Computer
CRN	Crane
CT	Controller
CU	Condensing Unit
CV	Conveyor equipment (belt, bucket, screw, etc.)
CYC	Cyclone, vortex
D	Air Dryer / Dehumidifier
DC	Data Cable (not for Contracts -for WMS only)
DD	Display Device
DEF	Defibrillation Unit
DM	Damper, Louvre
DP	Distribution Panel (Instrument Air, Oil, Water, Steam, etc. For electrical panels use PDP)
DR	Door (over-head or security system doors)

CODE	EQUIPMENT DESCRIPTION
DRV	Drive Electric, Mechanical
DRN	Drains (not for Contracts – for WMS only)
DS	Disconnect Switch
DT	Drip Trap
DU	Duct (not for Contracts – for WMS only)
DVS	Flow Diversion Structure
ELV	Elevator
ENG	Engine
EV	Evaporator
F	Filter
FA	Fire Alarm System
FAK	First Aid Kit
FD	Feeder, Chemical
FDT	Flame Detector
FEQ	Fire Extinguisher
FM	Force Main
FN	Fan
FP	Flushing Point (not for Contracts – for WMS only)
FU	Furnace
FX	Flame Arrestor
G	Gate(Sluice, Weir) or Stop Gate/Stop Logs
GA	Gauge (not for Contracts – for WMS only)
GB	Gearbox
GDR	Grinder, Comminutor
GEN	Generator
GQ	Grounds Equipment
GRF	Ground Fault Relay
GS	Gas Distribution (not for Contracts – for WMS only)
HE	Heat Exchanger
HPU	Hydraulic Power Unit
HTR	Heater
HU	Humidifier
INJ	Injector, Ejector, Eductor, Aspirator
INQ	Instrument Equipment
INT	Intake Structure
IRG	Irrigation System
LAG	Lagoon
LB	Load Break Switch
LD	Lifting Device
LHD	Line Heat Detector
LOA	Loading Dock
LP	Lighting Panel or Load Panel

CODE	EQUIPMENT DESCRIPTION
LR	Lubrication Ring
LTG	Lighting (emergency and security)
LTX	Lighting (exit)
M	Motor
MAN	Manifold Assembly
MCC	Motor Control Centre less than 750 volts
MEQ	Mechanical Equipment
METR	Meter
MH	Manhole
MON	Monitor
MT	Machine Tool
MX	Mixer, Flocculator and Agitator
OIT	Operator Interface Terminal
OTF	Outfall Structure
OZ	Ozonator
P	Pump
PA	Public Address System Device, PA Speaker
PD	Primary Digester
PDA	Personal Data Assistant (not for Contracts -for WMS only)
PDM	Pulsation Dampener
PDP	Power Distribution Panel Less than 750 volts
PIP	Piping Section or System (not for Contracts -for WMS only)
PLQ	Plumbing Equipment (not for Contracts -for WMS only)
PRNT	Printer
PRTY	Property
PS	Power Supply
PWU	Power Wash Unit
QUEN	Quencher
RC	Recorder
RD	Rupture Disk
RES	Reservoir
RPU	Remote Processing Unit
RTU	Remote Terminal Unit
SB	Scrubber (air, gas)
SC	Screen, Trash Rack,
SCAM	Security Camera
SCAN	Scanner
SCBA	Self-Contained Breathing Apparatus
SD	Secondary Digester
SEN	Sensor
SERV	Server
SLFR	Sliding Frame agitator

CODE	EQUIPMENT DESCRIPTION
SM	Shop Machine
SO	Sulphonator
SP	Sampler/Sampling Point (LIMS)
SPL	Spill Containment Kit
SQ	Safety Equipment
SS	Security System
ST	Starter
STR	Strainer
STRC	Structure (wall, ceiling, floor) – (not for Contracts – for WMS only)
SW	Switch
SWG	Breaker Greater than 750 volts
T	Tank, Vessel, Hot Water Tanks
TB	Tie Breaker less than 750 volts
TEL	Telephone, VoIP Phone Set
TPB	Tipping Bucket
TPD	Trap Primer Device (Electronic, Pressure Drop Activate, P-Trap, etc.)
TR	Transformer
TS	Transfer Switch
UPS	Uninterruptible Power Supply
UV	UV System/Chamber/Bank
V	Valve
VEH	Vehicle
VENT	Vent (not for Contracts -for WMS only)
VSS	Voltage Surge Suppression
WAP	Wireless Access Point
WEL	Well
WSC	Weigh Scale
WR	Welding Receptacle, Receptacle 600V AC

.1 Assign equipment codes according to which category the equipment is most closely related.

.2 Do not create separate Equipment tags for the different components of a device/equipment. For example, create only one Equipment code for a pump, motor (if less than 100HP), gearbox, and auxiliary oil pump, create only one equipment tag for a valve and its manual or electric actuator, etc.

2.5 INSTRUMENT CODES (FRAGMENT 3)

.1 This list contains some of the more commonly used instrument codes. Codes for other instruments not found in this list can be generated using the ISA letter identification table shown below:

LETTER	FIRST LETTER		SUCCEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS (2)		ALARM		
B	BURNER, COMBUSTION			CLOSE, STOP, DECREASE (1)	
C				CONTROL	
D	DENSITY	DIFFERENTIAL		OPEN, START, INCREASE (1)	
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			FAIL (1)
G			GLASS, VIEWING DEVICE		
H	HAND				HIGH (OPENED)
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW (CLOSED)
M	MOTOR, MOTION (1)	MOMENTARY		MOTOR (1)	MIDDLE OR INERMEDIATE
N					ON OR OPERATE (1)
O			ORIFICE, RESTRICTION		OVERLOAD (1)
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION	PUMP (1)	
Q	QUANTITY (2)	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTI-VARIABLE (2)		MULTI-FUNCTION (2)	MULT-IFUNCTION (2)	MULTI-FUNCTION (2)
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASIFIED (2)		UNCLASIFIED (2)	UNCLASIFIED (2)	UNCLASIFIED (2)
Y	EVENT, STATE, PRESENCE			RELET, COMPUTE, CONVERT	
Z	POSITION, DIMENSION			DRIVER, ACTUATOR, UNCLASIFIED FINAL CONTROL ELEMENT	

(1) USER'S CHOICE

(2) WHEN USED, SYMBOL OR SYGNAL LINE IS ANNOTATED

.2 Many of the following instrument codes are not used to identify physical devices. They are in this table for use as identification in P&ID drawings and Process Control Narratives and other related documentation. For example, a valve should always have a physical tag that includes “V” as the device code. FCV, PCV, LCV etc should be used only within the “bubble” on the P&ID to identify valve’s control function. Primary elements (sensors) are not physically tagged as they are an integral part of the instrument but they typically require a separate tag on P&IDs and other documentation.

.3 Codes for use on documentation only are shown in bold text:

CODE	INSTRUMENT
AE	**Analyzer Element**
ASH	Analysis Switch High
ASL	Analysis Switch Low
ART	Analysis Recording Transmitter
AIC	Analysis Indicating Controller
AIT	Analysis Indicating Transmitter
DIT	Density Indication Transmitter
DL	Data Logger
EIT	Voltage Indicating Transmitter
FCV	**Flow Control Valve**
FE	**Flow Element**
FFIC	Flow Ratio Indicating Controller
FSH	Flow Switch High
FSL	Flow Switch Low
FRT	Flow Recording Transmitter
FI	**Flow Indicator or Gauge**
FIC	Flow Indicating Controller
FIT	Flow Indicating Transmitter
FQ	Flow Totalizing Meter
FQIR	Flow Totalizing Indicating Recorder
FRIC	Dosage (or Ratio) Indicating Controller
FS	Flow Switch
FY	**Flow Analyzing Element**
HS	**Hand Switch (or Pushbutton)**
HMS	**Hand Momentary Switch (or Pushbutton)**
HMSB	**Hand Momentary Pushbutton – Stop**
HMSF	**Hand Momentary Pushbutton – Start Fast**
HMSH	**Hand Momentary Pushbutton – Start**
HMSL	**Hand Momentary Pushbutton – Start Reverse**
HMSS	**Hand Momentary Pushbutton – Start Slow**
IRT	Current Recording Transmitter
IIT	Current Indicating Transmitter

CODE	INSTRUMENT
JRT	Power Recording Transmitter (Protection, Monitoring & Control)
JIT	Power Indicating Transmitter (Monitoring Only)
KI	**Time Indicator (Clock)**
KIQ	**Total Runtime Meter**
LCV	**Level Control Valve**
LDIT	Level Differential Indication Transmitter
LE	**Level Element**
LI	**Level Indicator or Gauge**
LIC	Level Indicating Controller
LS	Level Switch
LSH	Level Switch High
LSHH	Level Switch High-High
LSL	Level Switch Low
LSLL	Level Switch Low Low
LSM	Level Switch Medium
LRT	Level Recording Transmitter
LIT	Level Indicating Transmitter
LT	Level Transmitter
MLB	**Motor Light Stop**
MLN	**Motor Light Run**
PCV	**Pressure Control Valve**
PDIT	Pressure Differential Indicating Transmitter
PI	**Pressure Indicator or Gauge**
PIC	Pressure Indicating Controller
PIT	Pressure Indicating Transmitter
PSH	Pressure Switch High
PSHH	Pressure Switch High High
PSL	Pressure Switch Low
PSLL	Pressure Switch Low Low
PRT	Pressure Recording Transmitter
SI	**Speed Indicator or Gauge**
SIT	Speed Indicating Transmitter
SSH	Speed Switch High
SSL	Speed Switch Low
SRT	Speed Recording Transmitter
TE	**Temperature Element**
TI	**Temperature Indicator or Gauge**
TIC	Temperature Indicating Controller, Thermostat
TIT	Temperature Indicating Transmitter
TSH	Temperature Switch High
TSL	Temperature Switch Low
TRT	Temperature Recording Transmitter

CODE	INSTRUMENT
VIT	Vibration Indicating Transmitter
VSH	Vibration Switch High
VSL	Vibration Switch Low
VRT	Vibration Recording Transmitter
WIT	Weight Indicating Transmitter
WSH	Weight Switch High
WSL	Weight Switch Low
WRT	Weight Recording Transmitter
XSH	Torque Switch
YAN	Alarm Horn
ZIC	Position Indicating Controller
ZIT	Position Indicating Transmitter
ZSH	Position Switch High (Open)
ZSLH	Position Switches Low and High
ZSL	Position Switch Low (Closed)
ZRT	Position Recording Transmitter

.4 Assign instrument codes in the same manner as equipment codes.

2.6 EQUIPMENT/LOOP NUMBER (FRAGMENT 4)

.1 Generally, the Equipment/Loop number is a four digit number (0001 to 9999); however, for existing electrical equipment, a four-character alphanumeric code can be used to represent existing numbering conversions that are difficult to change due to both health and safety and operational reasons. Whenever practical for all equipment (except these specific examples of existing electrical equipment) the first two digits are the sequential loop number. The numbering sequence for the loop is assigned with numbers geographically increasing from West to East, South to North, starting at 01. The third and fourth digits are used to number multiple occurrences of the same device type in the loop. The numbering should start at 01 and increase sequentially according to flow or process direction.

.1 For example:

a. The main component of the process, the pump, is numbered FHO-TRW-P-0800.

b. The associated loop device, in this case the suction valve, is numbered FHO-TRW-V-0801.

c. The second valve (check valve) in the same loop is numbered FHO-TRW-V-0802.

d. Where equipment is not associated with a major unit, assign numbers according to geographical layout. Start numbers with “0001”.

.2 For example:

a. A flow switch on a common header, connected to multiple pumps (loops) cannot be associated with any major unit. Therefore, the numbers “0001” such as FHO-TRW-FS-0001 shall be assigned.

.2 For water mains and sewers, use the first two numbers to identify chamber/manhole numbers (i.e. all equipment in Chamber 01 will have a 01xx loop number).

.3 For common systems, such as Plant Services (HVAC, City Water, Plant Water etc.) and Health and Safety (Exit signs, Emergency lights, Fire Extinguishers etc.) the first two digits refer to the process area. Refer to Appendix H "13040-Appendix A-common system tagging loop reservation". The list is based on process area in each facility.

.4 **The numbering sequence shall follow and be synchronized with existing PCS compliant tags within facilities.**

2.7 DUPLICATE ITEM SUFFIX (FRAGMENT 4A)

.1 This fragment is reserved for differentiating between duplicate devices that would otherwise have the same code.

.2 This fragment starts with A for the first repeated item. Subsequent items continue in alphabetical order.

.3 Suffixes should be assigned as consistently as possible. If applicable, the order of suffixes should follow process flow.

.4 For water mains and sewers, use this fragment in conjunction with fragment 4 as part of the chamber/manhole identification (i.e. MTI chamber 17A will use loop numbers 17xxA, etc.)

.5 Note that there is no dash between loop number and suffix (Fragment 4 and Fragment 4A) as Fragment 4A is actually extension of Fragment 4.

2.8 PCS I/O TAG NAMES

.1 Coding System:

.1 I/O Tag Names define points of information in the process control system software.

.2 The code consists of up to 30 characters and each section may be of an alphanumeric combination.

.3 Dashes are included as shown.

.4 The basic code shall be:

AAA-	**CCC-**	**AAAA-**	**NNNNA-**	**ACCCCCCA-**	**AA**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**

Where: A Denotes Alphabetic character (letter)
N Denotes Numeric character (number)
C Denotes generic character (either alphabetic or numeric)

.5 The different groups of characters are split into various fragments which have specific functions meanings. These fragments or groups of characters are denoted by the numbers 1 to 6 and have the following functions:

Fragment 1	Is a three-digit character representing the facility or location (Section 2.2).
Fragment 2	Is a two or three character code representing a process/sub-process performed within the facility or site (Section 2.3). Water mains, sewers, reservoirs and pumping stations are classified as processes in the tag name.
Fragment 3	Is a one to four-character code representing the equipment from which the signal is sent or received (Section 2.4 and 2.5)
Fragment 4	Is a four or five-character alphanumeric code that identifies the Equipment/loop number. Leading zeroes are used to fill the code for numbers with less than four characters (Section 2.6). The last character differentiates between otherwise duplicate equipment codes (Section 2.7). Note: For water mains and sewers, use the first two numbers to identify chamber/manhole numbers (i.e. all equipment in Chamber 01 will have a 01xx loop number). Use the last character in conjunction with fragment 4 as part of the chamber/manhole identification (i.e. MTI chamber 17A will use loop numbers 17xxA, etc.) For common systems, such as Plant Services (HVAC, City Water, Plant Water etc) and Health and Safety (Exit signs, Emergency lights, Fire Extinguishers etc) the first two digits refer to the process area. Refer to Appendix H "13040-Appendix A-common system tagging loop reservation". The list is based on process area in each facility.
Fragment 5	Is a two to eight-character code representing the signal or data. The last used character may differentiate between otherwise duplicate signals within the same loop as A,B,C, etc. Note: When signal or data represent virtual tag, it should be associated with physical device(Valve, transmitter and etc as example below). In some cases, physical device is RPU or CPU depending where the virtual signal is originated.
Fragment 6	Is a one to two-character code representing the source for virtual points.

.6 Fragments 1, 2, 3 and 4 correspond to the Equipment name of the device to which the I/O point is associated.

.7 Example Signal Coding for Process Control Systems:

a. The following are examples of control system data base names.

(a) THR-PRM-V-0551-VC

(1)	(2)	(3)	(4)	(5)	(6)
THR-	**PRM-**	**V-**	**0551-**	**VC**	
Humber Treatment Plant	Primary Treatment Process	Valve	No. 0551	Valve Control (Position Setpoint)	N/A

(b) FHA-TRW-P-0012-MN

(1)	(2)	(3)	(4)	(5)	(6)
FHA-	**TRW-**	**P-**	**0012-**	**MN**	
Harris Filtration Plant	Treated Water Process	Pump	No. 0012	Running	N/A

(c) TAB-STR-PSL-2332-PAL

(1)	(2)	(3)	(4)	(5)	(6)
TAB-	**STR-**	**PSL-**	**2332-**	**PAL**	
Ashbridges Bay Treatment Plant	Secondary Treatment	Pressure Switch Low	No. 2332	Pressure Alarm Low	N/A

(d) FCL-FLT-LIT-0012-LIA

(1)	(2)	(3)	(4)	(5)	(6)
FCL-	**FLT-**	**LIT-**	**0012-**	**LIA**	
Clark Filtration Plant	Filtration Process	Level Indicating Transmitter	No. 0012	Level Indication - First Duplicate Signal	N/A

(e) WTR-PEG-FIT-0324-FI

(1)	(2)	(3)	(4)	(5)	(6)
WTR-	**PEG-**	**FIT-**	**0324-**	**FI**	
Water Transmission	Eglinton Pumping Station	Flow Indicating Transmitter	No. 324	Flow Indication	N/A

(f) WTR-103-FIT-1200-FI

(1)	(2)	(3)	(4)	(5)	(6)
WTR-	**103-**	**FIT-**	**1200-**	**FI**	
Water Transmission	Water Main 103	Flow Indicating Transmitter	Chamber 12	Flow Indication	N/A

(g) TAB-PRS-V-0301B-YNYI-C

(1)	(2)	(3)	(4)	(5)	(6)
TAB-	**PRS-**	**V-**	**0301B-**	**YNYI**	**-C**
Ashbridges Bay Treatment Plant	Phosphorus Removal	Valve	No. 0301B	Computer Auto Request	from SCADA

(h) TAB-PRS-RPU-0521- KIYR-R

(1)	(2)	(3)	(4)	(5)	(6)
TAB-	**PRS-**	**RPU-**	**0521-**	**KIYR**	**-R**
Ashbridges Bay Treatment Plant	Phosphorus Removal	Remote Processing Unit	No. 0521	Time Indication: Year	from RPU

(i) TAB-PRS-LIT-0208 -LAHH-C

(1)	(2)	(3)	(4)	(5)	(6)
TAB-	**PRS-**	**LIT-**	**0208-**	**LAHHC**	**-C**
Ashbridges Bay Treatment Plant	Phosphorus Removal	Level Indicating Transmitter	No. 0208	Level Alarm High High	from SCADA

(j) TAB-PRS-LIT-0208-LAHH-R

(1)	(2)	(3)	(4)	(5)	(6)
TAB-	**PRS-**	**LIT-**	**0208-**	**LAHH**	**-R**
Ashbridges Bay Treatment Plant	Phosphorus Removal	Level Indicating Transmitter	No. 0208	Level Alarm High High	from RPU

(k) TAB-PRS-RPU-0521-SYFULL-R

(1)	(2)	(3)	(4)	(5)	(6)
TAB-	**PRS-**	**RPU-**	**0521-**	**SYFULL**	**-R**

Ashbridges Bay Treatment Plant	Phosphorus Removal	Remote Processing Unit	No. 0521	System Fault Table Full	from RPU

b. At a minimum, PCS signals and data points are to be assigned point names for all data transferred between programmable devices and all points in the Human-Machine Interface (HMI) and historical databases, unless otherwise stated in the software standards.

2.9 SIGNAL CODES (FRAGMENT 5)

.1 Follow these guidelines when assigning signal and data codes:

.1 Use codes defined in this standard where appropriate

.2 For RPU system variable names, use the abbreviations and short names used in the RPU manufacturer's programming manuals.

.3 Use the loop number segment of the point name to distinguish between different devices or instruments rather than creating a new code. For example use "MN" to denote running status for the motor in loop 0001, 0002, 0003 and other loops. Do not create special codes to differentiate between different loops.

.4 Use the device type segment of the point name to distinguish between different types of devices or instruments in the same loop rather than creating a new code. For example use "MN" to denote running status for pumps, conveyors, blowers, motors and other devices. Do not create special codes to differentiate between the types of device.

.2 This list contains some of the more commonly used signal codes. Codes for other signals and data not found in this list can be generated using the guidelines below.

CODE	SIGNAL/DATA CODE DESCRIPTION
AAH	Analysis Alarm High
AAL	Analysis Alarm Low
AAX	Analysis Alarm Warning
AI	Analysis Indication
AIC	Analysis Indication Control
AXA	Instrument Failure Alarm
BB	Burner Off
BF	Burner Failure
BH	Burner On
DI	Density Indication
EAL	Loss of Power Alarm
EA	Voltage phases A-B

CODE	SIGNAL/DATA CODE DESCRIPTION
EB	Voltage phases B-C
EC	Voltage phases A-C
FAH	Flow Alarm High
FAHH	Flow Alarm High High
FAL	Flow Alarm Low
FALL	Flow Alarm Low Low
FH	Flow Impulse
FI	Flow Indication
FIC	Flow Control
FR	Flow Record
HAS	Emergency Stop Alarm
HMB	Stop Request
HMD	Start Request
HS	Manual/Auto
II	Current Indication
IIA	Current - Phase A
IIB	Current - Phase B
IIC	Current - Phase C
JI	Power Indication
JQ	Energy
JY	Power Factor
KQ	Run Time
LAH	Level Alarm High
LAHH	Level Alarm High High
LAL	Level Alarm Low
LALL	Level Alarm Low Low
LDI	Level Differential
LI	Level Indication
MAL	Motion Alarm Low
MB	Stop Command
MF	Motor Failed
MH	Start Command
MHF	Start Fast
MHS	Start Slow
ML	Start Reverse
MLB	Motor Off Status
MN	Running

CODE	SIGNAL/DATA CODE DESCRIPTION
MNB	Stopping
MND	Starting
MNH	Running Forward
MNL	Running Reverse
OVRD	Override
PAH	Pressure Alarm High
PAHH	Pressure Alarm High High
PAL	Pressure Alarm Low
PALL	Pressure Alarm Low Low
PC	Pressure Setpoint
PDH	Pressure Differential High
PDI	Pressure Differential
PI	Pressure Indication
PR	Pressure Record
QAH	Overcrank Alarm
SAH	Speed Alarm High
SAHH	Speed Alarm High High
SAL	Speed Alarm Low
SALL	Speed Alarm Low Low
SC	Speed Setpoint
SDI	Speed Differential
SI	Speed Indication
SW	Software
TAH	Temperature Alarm High
TAHH	Temperature Alarm High High
TAHL	Temperature Alarm High/Low
TAL	Temperature Alarm Low
TALL	Temperature Alarm Low Low
TC	Temperature Control
TI	Temperature Indication
VA	Position A Select
VB	Position B Select
VC	Position Setpoint
VH	Open Command
VI	Vibration Alarm
VL	Close Command
WA	Torque Alarm

CODE	SIGNAL/DATA CODE DESCRIPTION
WAH	Torque Alarm High
WAL	Torque Alarm Low
WC	Torque Setpoint
WI	Weight Indication
XA	General Alarm
YA	Not Available
YN	Computer Mode
YQ	Operation Totalizer
YSEL	Mode Select
YU	Reset
ZAH	Position Alarm High
ZAL	Position Alarm Low
ZA	Position A Indication
ZB	Position B Indication
ZH	Opened
ZI	Position Indication
ZL	Closed

.3 Codes for other signals and data not found in the list can be generated using the following guidelines:

.1 Use ISA Letter Identification Table (see Section 2.5).

.2 Use the abbreviation “A” for analysis for all analytical measurements; do not use chemical abbreviations (e.g. CL2, FE, FECL2, and O2), laboratory test designations (e.g. TSS, SS, NTU) or other abbreviations (e.g. DEN for density, LEN for length).

.3 Use abbreviations for measured variable; do not use “X” to denote the measured variable.

.4 Create as few special codes as practical. Data point names need to be unique within an RPU or within the City-wide HMI environment. Data names do not need to describe the datum; the description belongs in the description field.

.5 Use abbreviations in a consistent manner. That is, use only one abbreviation for the same meaning.

.6 Use a hyphen to separate portions of the data code if needed to clarify the name. Use no other special characters.

.7 Use the following abbreviations as needed:

Abbreviation	Meaning
ACT	Actual
BLK	Block
C	From SCADA, usually as the last letter in a data code
CLK	Clock
COND	Conditioned
CV	PID "CV" Control Variable
DB	Deadband
DT	Day of Week
DUPL	Duplicate
DV	Device
DY	Day of Month
EN	Enable
FLT	Fault
HR	Hour
ID	Identity
JOG	Jog
L	Latched, usually as the last letter in a data code
MAX	Maximum
MIN	Minimum or Minute
MTH	Month
ND	Needed, Required
NOR	Normal
OK	Okay, Successful
OS	Out of Service
OV	Over
PID	Proportional Integral Derivative
PRE	Preset
PV	PID “PV” Process Feedback
READ	Read
REQ	Request
RF	Refresh
RS	Restart
SEC	Second
SEL	Select
SP	Setpoint
SQ	Sequence
T	Timer, usually as the first letter in a data code for a system variable
TT	Temporary, usually as the last letter in a data code
TMP	Temporary
TMR	Timer
TRAN	Transition
UN	Under
VAL	Value
W	Word, followed by the number of the word
WRI	Write
YR	Year

.8 Full list of developed and accepted signal code are available upon request.

2.10 REAL OR VIRTUAL POINT TYPE (FRAGMENT 6)

.1 This fragment is assigned as needed to differentiate different virtual points attached to the same root input or output. It is a one to two-character code representing the source for virtual points.

- C – SCADA to PLC (all facilities)
- CR – SCADA to PLC (WTR tags only)
- R – PLC to SCADA (all facilities)
- RC – PLC to SCADA (WTR tags only)

2.11 POMS AND LIMS USAGE

.1 The use of facility, process or equipment codes in defining calculations or points of information in the performance and operations management System (POMS) and Laboratory Information Management System (LIMS) shall be consistent with this standard.

2.12 LIMS DATA NAMES

.1 The use of facility, process or equipment codes in defining sample locations, calculations or points of information in the laboratory information management system (LIMS) shall be consistent with this standard.

.2 Coding System:

.1 The code consists of up to 28 characters and each section may be of an alpha-numeric combination.

.2 Dashes are included, as shown in the examples, below

.3 The basic code shall be:

AAA-	**CCC-**	**AAAA-**	**NNNNA-**	**CCCC-**	**CCCC**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**

Where:
- A Denotes Alphabetic character (letter)
- N Denotes Numeric character (number)
- C Denotes generic Character (either alphabetic or numeric)

.1 The different groups of characters are split into various fragments, which have specific functions meanings These fragments or groups of characters are denoted by the numbers 1 to 6 and have the following functions:

Fragment 1 is a three-digit character representing the facility or location (site) (2.2).

Fragment 2 is a two or three character code representing a process/sub-process performed within the facility or site (2. 3). Water mains, reservoirs and pumping stations are classified as processes in the tag name.

Fragment 3 is a one to four-character code representing the type of equipment or instrument codes (2.4 and 2.5).

Fragment 4 is a four or five character alphanumeric code that identifies the Equipment/loop number (2.6). Leading zeroes are used to fill the code for numbers with less than four characters. The last character differentiates between otherwise duplicate equipment codes (2.0).
For water mains and sewers, use the first two numbers to identify chamber/manhole numbers (i.e. all equipment in Chamber 01 will have a 01xx loop number). Use the last character in conjunction with fragment 4 as part of the chamber/manhole identification (i.e. MTI chamber 17A will use loop numbers 17xxA, etc.)
For common systems, such as Plant Services (HVAC, City Water, Plant Water etc) and Health and Safety (Exit signs, Emergency lights, Fire Extinguishers etc) the first two digits refer to the process area. Refer to Appendix H "13040-Appendix A-common system tagging loop reservation". The list is based on process area in each facility.

Fragment 5 is a four character alpha-numeric code that identifies the type of process or sub-process sample

Fragment 6 is a four character alpha-numeric code that identifies the sampling point number

.2 Examples LIMS Data Coding:

a. TNT-AER-T-0001-CENT-SP01

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TNT-	**AER-**	**T-**	**0001-**	**CENT-**	**SP01**
North Toronto Treatment Plant	Aeration Process	Tank	No. 0001	Centrate	Sample Point No. 01

2.13 LIMS CODES (FRAGMENT 5)

.1 This list contains some of the more commonly used LIMS Process Sample Codes.

CODE	LIMS Process Codes
AIRE	Air Emissions
AMX	Morning Period
BMOI	Plant Moisture Balance
BSL	Blended Sludge
BYPS	Bypass
CENT	Centrate
DAY	All Day Period
DAF	Diffused Air Flotation
DSL	Digested Sludge
EFF	Effluent
FEED	Feed
GRT	Grit

CODE	LIMS Process Codes
IASH	Incineration Ash
INF	Influent
ML	Mixed Liquor
MLSS	Mixed Liquor Suspended Solids
PHOS	Phosphorous
PM	Afternoon Period
POLY	Polymer
RASL	Return Activated Sludge
ROYC	Royce Meter
RWSL	Raw Sludge
SCM	Scum
SCN	Screenings
SLCK	Sludge Cake
SUBN	Subnatant
SUPN	Supernatant
TF	Transfer Tank
TWAS	Thickened Waste Activated Sludge
UDS	Undigested Sludge
VA	Volatile Acid Sampling
WAS	Waste Activated Sludge

PART 3 PHYSICAL TAGS

3.1 GENERAL

.1 Equipment/devices (assets) must have a physical tag attached with a unique number in accordance with this standard. There are two types of tags in use at Toronto Water facilities:

.1 Aluminum Bar Code Tags – All assets will have an Aluminum Bar Code Tag for identification and for use with bar code scanners for asset management purposes.

.2 Lamacoid Tags – Lamacoid tags (with no bar code) are to be used only for electrical equipment that do have a PCS tag (i.e. Switchgears, Load breakers, MCCs, Transformers, Switches, Network Closets, Control Panels serving multiple devices etc). So in this context, the lamacoid tag is the asset tag but only for electrical equipment and panels.

3.2 SUPPLEMENTAL TAGS

.1 An asset can have multiple tags associated with it to identify supplementary items such as a disconnect switch, device control panel, VFD, source of power tag, MCC starter/disconnect tag etc. These supplementary tags shall be lamacoid types which are in addition to the primary aluminum bar code tag on the primary asset.

.2 Some equipment/devices will require a larger tag that matches the physical characteristics of the equipment. These identifications are required on larger pieces of equipment installations to be completed based on the following: all Tanks, Cranes , Centrifuges, Pumps, Generators, Engines, HVAC Units, Blowers, Large Motors, Large Compressors, Feeders, Evaporators, Furnaces, Scrubbers, Large Valves/Gates, Large Filters and all other similar large equipment. These larger major pieces of equipment require the larger tag identification for ease of identification from a distance for both operational and safety related requirements. Larger tags are also required for the equipment physically located on the places where the tag cannot be easily read (i.e. valve mounted high on the overhead pipe). In some cases multiple large tags are required.

3.3 MOUNTING

.1 Tags are to be attached directly on pieces of equipment to which the tag is related in plain view of a person walking by the equipment.

.2 Equipment warranties or equipment performance are not to be affected by the mounting of the tags.

.3 They should be attached using screws and should be straight/level with no damage and no kinking (bending around curve is allowable).

.4 The surface area should be cleaned properly prior to installation.

.5 Mount tags so that they are readily apparent and legible.

.6 Place tags within a height range of 1200mm to 1650mm (4 to 5 ½ feet) from the floor if possible.

.7 Do not obscure or mount over other nameplates, labels or tags.

.8 Attempt to locate the tags as close as possible to existing manufacturer’s nameplate tags.

.9 In situations where equipment is not in plain view of staff, the aluminum tag should be mounted on a wall under the equipment or similar location such that the required information is in plain view of a person walking by as close as possible to the equipment. Where lamacoid tags are used, the tag should be attached directly to the equipment and sized such that it is visible to staff walking nearby. In situations that are unique or unclear for the mounting of tags, consult with the Optimized Maintenance Unit.

.10 The Optimized Maintenance Unit will approve the material type (Aluminum or Lamacoid) based on the particular locations. Aluminum is required on all equipment and devices that may be subjected to painting and outdoor installations. Lamacoid tags are required on all control panels and on equipment in corrosive environments, including all areas that may be exposed to chlorine fumes (filter buildings, flocculation areas, chlorine storage and feeder rooms, etc.).

.11 75mm (three inch) stencilling (or an appropriate size proportional to the size of the equipment) shall be selected for the large tags. The colour of the paint/tag is to be complementary to the colour of the equipment to ensure that it is visible from a distance.

3.4 MOUNTING EXAMPLES

.1 Valves:

.1 For valves the bar-coded tag is to be mounted on the process flange, if flange is wide enough. If flange is not wide enough it is to be on the process side at both sides of the tag with stainless steel wire.

.2 Pumps:

.1 For pumps under a 100 hp the tags are to be mounted on the base plate for the assembly. For motors over a 100 hp the tags are to be mounted on the base plate of the motor. If base plate mounting is not acceptable, attach tag on the process piping, wall or adjacent structure.

.2 For very large pumps, the bottom flange of the pump is to be used for mounting of tag. This part of the pump is very seldom ever changed.

.3 Instruments:

.1 For instruments the bar-coded tag is to be mounted to the conduit feeding the device preferably at the bottom of the device. For some instruments if mounting to conduit is not possible it can be mounted to the concrete wall close to the device location.

.2 The elements for transmitters are to be tagged with the same tag as the transmitter. Element to have lamacoid tag and the barcode should go on transmitter.

.4 Panels:

.1 Device disconnects, switchgear, MCC's and Network Closets are not to be drilled (unless new) such that unnecessary shutdowns of equipment are required. Attach tags to this type of equipment with double sided tape or adhesive.

.2 All sources of power tags, for 600V devices, are to have tag attached to conduit entering device with stainless steel wire or on wall or structure clearly visible.

.3 If a 600V device has a local disconnect, the source of power tag is to be attached to wall beside disconnect operating handle with stainless steel screws and plastic anchors.

.4 For some 600V devices with a local disconnect the source of power tag may have to be attached to the front face of disconnect with double sided tape or adhesive.

.5 All MCC or switchgear tags are to be attached to equipment with double sided tape or adhesive (unless new).

3.5 EVALUATION CRITERIA FOR PHYSICAL TAGGING IN THE FIELD

.1 A device requires physical tagging if it has any of the following characteristics:

.1 Desire to retain asset specifications/data.

.2 Desire to retain costing information.

.3 It appears in Operating Procedures or Process Narratives (not all equipment devices show on P&ID's).

.4 Requires scheduled maintenance and a record of maintenance activity.

.2 The level to which a device/equipment is to be tagged will depend on several factors. All the factors below must be considered and met using the decision flow diagram below:

.1 Criticality 1, 2, 3 (see Table below).

.2 Impact on process – as a minimum referenced in P&IDs (Process & Instrumentation Diagram) and/or SOPs.

.3 Existence within WMS (Work Management System) asset hierarchy.

Criticality Evaluation

H&S / Environmental	1	Safety/Environmental impact. Failure or missed planned maintenance may impact safety for staff/the public and the surrounding environment)
High	2	Failure or missed planned maintenance of this device will immediately impact the operation. I.e. for example if back-up equipment is available criticality would be medium. Equipment requiring regulatory maintenance would fall under this category
Medium	3	Failure of this device may/will, over time impact the process, and result in a high cost
Low	4	No impact to the station function

.3 A group of devices/equipment may be tagged as one asset depending on their function in the process. The focus must always be on the component which is providing the main function.

.1 For example a pump driven by a motor will be initially tagged with one tag. This one 'tag' will reference both the motor and the pump. However based on the above "Device/Equipment Definition", and "Factors that must be considered" criteria, the motor may potentially be tagged as well.

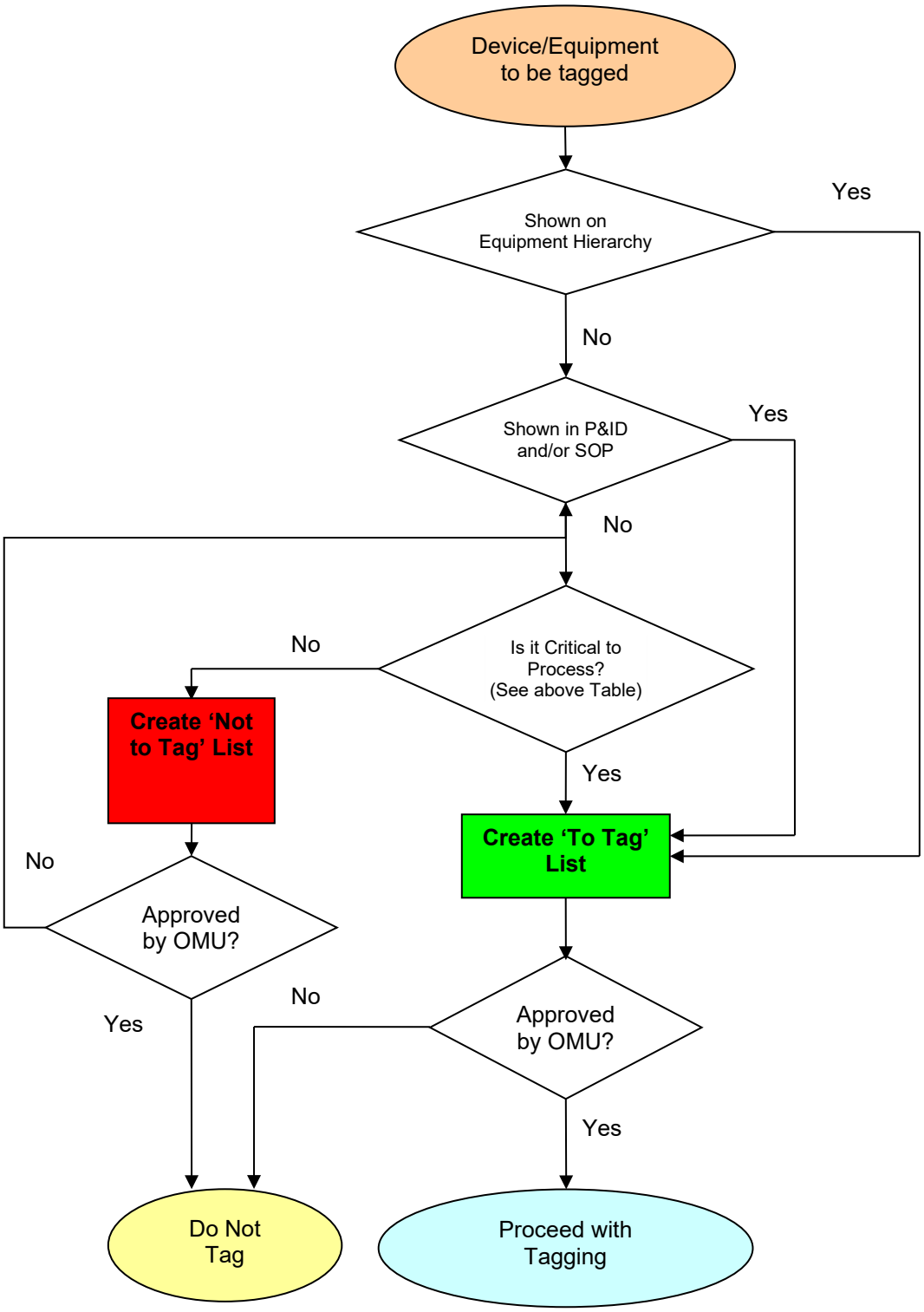
.2 In the case of a valve activated by an actuator, it will be initially tagged as one asset with focus on the valve. Again there might be cases where the actuator may require tagging too.

.4 Important:

.1 Before proceeding with tagging, lists of equipment/devices ‘to be tagged’ and ‘not to be tagged’ must be submitted to OMU for approval during the detailed design phase.

.2 The decision-flow diagram below together with the above definitions will help Consultants evaluate if a device/equipment is to be tagged.

.3 If there are further question about tagging or not tagging a device/equipment contact the Optimized Maintenance Unit for further assistance.


Device/Equipment to be tagged
Shown on Equipment Hierarchy
Yes
No
Shown in P&ID and/or SOP
Yes
No
Is it Critical to Process? (See above Table)
No
Create 'Not to Tag' List
Yes
Create 'To Tag' List
No
Approved by OMU?
Yes
No
Approved by OMU?
Yes
Do Not Tag
Proceed with Tagging

3.6 ALUMINUM TAG SPECIFICATIONS

.1 All equipment will have a standard bar code tag (shown below).

.2 Elements of the bar code tag are as follows:

.1 The equipment tag number.

.2 A barcode representing the unique equipment tag, centered below the equipment tag and coded using the following barcode specification:

a. Symbology: Code 128 auto.

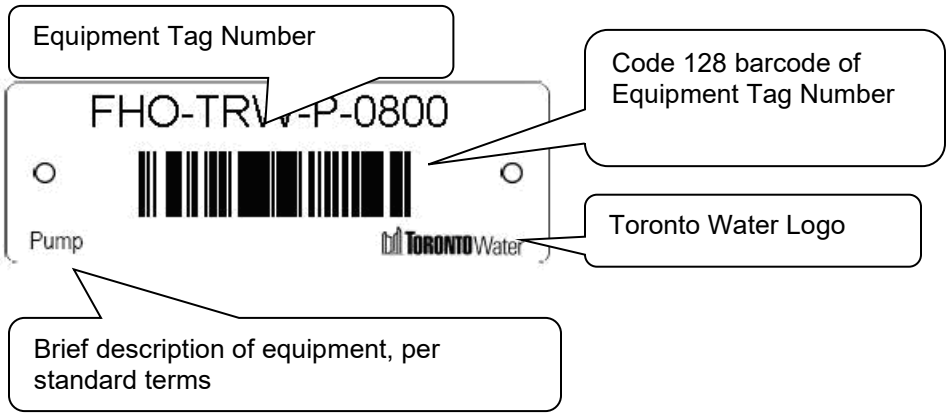
b. X-Dimension: 0.013".

c. Ratio: 3:1.

d. Height: 0.375".

.3 A brief description of the equipment (bottom left corner).

.4 Toronto Water logo (bottom right corner).



.3 Physical tag specifications:

Size	75mm x 25mm (3” x 1”) (all equipment)
Thickness	Aluminum: 0.8mm (0.032“), Lamacoid: 1.5mm (0.060”), Stainless Steel (S.S): 0.8mm (0.032“).
Material	Teflon coated Aluminum unless approved differently by the TW Optimized Maintenance Unit, Stainless Steel, or Lamacoid
Coating	3M Teflon UV and anti paint topcoat (Aluminum Only)
Fastener hole size	3mm (1/8”)

Fastening Method	Specified rivets only unless approved differently by the TW Optimized Maintenance Unit. 1.2mm (3/64") Stainless Steel wire cable with swaged coupling for devices to small to rivet.
Rivet Specifications	3mm (1/8") SS round head or blind SS pop rivets 
Equipment Tag Number FONT	Arial, 16pt
Barcode FONT	Code 128 auto, X-Dimension: 0.33mm (0.013"), Ratio: 3:1, Height: 9.5mm (0.375")
Barcode size	45mm x 9.5mm (1.75” x 0.375”)
Equipment description Font	Arial, 10 pt
Toronto Water LOGO	22mm x 4.5mm (0.875” x 0.175”)
Adhesives and Wire for affixing labels	Not allowed unless approved by the TW Optimized Maintenance Unit, or design of the device would be compromised by drilling.

.4 As per the brief equipment description in the above tag (bottom left corner), “Pump” labels are to contain equipment description names and as required, followed by specific functional detail. Not all equipment description requires the functional details if the details to add do not provide helpful information in addition to the tag name information. For example:

.1 Pump (no need to add Treated Water as that information is in the Tag fragment - TRW).

.2 Motor (no need to add Treated Water as that information is in the Tag fragment - TRW).

.3 Valve, Butterfly (tells the reader type of the valve – ads more value).

.4 Valve, Gate, Actuated (tells the reader type of the valve and it has actuator– ads more value).

.5 Compressor, Piston (tells the reader type of the compressor – adds more value) etc.

3.7 LAMACOID TAG SPECIFICATIONS

.1 Material to be engraved gravoploy laminate nameplates, 1.5mm thick with bevelled edges.

.2 Use text with the following characteristics:

.1 Lettering – Uppercase.

.2 Font – Times New Roman.

.3 Style – Regular.

.4 Size – Maximum to fit label width, minimum 3mm.

.5 Character Spacing – Normal.

.6 Justification – Center lettering on each line.

.7 Colour – Black lettering on White background.

.3 The following table lists the characteristics of common tag types in use at Toronto Water facilities:

Tag Type	Size	Lines	Font Height
A	40 x 12 (1 ½" x ½")	1	line 1 = 6.5mm
B	50 x 20 (2" x ¾")	1	line 1 = 6.5mm
C	75 x 25 (3" x 1")	1	line 1 = 5mm
D	75 x 31 (3" x 1 ¼")	2	line 1 = 6.5mm, line 2 = 5mm
E	75 x 31 (3" x 1 ¼")	3	line 1 = 6.5mm, line 2&3 = 4mm
F	75 x 31 (3" x 1 ¼")	3	line 1 = 5mm, line 2&3 = 5mm
G	100 x 40 (4" x 1 ½")	3	line 1, 2 & 3 = 6.5mm
H	150 x 25 (6" x 1")	1	line 1 = 12.5mm
I	150 x 31 (6" x 1 ¼")	2	line 1 = 12.5mm, line 2 = 6.5mm
J	150 x 31 (6" x 1 ¼")	2	line 1 = 6.5mm, line 2 = 6.5mm
K	250 x 50 (10" x 2")	2	line 1 = 15mm, line 2 = 9mm
L	200 x 75 (8" x 3")	3	line 1&2 = 15mm, line 3 = 9mm
M	210 x 50 (8.3" x 2")	2	line 1 = 12mm, line 2 = 12m

3.8 LAMACOID TAG EXAMPLES

.1 Tags for MCCs/Switchgears/PDPs:

.1 Typical example (Type K):

THC-ELS-MCC-0101

LOWER PLANT BLDG. A 600 V MCC

a. Line 1: Identify the equipment number.

b. Line 2: Equipment description.

c. This is equipment tag to identify MCC, Switchgear or PDP. Tag to be mounted on the left upper corner of MCC, Switchgear or PDP. In main-tie-main configuration associated tags to be mounted on left and right upper corner of MCC, Switchgear or PDP.

.2 Tags for Electrical Panels/Switches:

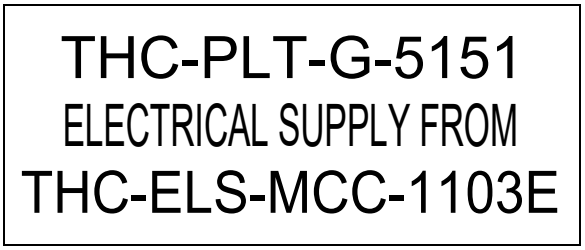
.1 Typical example (Type J):

a. Line 1: Identify the equipment number.

b. Line 2: Equipment description (Scaled text width to fit label width when needed).

.3 Source of Power Tag (Supplemental Tag):

.1 Typical example (Type F):



a. Line 1: Identify the equipment number.

b. Line 2: “ELECTRICAL SUPPLY FROM” (Scaled text width to fit label width).

c. Line 3: MCC or electrical supply equipment number.

.4 MCC Starter/Disconnect Tag (Supplemental Tag):

.1 Typical example for Switchgears, Switchboards and PDP – above 750 V (Type J):

EFFLUENT PS TRANS. 4160 V/600 V
THR-ELS-TR-1900

a. Line 1: Equipment description.

b. Line 2: Identify the equipment number.

.2 Typical example for MCCs, PDPs – less than 750 V (Type D):

BYPASS CHANNEL GATE
THC-PLT-G-5151

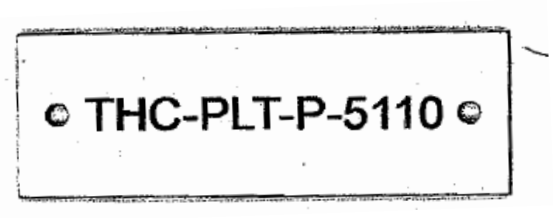
a. Line 1: Equipment description (Scaled text width to fit label width when needed).

b. Line 2: Identify the equipment number.

c. These are supplemental tags to identify equipment that will be de-energized when the associated circuit break/disconnecting device is opened.

.5 Tags for Control Stations (Supplemental Tag):

.1 Typical example (Type C):



a. Line 1: Identify the equipment number

b. This is a supplemental tag to identify equipment to which this control station or disconnect switch is related.

.6 Lamacoid Tags for Network Closets:

.1 Typical example for Telecom Enclosures and Termination Panels (Type L):

TAB-ITS-COM-2000
TELECOM ENCLOSURE
DEWATERING BLDG FLR 5 CTRL RM

.2 Typical example for Core Networks/ Server Cabinets (Type M).

FIS-ITS-COM-0300
SERVER CLOSET

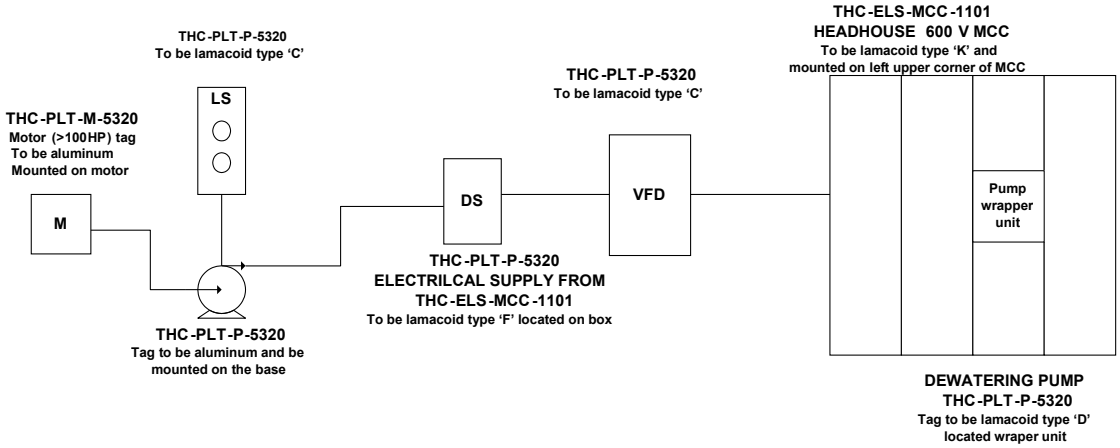
.3 Typical example for Water Supply Systems (Type L).

WTR-PEL-COM-2000
TELECOM ENCLOSURE
GENERATOR BLDG. MAIN FLR, ELEC. RM

3.9 PROCESS TAGGING EXAMPLES

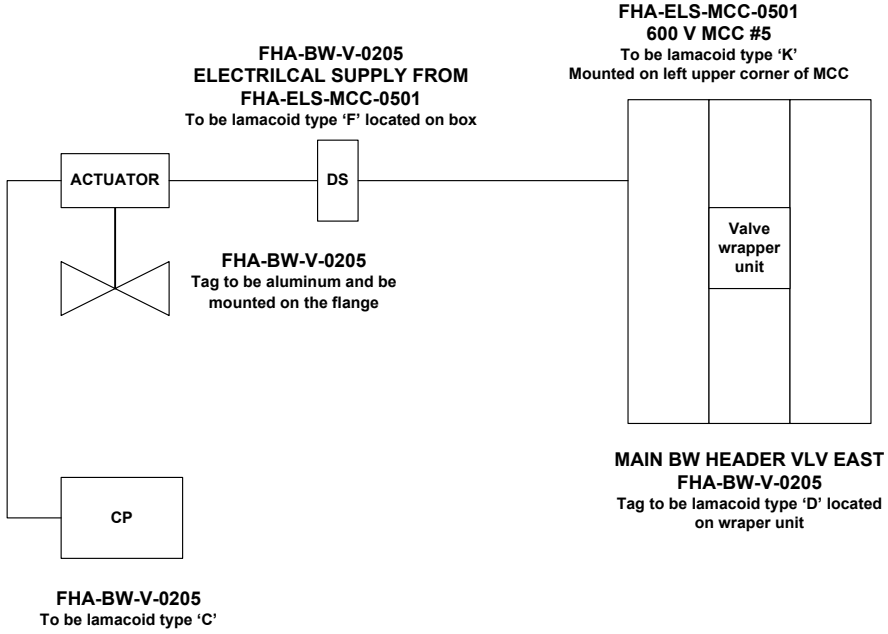
.1 The following diagrams illustrate some typical process equipment configurations and the appropriate tagging arrangement.

.1 Example 1:

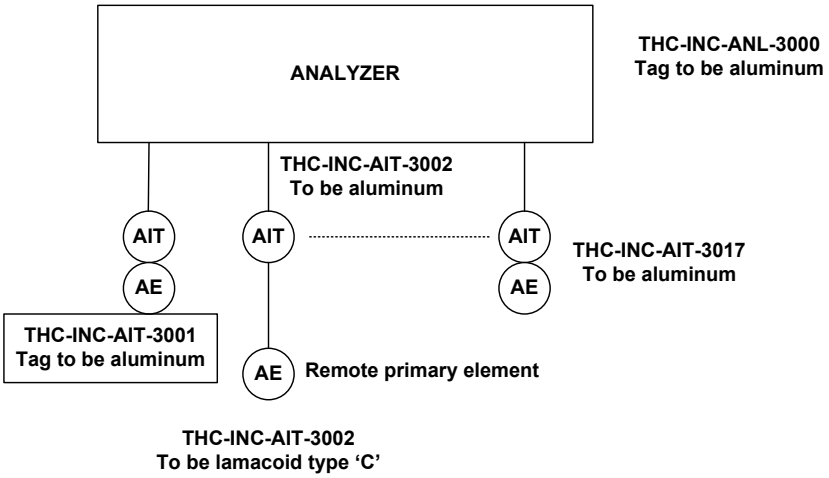


Note: Pump THC-PLT-P-5320 is real pump however some tags are added to address potential features (Motor, VFD etc).

.2 Example 2:



.3 Example 3:



3.10 PHYSICAL TAG LIST EXAMPLES

.1 The equipment physical tag lists are attached to this standard. Please see:

.1 Appendix I (Appendix B)-Equipment (Asset) Tags List-Aluminum (Example)

.2 Appendix J (Appendix C) Equipment (Asset) Tag List-Lamacoid (Example)

.3 Appendix K (Appendix D)-Supplemental Tag List-MCC Starter Disconnect-Lamocoid (Example)

.2 Consultant is to produce "Large tag" list if require in accordance with Section 3.2. When stencilling is used as a method for large tags identify letter size, paint and background colour. Mylar could be used only if approved by OMU. If approved identify size, letter size, and letter and background colour.

3.11 EXISTING EQUIPMENT IDENTIFICATION NUMBERING

.1 If a project involves re-programming or re-calibrating existing equipment, it shall be re-tagged as required according to the following guidelines:

.1 Remove all former or conflicting references to equipment/device numbers to ensure no ambiguity as to the correct and only equipment tag number.

.2 For any existing electrical equipment numbers that cannot be removed and replaced with tags that follow this standard (facility locations are to determine this based on both Health and Safety and operational impact) – new tags are to be produced to follow this standard and all old references to equipment are to be removed. The existing numbering conventions for these pieces of equipment are to be designed into Fragment 4 utilizing alphanumeric naming.

.3 Tagging installations on electrical equipment (including Circuit Breakers (CBs) and Motor Control Centers (MCCs)) are to be as per the above to ensure that all

electrical isolation (lock-out) locations are clearly identified with the same equipment number as the device for which it supplies power isolation. The Starter/Breakers will not be setup in the WMS system and they will be part of the Motor/electrical equipment for which they provide isolation for. Due to this, the Starter Breakers will not require unique TW Equipment Tags. All lock-out devices need to be documented to show that they contain the tags identical to the tags on the field devices (equipment).

3.12 ENTITY INFORMATION LIST (WMS LIST)

.1 If project involves installation of new equipment, upgrade or replacement, Entity Information List (WMS List) shall be completed.

.2 Prior to completion of this list the Project Manager shall supply a current, updated spreadsheet as required.

.3 The following page lists the column headers from the above spreadsheet in the format the info would be collected. "Entity Basic" and "PCS & Procurement" Add-on information are common for all Entities. The rest of the entity information would be collected by entity classification: Motor Add-on, Pump Add-on, Breaker Add-on, Valve Add-on, Instrument Add-on and HVAC Add-on. Additional entity classification "Add-ons" should be developed (i.e. Actuator Add-on, VFD/VSD Add-on, Blower Add-on, Centrifuge Add-on, Compressor Add-on, Pressure Vessel Add-on, Chlorinator Add-on etc.) when required.

.4 Most of the "Entity Basic" information are related to the design and are to be provided by Consultant. Entity Basic cells: Entity Site Name, Parent Site Name, Entity Type, Entity Classification, and Entity Category have a pull-down menu with data to choose from. Any addition to the pull down many is pending OMU approval.

.5 All data in the "Add-ons" are data related to the specific equipment and are to be provided by Contractor. Contractor is also to provide "Recommended Maintenance based on Manufacturers recommendation" information.

.6 The following paragraph describes Entity (equipment/device) naming convention and most common naming examples.

.1 Use format: Device, Type, Function, Location to describe equipment for example:

a. Valve, Ball, Actuated, Suction, Pump P-1100 (or Pump 1100), Raw Water Pumping Basement.

b. Pump, Centrifugal, VFD, Primary Sludge Pumping, Gallery 12.

c. Fan, Centrifugal, Supply Air, AHU-0720, Thickening Building Basement/Sub-basement Area.

d. Analyzer, Density, Common Discharge, TWAS Pumps P-5820 and P-5830 (or TWAS Pumps 5820 and 5830).

e. Transmitter, Flow, Polymer Dilution Water, Thickening Centrifuge CF-0600 (or Centrifuge 0600).

f. Transmitter, Power Recording, Backwash Pump 0501, MCC 0501, Low Lift PS.

g. Switch, Level, Low, Service Air, Vacuum Tank 0200, Back Wash Pumps.

h. Valve, Ball, Isolation, City Water Pressure Control Outlet, Boiler Building, Hot Water System.

i. Damper/Louver, Pumps Room, Eglinton PS.

.2 The Entity name should be limited to 100 characters including space in-between words. Abbreviation should be used when necessary.

.3 Use words: Ball, Knife, Gate, Pressure Relief etc. to describe valve type.

.4 Use words: Actuated, Solenoid, Pneumatic etc. to describe valves with operator other than manual. Do not use word "Manual" for manual valves.

.5 Use words: Suction, Discharge, Isolating, Interconnecting, Inlet, Outlet, Drain, etc. to describe valve relationship with other devices.

.6 Use additional wording to complete valve function i.e.:

a. Pump P-1100 (or Pump 1100) for Pump's Suction, Discharge or By-Pass valves.

b. Tank T-2000 (or Tank 2000) Inlet Line Drain.

c. Ferrous Chloride Storage Tank 0100, Discharge Header A etc.

.7 Use words: Centrifugal, Gear, Diaphragm, Metering etc to describe pump type.

.8 Use words: Density, Chlorine, Dissolved Oxygen, Ozone, pH etc. to describe analyzer type.

.9 Use words: Flow, Level, Pressure, Temperature etc. to describe transmitter type.

.10 Use words: Ultrasonic, Magnetic, Doppler, Venturi, Coriolis etc. to additionally describe transmitter type

.11 Use word Switch to describe discrete point measuring instrument followed by Level, Float, Flow, Temperature, etc. to identify measuring variable

.12 Use words: Low, High, Low Low, High High etc. to further describe function of discrete point measuring instrument.

3.13 SUPPLEMENTS

.1 Supplements listed below, following “End of Section”, are part of this specification:

.1 System Tagging Loop Reservation

.2 Equipment (Asset) Tags List-Aluminum(Example)

.3 Equipment (Asset) Tag List-Lamacoid(Example)

.4 Supplemental Tag List-MCC Starter Disconnect-Lamocoid(Example)

.5 Supplemental Tag List-Source of Power-Lamacoid(Example)

.6 Supplemental Tag List-Control Station-Lamacoid(Example)

.7 WMS Entity Information

.8 Electrical Tagging Loop Assignment Scheme

END OF SECTION

TORONTO

SECTION 13105

GENERAL INSTRUMENTATION REQUIREMENT

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 Comply with the requirements of Section "13010-Process Control General".

.2 This section provides general requirements for Sections 13105 though 13361.

1.2 STANDARDS OF CONFORMANCE

.1 Instrument Society of America, ISA-S50.1, current edition, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.2 ISA Standard -S20: Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

.3 National Electrical Manufacturers Association (NEMA), Pub. No. 1CS-6, enclosures for industrial controls and systems.

.4 Underwriter Laboratories, UL508, Standards for Industrial Control Equipment.

.5 Canadian Standards Association (CSA), Ontario Electrical Safety Code (OESC) and Toronto Hydro.

.6 Approvals:

.1 Factory Mutual (FM) approval for explosion proof and intrinsic safety I5.

.2 Canadian Standards Association (CSA) approval for explosion proof and intrinsic safety C6.

1.3 GENERAL INSTRUMENTATION REQUIREMENTS

.1 Provide instruments with conformably coated printed circuit boards if available from the listed manufacturers in order to prevent damage by dust, moisture, fungus and airborne contaminants.

.2 Provide instruments complete with mounting hardware, floor stands, wall brackets or instrument racks as required by the manufacturer.

.3 Instrument Data Sheets:

.1 Data sheets have been prepared during design and implementation to cover each instrument.

.2 Each instrument will be listed and pertinent information recorded including: tag number and description, complete model number, ranges, setpoints, materials and special mounting details for non-typical applications.

.3 Provide instrument enclosures NEMA/EEMAC rated for the environment. In hazardous areas, meet the OES Code Class, Group, and Division as shown or specified. In areas subject to flooding, provide submergence rated enclosures.

1.4 SUBMITTALS

.1 Comply with the provisions of Division 1 General Requirements, Submittals Section.

.2 Submit the following for each model instrument provided:

.1 Manufacturer's design and performance specification data and descriptive literature.

.2 Equipment dimensioning and installation requirements and recommendations.

.3 Required and optional accessories lists.

.4 Electrical/pneumatic signal and power connection diagrams.

.5 Operation and maintenance documentation for each type instrument after product approval.

.6 Calibration certifications from the manufacturer for each calibrated instrument.

.7 Calibration certifications from the manufacturer for each calibrated instrument.

.8 List of optional accessories.

.3 Submit the following for each instrument provided.

.1 Tag number and description.

.2 Complete model number.

.3 Instrument Data Sheets (ISA Standard -S20) with all fields completed.

.4 Catalog literature edited to indicate specific items provided.

.5 Mounting details for all typical installation requirements and special details for non-typical applications.

.6 Methods and materials required for installation. Include power and signal connection details.

.7 Other specific submittal information as specified in the particular instrument specification.

.4 Comply with the requirements of Division 1 General Requirements, Submittals Section for operations and maintenance documentation.

1.5 QUALITY ASSURANCE

.1 Provide instrumentation of rugged construction designed for the site conditions. Provide only new, standard, first-grade materials throughout, conforming to standards established by Underwriter's Laboratories (UL), Inc., and so marked or labeled, together with manufacturer's brand or trademark.

.2 Provide material and equipment in accordance with applicable codes and standards, except as modified by the specifications.

.3 Use single source manufacturer for each instrument type. Use the same manufacturer for different instrument types whenever possible.

.4 Coordinate instrumentation to assure proper interface and system integration. Provide signal processing equipment, to include, but not be limited to, process sensing and measurement, transducers, signal converters, conditioners, transmitters, receivers and power supplies.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Provide and securely attach the tag number and instructions for proper field handling and installation to each instrument prior to packaging.

.2 Package instrumentation to provide protection against shipping damage, dust, moisture and atmospheric contaminants.

.3 Include a shipping label which contains the following information:

.1 Tag number and description.

.2 Instructions for unloading, transporting, storing and handling at the site.

.4 Unload, transport, store and handle instrumentation at the site. Inspect instrumentation for damage in shipment and return damaged instrumentation to the manufacturer.

.5 Do not store instrumentation out-of-doors. Provide dry, clean storage facilities.

1.7 WARRANTY

.1 See the General Conditions.

1.8 CUSTOM SOFTWARE MANUALS – PREPARED BY CONTRACTOR

.1 Provide complete documentation for all software developed specifically to meet requirements of this Contract, i.e. modifications to standard software and nonstandard software.

.1 Structure the documentation such that each level develops a different degree of detail.

.2 Begin with a broad approach (Systems Manual), focus on smaller pieces of the overall system (Subsystem Documentation) and finally pinpoint the finest detail (Program Documentation).

.2 Provide a system's manual which describes the overall content of the systems software. Describe what is included in the software and not how the components function. Provide a global view of the system and a complete description of the interaction of the various software subsystems. Include the following:

PART 2 PRODUCTS

2.1 INSTRUMENT SCHEDULE

.1 Provide instrumentation as shown on the instrument list in Section 13199.

.2 The wording “as noted” used with in individual specification sections describing instruments refers to the information located in Section 13361.

2.2 MANUFACTURERS

.1 Provide the following availability and local support for proposed manufacturers if different from the manufacturers cited in the individual instrument specifications.

.1 Replacement electronics, sensors and transmitters must be stocked locally, within two hours delivery.

.2 Other hardware is to be available in no longer than 5 days.

.3 On-site technical support within 24 hours is to be available.

.2 Provide instruments from the listed manufacturers.

Spec. #	Instrument	Manufacturer
13130	Magnetic Flow Meter (Normal)	MJK Magflux series
13134	Thermal Mass Flow Meter	Kurz B series
13138	Air Flow Switch	Dwyer AVFS
13158	Float Switch	APG FS-410
13171.1	Ambient Air Temperature and Humidity Transmitter	Pribusin TWTS-X
13191	Flame Detector	MSA FlameGard 5
13200	Gas Detector	MSA Ultima X5000
13200	Gas Detection Controller	MSA Sentry io
13352	Combination Horn and Beacon	Honeywell/System Sensor P2RL
13361	Power Quality Meter	Eaton PXM 1000 series

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install instruments as shown on the furnished instrument installation.

.1 The instrument installation details furnished with the Specification are not to scale.

.2 Obtain and use instrument mounting details from the manufacturer or supplier for installation purposes.

.3 Where the instrument installation details furnished with the Specification conflict with the manufacturer's installation detail, mount the instrument in accordance with manufacturer's specifications and instructions.

.4 Install units where indicated on the Contract Drawings.

.2 Unless shown otherwise, do not mount direct reading or electrical transmitters on process piping. Mount on instrument racks or stands or in enclosures near the sensor at a level that permits viewing from floor elevation.

.3 Install the instrumentation and auxiliary devices such that they are accessible for operation and maintenance.

.1 Generally, install instrumentation to be accessible from floor level or grade.

.2 Locate indicators such that indicator display is readily readable at eye level (1500mm –1600mm) from floor elevation.

.3 Locate transmitter with adequate clearance and accessibility for service. For pipe/rack mounted instruments at least 1000 mm distance/ clearance to the wall.

.4 Allow sufficient clearance for cover removal and adjustment of switches.

.5 Provide adequate clearance (50mm minimum) from piping and other obstructions for operation of valve handles.

.6 Provide safe access to the sensor.

.4 Coordinate with Division 15 and 16 disciplines to provide power, conduits, process pipe-fittings, clearances and devices required for installation.

.5 Route signals in flexible, armored conduit for up to a meter (as appropriate to allow removal of the sensor) and thereafter in rigid steel conduit.

.6 Support sensor heads and electronic enclosures with a separate support bracket where the:

.1 Process pipe or tank is not adequate to support the additional weight.

.2 Process pipe or tank vibrates excessively (beyond manufacturer's recommendation).

.3 Instrument head extends more than 200mm from the pipe or tank wall.

.7 Where vibration of the process piping is excessive (beyond manufacturer's recommendation), connect instruments using flexible tubing.

.8 Wall mounted supports are preferred over free-standing stands.

.9 Attach a stainless-steel tag with engraved letters to each primary element, transmitter, and readout. Include the following information:

.1 Tag number.

.2 Description.

.3 Include manufacturer name and model number if not discernible on the instrument.

3.2 ELECTRICAL SUPPLY

.1 Power supply to 120 VAC instruments is to be from the RPU Control Panel specific to the loop requirement.

.2 Provide individual breakers for power distribution to 120 VAC instruments or power supplies.

.3 Provide a separate (independent) circuit on a power distribution panel board to power each analyzer.

.4 Provide a local power on/off switch for each 120 VAC powered instrument.

3.3 FIELD QUALITY CONTROL

.1 Provide instrument manufacturer's services for installation assistance, field calibration, startup and training as specified in the individual instrument Sections.

.2 Remove shipping stickers, paint splatters, dirt, grease and other contaminants to restore the instrumentation to a clean and like new condition prior to final acceptance.

3.4 CONFIGURATION, VERIFICATION, SIMULATION, AND CALIBRATION

.1 After the instrument is fully installed, (including mounting, process connections, signal connections and power connections) and after powering up the instrument.

- Verify the configuration of the instrument by checking the Calibration Ranges, units of measurement, Output Signal types, alarm signals settings, medium type and all other parameters in the configuration.

- Be sure that all parameters have been configured as design or contract documents.

- Document configuration parameters for future use.

- If the instrument has the ability of simulation, simulate the instrument for the calibration ranges by coordinating with process.

- Verify the readings on SCADA or PLC.

- If reading is not correct, the problem should be found before putting this device in operation.

.2 After the instrument has been configured correctly, perform preventative maintenance tasks and calibrate the instrument if calibration is possible.

.3 Calibrate measurements over the range of the instrument including zero, full range and three intermediate points. Repeat 2 times for increasing and decreasing test points. For differential pressure (Level and Flow), repeat test 2 times at 0-100% calibrated range for increasing and decreasing test points.

.4 Demonstrate alarms by varying process conditions. Pay attention to the type of alarms, rising or falling and also dead-band. The alarms should be tested for the type of alarms. For example if the alarm is rising type, the test should be done by increasing the process test value to the set point. Repeat 3 times.

.5 Prepare instrumentation installation and calibration certification sheet for each primary element sensor and electronic indicator/analyzer/transmitter for each instrument uniquely specified.

.6 For each certification sheet, include the following information:

.1 Project name.

.2 For each certification sheet, include the following information.

.3 Manufacturer.

.4 Model and serial number.

.5 Date, time and person who performed calibration.

.6 Calibration data to include:

a. Input, output, and error at 0, 25, 50, 75, and 100 percent of span for analog instruments.

b. Switch setting, contact action, and deadband, if applicable, for discrete elements.

.7 Space for comments.

.8 Certification by installer and acknowledgment by contractor and date.

3.5 TESTING

.1 Comply with the requirements of PCS Implementation Guidelines Appendix N (Appendix C) - Instrument and Equipment Testing.

3.6 TRAINING

.1 Provide comprehensive training session by manufacturer's representative for each instrument type to operating and maintenance personnel.

.2 Provide separate single training sessions for operations and maintenance.

END OF SECTION

TORONTO

SECTION 13130

MAGNETIC FLOW METER

TABLE OF CONTENTS

PART 1 GENERAL

.1 See Section 13105 General Instrumentation Standard for general requirements.

PART 2 PRODUCT SPECIFICATION

2.1 NORMAL MAGNETIC FLOW METER

.1 Service

.1	Tag Number	FHS-ELS-FIT-0101
.2	Process Fluid	Potable Water
.3	Process Temperature	0…40 deg. C.
.4	Process Pressure	0…150 psi

.2 Performance

.1	Nominal Flow	25 m3/h
.2	Accuracy	± 0.25% of rate
.3	Turn Down Ratio	50:1

.3 Flow Tube

.1	Type	Pulsed DC magnetic field (or AC), process specific.
.2	Line Size	75 NPS
.3	Body Material	Carbon Steel
.4	Flange	ANSI 16.5
.5	End Conn.:	As noted
.6	Liner Material	Hard Rubber
.7	Electrode	14571 / AISI 316 TI
.8	Grounding	Yes, Grounding Ring DN80, 75 NPS
.9	U.S. Cleaning	No
.10	Empty Pip Detect	Yes
.11	Housing	IP 68, NEMA 6P –Provide potting gel
.12	Flow	Reverse flow detection as required.

	.13	Conductivity	5 micros/cm minimum
	.14	Minimum Flow	0.2 m/s minimum
	.15	Automatic Zero Stability	Yes

.4 Transmitter

	.1	Enclosure	IP67 NEMA 6
	.2	Mounting	Compact
	.3	Converter	120VAC, 60Hz
	.4	Display	Yes
	.5	External Communication	No
	.6	Sensor Cable	To suit the application
	.7	Analog Output	4-20mA DC isolated into 600 ohms
	.8	Pulse Output	1 Pulse / Cubic Meter
	.9	Relay Output	One SPDT, 5A rated at 120VAC (instrument fault)
	.10	Indication	Local LCD, Eng units, 3-1/2 digits, (½" minimum height)
	.11	Options	LCD indication of both flow & totalized flow
	.12	Communication	Modbus RTU or other approved by City of Toronto

.5 Electrical

	.1	Approval	CSA
	.2	Class/Div/Group	As noted

.6 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section 13105 General Instrumentation Standard for general execution requirements.

3.2 INSTALLATION

.1 Install with specified secondary element (Not necessarily applicable).

.2 Install meters downstream from pumps.

.3 Never install a meter where gas can collect or a line can self-drain when flow stops.

.4 Install meters where the pipe remains full at all times.

.5 Install meters in vertical pipes where flow is upward.

.6 Install a by-pass line and three shutoff valves for critical process units so the meter can be removed without process line shutdown. Provide flushing and draining connections.

.7 Install the transmitter remotely from the primary element where the primary element is in a location where a submergence hazard exists, or on a vertical pipe, or on a pipe with high vibration or where the pipe is150mm (6 inches) or more in diameter.

.8 Ground the meter in accordance with manufacturer's instructions.

.9 Install meters with at least five pipe diameter straight line upstream and two pipe diameter straight line downstream.

.10 Install separate conduits for signal and power wiring to the meter and between the transmitter and control panel.

.11 Install meters upstream from control valves.

END OF SECTION

TORONTO

SECTION 13134

THERMAL MASS FLOW METER

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 General Instrumentation Standard for general requirements.

1.2 SUPPORTING CALCULATIONS

.1 Furnish supporting calculations for insertion/body length (from tip of probe to process connection) based upon pipe size and sensor mounting requirements.

.2 Note the insertion length on an application specific installation detail prepared and submitted for each unit.

PART 2 PRODUCT SPECIFICATION

2.1 THERMAL MASS FLOW METER

.1 Service

.1	Tag Number	FHA-ELS-FIT-0102
.2	Fluid	Natural Gas
.3	Operating Pressure	3.5” – 7” WC
.4	Operating Temperature	0-50 deg.C

.2 Performance

.1	Flow Range	0- 4MM BTU, 10-12” WC
.2	Accuracy	±1% of rate

.3 Sensor:

.1	Type	Insertion mass flow sensor
.2	Material	C-276 alloy
.3	Length	As required
.4	Compensation	Integral temperature/pressure
.5	Cable	N/A
.6	Mounting	In accordance with manufacturers recommendations
.7	Fitting	75 NPS
.8	Enclosure	NEMA 4X

	.9	Indication	Flow indication local to sensor
.4	Transmitter		
	.1	Output	4-20mA DC isolated into 600 ohms
	.2	Power Supply	120VAC, 60Hz
	.3	Enclosure	NEMA 4X
	.4	Indication	Local LCD indication of flow, totalized flow in Engineering Units. Integral Display.
	.5	Calibration Range	As noted
.5	Electrical		
	.1	Approval	CSA
	.2	Class/Div/Group	As-noted

.6 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section Execution at 13105 General Instrumentation Standard for general execution requirements.

.2 Provide on-site field calibration and training program by Manufacturer's Service Technician.

END OF SECTION

TORONTO

SECTION 13138

AIR FLOW SWITCH

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general requirements.

PART 2 PRODUCT

2.1 AIR FLOW SWITCH

.1 Service:

.1	Tag Number:	FHA-ACC-FSH-6822
.2	Fluid:	Ambient air
.3	Temperature min/max:	-10°C to 50°C
.4	Relative Humidity:	0 to 90% RH

.2 Performance:

.1	Flow Range:	0 to 10 m/s
.2	Response Time:	3 seconds

.3 Sensor:

.1	Type:	Thermo-anemometer
.2	Wetted Material:	PBT body, titanium sensor
.3	Housing	PBT
.4	Cable Length:	Suited to fit
.5	Mounting:	In accordance with manufacturers recommendations
.6	Local Junction Box:	N/A
.7	I.S. Relay	N/A

.4 Switch:

.1	Switch Type:	Mercury-free Dry contact, NO
.2	Contact Form	SPDT Form C
.3	Rating:	3A continuous at 30VDC/250V AC

.5 Electrical:

.1	Power Supply:	120VAC, 60 Hz
.2	Housing	IP65
.3	Approval:	CSA
.4	Class/Div/Group:	As noted

.1 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general execution requirements.

.2 Provide termination panel complete with terminal blocks and DIN rail for connecting the corded end of the air flow switch to 120VAC incoming power from the UPS. Mount termination panel on the wall or floor stand within 2 meters of the air flow switch.

END OF SECTION

TORONTO

SECTION 13158

FLOAT SWITCH

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general requirements.

PART 2 PRODUCT

2.1 FLOAT SWITCH

.1 Service:

.1	Tag Number:	FHA-ELS-LSH-0101
.2	Fluid:	Oil/Coolant/Water
.3	Temperature min/max:	-40°C to 60°C
.4	SG:	0.95 to 1.1

.2 Performance:

.1	Differential	40mm (1-3/8 in.)

.3 Sensor:

.1	Type:	Direct-acting float with an enclosed switch and integral cable
.2	Float Material:	Buna N
.3	Entire Assembly:	Watertight and impact-resistant
.4	Cable Length:	Suited to fit
.5	Cable Type:	Potted at float
.6	Mounting:	a) Cable-to-pipe clamp, corrosion-proof cable for 1-inch pipe b) Pipe-to-wall bracket for 1-inch pipe
.7	Local Junction Box:	N/A
.8	I.S. Relay	N/A

.4 Switch:

.1	Switch Type:	Mercury-free Dry contact, NO/NC

	.2	Contact Form	SPDT Form C
	.3	Rating:	5A continuous at 120V AC

.5 Electrical:

	.1	Approval:	CSA and Factory Mutual (FM)
	.2	Class/Div/Group:	As noted

.6 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general execution requirements.

END OF SECTION

TORONTO

SECTION 13171

AMBIENT AIR TEMPERATURE TRANSMITTER

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general requirements.

PART 2 PRODUCT SPECIFICATION

2.1 AMBIENT AIR TEMPERATURE TRANSMITTER

.1 Service:

.1	Tag Number:	FHA-ELS-TIT-0101
.2	Fluid:	Ambient Air
.3	Temperature min/max:	0°C to 40°C
.4	Pressure min/max:	Atmospheric

.2 Performance:

.1	Accuracy:	± 01°C or better
.2	Repeatability:	± 0.1 % of span
.3	Response Time:	Less than 10 seconds

.3 Sensor:

.1	Type:	PT 100 RTD

.4 Transmitter:

.1	Outputs:	4-20mADC isolated into 600 ohms
.2	Power Supply:	24VDC loop powered
.3	Enclosure:	NEMA 4 preferred, or as noted
.4	Mounting:	Single Outlet Box, Direct Wall Mounting
.5	Indication:	None
.6	Alarm Relay:	None
.7	Calibration Range:	-20 to 80°C

.5 Electrical:

.1 Approval: CSA and Factory Mutual (FM)

.2 Class/Div/Group: As noted

.6 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general execution requirements.

.2 Locate temperature transmitter about 1.5m (5ft.) above the floor in an area with good air circulation and average temperature.

.3 Do not locate temperature transmitter on an outside wall, or where the transmitter will be affected by drafts or radiant heat from the sun or any other heat source.

END OF SECTION

TORONTO

SECTION 13191

FLAME DETECTOR

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 – General Instrumentation Standard for general requirements.

PART 2 SPECIFICATION

2.1 UV FLAME DETECTOR

.1 Service:

.1	Tag Number:	FHA-ELS-FDT-0101
.2	Fluid:	Air
.3	Process Temperature:	-30 to 50°C

.2 Performance:

.1	Accuracy:	±5.0% of value

.3 Sensor:

.1	Type:	Ultra Violet Flame Detector
.2	Sensitivity:	100%
.3	Time Delay	4 seconds
.4	Field-of-View:	100 degrees @ 100ft, 90 degrees @ 210ft
.5	Input Power:	24 VDC
.6	Housing:	Stainless Steel
.7	Mounting:	Manufacturers mounting bracket
.8	Vibration:	Meets or exceeds MIL Spec 810 C Method 514.2, Curve AW

.4 Switch:

.1	Number of contacts:	Non-Latch Alarm / Non-Latch Warning Energized
.2	Alarm Output	4-20 mA Source Current, Relays, Single, Modbus
.3	Voltage:	120V AC, 60 Hz
.4	Current:	5A

.5 Electrical:

.1	Approval:	CSA
.2	Housing	Stainless Steel
.3	Cable Entry	2 x ¾" Entry
.4	Class/Div/Group:	Unclassified

.6 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section 13105 – General Instrumentation Standard for general execution requirements.

END OF SECTION

Toronto Water
Instrumentation Specification Standards
Division 13000

PCS Tag #	Device Description	Process Function	Model Number	Fluid	Measuring Unit	Device Range		Calibration Range		Installation Detail	Instrument Notes
						Min	Max	Min	Max		

TORONTO

SECTION 13199

INSTRUMENT LISTING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 This Section outlines the specific instrumentation to be incorporated into this project, and provides the required Data Sheet listing of the instrument parameters to be adhered to for these works.

PART 2 SPECIFICATION

2.1 INSTRUMENT LISTING

.1 "13199-Attachment 1-Instrument Listing-Sample Table" outlines the necessary instrumentation, identification and associated range parameters.

.2 For instruments identified in the drawings, but not included in the list, the ranges shall be finalized at the time of shop drawing review.

2.2 INSTRUMENTATION DATA SHEETS

.1 Instrumentation Data Sheets to be prepared to cover each of the instruments proposed for this project. These are based on the latest version of Instrumentation Society of America's (ISA) standards.

.2 Each instrument is listed with pertinent information recorded including:

.1 Tag number & description,

.2 Model number,

.3 Ranges,

.4 Setpoints,

.5 Materials and

.6 Special mounting details for non-typical applications.

PART 3 EXECUTION

3.1 INSTRUMENTATION LISTINGS

.1 Complete the Instrumentation listing of "13199-Attachment 1-Instrument Listing-Sample Table" or as PCS confirmed list

3.2 INSTRUMENTATION DATA SHEETS

.1 Complete the balance of the information required on these sheets as part of the Shop Drawing submission.

TORONTO

SECTION 13200

GAS DETECTOR

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 General Instrumentation Standard for general requirements.

PART 2 SPECIFICATIONS

2.1 CO GAS DETECTOR – CATALYTIC BEAD

.1 Service

.1	Tag Number	FHA-ELS-AIT-0102
.2	Fluid	CO Gas
.3	Operating Pressure	Ambient
.4	Process Temperature	-40 to 90ºC
.5	Humidity	0 to 95%, non-condensing

.2 Performance

.1	Range	0 to 100 PPM
.2	Response Time	Less than 30 seconds

.3 Sensor

.1	Type	Catalytic Bead
.2	Enclosure	NEMA 7 in general
.3	Enclosure Mounting	Surface / Conduit
.4	Material	Stainless Steel
.5	Compensation	Temperature/Pressure/Humidity
.6	Outputs	4-20mA DC isolated (600 Ohms)

.4 Electrical

.1	Approval	CSA
.2	Class/Div/Grp	Unclassified

.5 Manufacturers

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

2.2 METHANE GAS DETECTOR – INFRARED SENSOR

.1 Service

.1	Tag Number	FHA-ELS-AIT-0101
.2	Fluid	Methane Gas
.3	Operating Pressure	Ambient
.4	Process Temperature	-40 to 90 ºC
.5	Humidity	0 to 95%, non-condensing

.2 Performance

.1	Range	0 to 100% LEL
.2	Response Time	Less than 7 seconds
.3	Drift	Zero Drift < 1% per Year

.3 Sensor

.1	Type	Infrared Absorption, Point Type
.2	Enclosure	NEMA 7 in general
.3	Enclosure Mounting	Surface / Conduit
.4	Material	Copper Free Aluminum
.5	Compensation	Temperature/Pressure/Humidity
.6	Optics	Optical Integrity > 70% Blockage
.7	Outputs	4-20mA isolated (600 Ohms)
.8	Configuration	Dual Conduit Bottom Entry
.9	Fittings	Dust/Splash Guards c/w Test Port for One Man Non Intrusive Calibration
.10	Options	Must be capable of alarming on 100% gas flooding.

.4 Electrical

.1	Approval	CSA

	.2	Class/Div/Grp	As noted

.5 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

2.3 CONTROLLER

.1 Service

.1	Tag Number	FHA-ELS-CT-0101
.2	Fluid	Methane gas, CO gas
.3	Ambient Temperature	0 to 40ºC
.4	Ambient Humidity	0-99% RH, non-condensing

.2 General

.1	Display	Minimum 7” touchscreen LCD
.2	Functional Indicators	Normal, Alarm, Fault
.3	Mounting	Wall mount
.4	Enclosure	NEMA 4X
.5	Power Supply	120 VAC, 50-60 Hz
.6	Reset/Ack	Local reset and silence
.7	Alarms	Three adjustable alarms from 5-100% of span
.8	Number of modules	Include optional IO modules
.9	Digital Inputs	Minimum 6 discrete dry contact
.10	Relay Output	Minimum 6 relay outputs, configurable
		Dry contact, 2A configurable for latching/non-latching, time delay and horn activation.
		Relay Output Dry contact, 2A configurable for latching/non-latching, time delay and horn activation.
		Provide Normally Open (N.O) contact outputs to be wired to the Mechanical Control Panel FHA-ELS-CP-0101:

			Contact 1: Configure output as common alarm for Methane Hi-Hi (25% LEL) and Methane General Alarm Contact 2: Configure output as common alarm for CO Hi-Hi (80 PPM) and CO General Alarm Contact 3: Configure output as common alarm for Flame Detector Instantaneous alarm and Flame Detector Sustained Alarm Provide Normally Open (N.O) contact outputs to be wired to the existing RPU Panel FHA-SPC-RPU-2022: Contact 4: Methane gas general alarm Contact 5: Methane gas Hi alarm (20% LEL) Contact 6: Methane gas Hi-Hi alarm (25% LEL) Contact 7: CO gas general alarm Contact 8: CO gas Hi alarm (50 PPM) Contact 9: CO gas Hi-Hi alarm (80 PPM) Contact 10: Flame detector general alarm Contact 11: Flame detector Instantaneous alarm Contact 12: Flame detector Sustained alarm Provide Normally Open (N.O) contact output to be wired to the combination horn/beacon: Contact 13: Horn/beacon
	.11	Analog Inputs	Minimum 6, 4-20mA
	.12	Analog Outputs	Minimum 6, 4-20mA, 2 wire Provide Analog Output to be wired to the existing RPU Panel FHA-SPC-RPU-2022: Output 1: Methane gas indication (0-100% LEL) Output 2: CO gas indication (0-100 PPM)
	.13	Reset	Local manual
.3	System Enclosure		

.1	Mounting	Wall
.2	Enclosure	NEMA 4X or as noted

.4 Electrical

.1	Approval	CSA
.2	Class/Div/Group	Unclassified

.5 Manufacturers

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

2.4 CALIBRATION KIT

.1 Components

.1	Gases	Span and zero gases
.2	Pressure and flow regular	Provide
.3	Carrying case	Molded plastic

.2 Quantity — Two for each type of range of sensor

PART 3 EXECUTION

3.1 GENERAL

.1 See Section 13105 General Instrumentation Standard for general execution requirements.

END OF SECTION

TORONTO

SECTION 13300

CONTROL PANEL DESIGN

TABLE OF CONTENTS

PART 1 STANDARD ADMINISTRATION

1.1 STANDARD REQUIREMENT

.1 This standard is to be followed by all designers. The design guidelines expressed in this document are to be understood together with the standard panel installation drawings and standard specifications.

.2 Guidance given in this document sets out preferences of the Water and Wastewater Section for panel construction and installation. It is intended for use by skilled and experienced designers. It is not intended as a comprehensive primer on panels. **The designer is responsible for producing a complete design, fully in compliance with regulatory and industry standards.**

.3 Direction is given in terms of principles and objectives rather than specific definitions. The intent is to provide guidance, but not to provide completed designs. The designers are responsible for using these guidance for making specification.

.4 The intended use of the document is mainly in design of new panels and panel upgrades. It can also be used to develop recommendations during field verification; however, this document does not provide direction on when to replace a panel. The decision to replace an existing panel depends on the specific costs and benefits of each instance.

.5 The document is directed to designers.

.6 Section "2-Control Panels" cited in this document include the standard number for cross-referencing to the specification.

.7 The specifications for panel components are split into several sections in order to use for panels to be upgraded as well as new panels.

1.2 COORDINATION WITH ELECTRICAL DESIGN

.1 Coordinate power feeds to control panels.

.2 Coordinate UPS location. In some cases, the UPS could be located inside the power panel. In other cases, the UPS could be located inside or near the control panel.

1.3 PANEL SPECIFICATIONS

.1 When preparing tender documents, verify the manufacturers and models cited in the standard panel and related specifications as still available.

.2 If the model or manufacturer is no longer available, make a recommendation to the PCS Standards Team on a suitable replacement.

.3 Develop specifications for package panels (i.e. panels packaged with process equipment such as compressors, waste gas burners, boilers, centrifuges, large blowers and polymer preparation systems).

PART 2 CONTROL PANELS

2.1 13310 – PANEL CONSTRUCTION

.1 Specify the EEMAC/NEMA type according to the area classification

.2 Select standard panels that are large enough to contain all required equipment, with 25% additional space for expansion.

.3 Panel design to include internal and external layout.

.4 Status lights to be arranged above corresponding pushbuttons or selector switches.

.5 Digital and analog indicators to be arranged above corresponding controls.

.6 Door handles are to be 3 point lockable.

.7 Design panels following the requirements of Section 13310.

.8 Provide 15 Amp 208/120 VAC supply to the panel. One 120 VAC supply feeds instruments via a fused terminal block.

.9 Define labels that are to be affixed to equipment locations including terminal blocks, wiring, face-of-panel mounted instruments, panel interiors for each device mounted on the panel exterior and interior, pumps, control valves, field instruments and field transmitters.

.10 Follow ISA-RP60.6-1984, Recommended Practice for Nameplates, Labels and Tags for Control Centres.

2.2 13311 – ENCLOSURES

.1 Select enclosure to provide 25% spare capacity.

.2 Define the enclosure material. In general, steel panels are preferred, but fibreglass and stainless steel can be used as required.

2.3 13312 – ENCLOSURE ACCESSORIES

.1 Identify panel service conditions if different than defaults. The default indoor conditions are: temperature from 0 to +50°C and humidity of 95% RH, non-condensing. The default outdoor condition temperature is from -30°C to+ 50°C.

.2 Define in a schedule or on the panel drawing any required accessories.

2.4 13320 – PANEL WIRING

.1 Design wiring in accordance with provisions of Section 13320.

.2 Show one general alarm status light on each RPU panel.

2.5 13340 – PANEL SERVICE

.1 Show output over voltage and over current protective devices that protect instruments from damage due to power supply failure.

2.6 13350 – SELECTOR SWITCHES, PUSH-BUTTONS AND INDICATING LIGHTS

.1 Follow the PCS Implementation Guidelines - Color Convention

.2 Use key switches only where requested by Owner.

.3 Use mushroom head push buttons for emergency stop and safety related functions.

END OF SECTION

TORONTO

SECTION 13305

FIELD WIRING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 FIELD WIRING

.1 Field Wiring is the wiring that connects the field equipment (instruments, control stations, control panels, MCC) to the Main Process Control Unit. Use only CSA approved labels for cables and conductors.

.2 Provide field cables as per Division 16 – Electrical ("16122 Wires and Cables").

PART 2 PRODUCTS

2.1 ANALOG SIGNALS

.1 **Definition:** Analog signals are 4-20 mA inputs received from field instruments.

.2 **Single Pair Cable**: For individual instrument circuits use single-pair, two inch lay, twisted, foil 100% shielded with drain wire, #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600 volts.

.3 **Multi-Pair Cables:** For multiple instrument circuits, use multi-pair cables made up of individual single pair, two inch lay, twisted, foil 100% shielded with suitable drain wire, #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600 volts.

.4 **Shields:** Signal shields should have one ground point located at the power source unless otherwise recommended by the instrument/equipment manufacturer. Shields should be continuous through cabinets, panels and junction boxes.

2.2 DC DIGITAL SIGNALS

.1 **Definition:** DC digital signals are at 24VDC originating from contact inputs.

.2 **Single Pair Cable:** For individual contact closure circuits use single pair, two inch lay, twisted #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600V with RW90 insulation with PVC jacket.

.3 **Multi-pair Cable:** For multiple contact closure circuits use multi-pair cables made up of individual single pair two inch lay, twisted, #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600V with RW90 insulation with PVC jacket.

2.3 AC DIGITAL SIGNALS

.1 **Definition:** AC digital signals are 120VAC and less than 15 amperes, and received from contact outputs used for controlling 120V devices such as motor starters, push-buttons, pilot lights, and the like.

.2 **Single Conductor:** For single circuit use single conductor #14 AWG, 19 strand copper conductor at 600V with RW90 insulation with PVC jacket.

.3 **Multi-Conductor:** For multiple circuits use multiple conductor #14 AWG, 19 strand copper conductor at 600V with RW90 insulation with PVC jacket.

PART 3 INSTALLATION

3.1 GENERAL

.1 Avoid running cables inside or under power cable trays. Where field wiring is in power cable trays, insulation must be equal to or greater than the highest voltage in the cable tray.

.2 Where power or signal cables must cross, make them cross at an angle of 90 degrees.

.3 Communication cables will not be mixed with power or signal cables.

3.2 SIGNAL SEPARATION

.1 **Analog and 24VDC Discrete Signals:** Analog 4-20mA signals and 24VDC discrete signals should normally be in separate conduits. An exception to this standard may be made in cases where it would cause parallel conduit runs to the same device and combining signals would eliminate one conduit. In cases where the exception is used, both the analog and discrete signals should be twisted shielded pairs as described for analog signals previously. This exception will be limited to 3 meters only.

.2 **AC Digital and Control:** AC digital signals and AC control wiring may occupy the same conduit but all instrument power circuits should be isolated by a separate conduit from all AC digital and control circuits.

.3 All conduits for signal cables shall be rigid metallic conduit unless indicated otherwise with the last meter flexible connecting to the field instrument with condensation loop.

3.3 MISCELLANEOUS

.1 Spare Conductors:

.1 Spare conductors in each conduit should be equal or more than 15% of the both present and (defined) future conditions of conductors, but in no case less than two spare wires or one pair should be installed.

.2 Each cable should have 10% spare conductors but not less than two conductors.

.3 Spare conductors should be terminated on a marked terminal strip or connector pin at each end.

.2 Termination:

.1 Wire at both ends of the cable should be terminated with pre-insulated solderless spade or ring lugs for maximum physical strength and electrical conduction.

.2 Wires should not be terminated on adjacent terminal points if accidental short-circuiting could cause tripping or closing of a breaker.

.3 Colour Coding:

.1 Cables or conductors may require colour coding to suit process requirement.

3.4 CABLE IDENTIFICATION

.1 Cable numbers

.1 For Cable Tagging and identification refer to Electrical Standard "16122-Wires and Cables" latest revision

.2 A Cable schedule will be provided showing Cable I.D., Cable Type, Origin, and Destination.

.3 Cable tags should be both end of cable plus inside and outside of Panels.

.2 Cable Markers

.1 For Cable Markers refer to Electrical Standard "16122-Wires and Cables" latest revision.

3.5 WIRING IDENTIFICATION

.1 General

.1 All terminal and wire identification shall be determined from the control schematic diagram.

.2 Tag field wires with the field device tag information:

a. For devices connected to control panels, RPUs, MCCs, junction boxes, etc show field source information and control schematic ladder diagram rung number.

b. Label wires at both ends with the same information.

.3 Note: If a control schematic is not available and/or the diagram rung numbers are not clear, use the terminal numbers as the source or/and destination identifiers and contact PCS for final decision on wiring identification.

.2 Tagging and Labelling

.1 Field source information consists of the following:

a. The process/sub-process code (up to 3 characters),

b. the device code (up to 4 characters) and

c. loop number (up to five characters) as per 13040 Equipment and Data Tagging Standard,

d. Note that the process/sub-process code could be dropped for the facilities where no more than one process exists such as:

(a) Water Supply-Main Transmission System,

(b) WPC Collection System,

(c) Storm Water Management, etc.

.2 Use field source information first, rung number second and consecutive alpha characters (A, B, C,…) for individual wires on the same rung. For example: **FLT-V-0201-15** that **FLT-V-0201** is the field source equipment and **15** is the rung number.

.3 Wire identifiers should not change unless they go through an instrument, switch, light, or other physical devices in the panel. Wires passing through a junction box without a change in function would retain the same wire identifier.

.4 Include hyphens and leading zeroes in the field source and rung information.

.5 Generally, keep the wire tag to 18 characters or less. For longer tags, use smaller font.

.6 Identify power supply wire coming from RPU power distribution panel (Not I/O Cards) to instruments and devices by fuse L-FUxx or circuit breaker L-CBxx identifier for AC power and as DC-FUxx or DC-CBxx for DC power where xx represent fuse number. Refer to Table 1.1 for various examples:

Devices and Instruments Power Fuse **FU** or Circuit Breaker **CB** Tag	Voltage	Wire Tag
FU01	AC	L-FU01
FU101	DC	DC-FU101
CB05	AC	L-CB05
CB201	DC	DC-CB201

Table 1

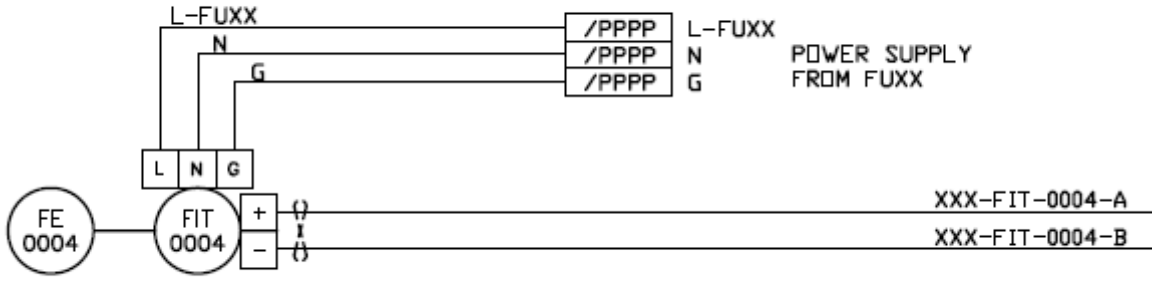


Figure 1- Power Supply to Instrument (L-FUxx)

.7 Use fuse identifier for power supply wire coming from I/O modules of RPU panel to the instrumentation and equipment as:

a. Lx-yy-zz for AC power and

b. DCx-yy-zz for DC power

c. where:

(a) x is rack number,

(b) yy is slot number and

(c) zz is fuse number related to that DI module.

d. Refer to Table 2 for different examples:

IO Module Rack/Slot/Point	Voltage	Fuse **FU** or Circuit Breaker **CB** Tag	Wire Tag	IO Signal Power Supply Wire Tag
0/9/1	AC	FU0-09	L0-09	L0-09-01
1/2/14	DC	CB1-02	DC1-02	DC1-02-14
2/11/5	DC	FU2-11	DC2-11	DC2-11-05

Table 2

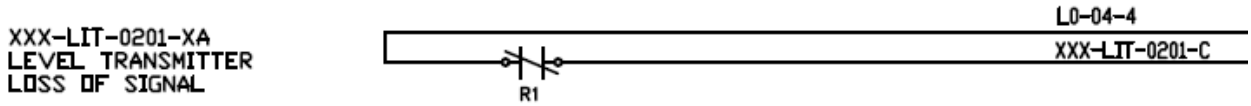


Figure 2- Power Supply to Instrument from Digital Inputs (L0-04-4)

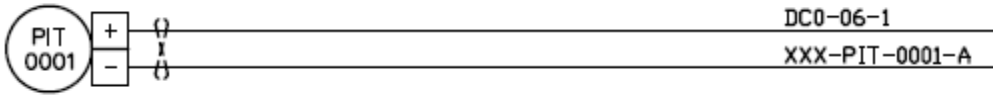


Figure 3- Power Supply to Instrument from Analog Inputs (DC0-06-1)

.3 Wire identification examples:

.1 **Example 1**: Wire identifiers FLT-V-3302-06 and FLT-V-3302-06A -Filter No.33 backwash valve

a. FLT -Filtering, process/sub-process code

b. V -Valve, device code

c. 3302 -Loop number

d. 06 -Control schematic rung (first rung on the control schematic where wire is shown)

e. 06A -Wire on the same rung as previous but function changed (the other side of the open/stop/close switch)

.2 **Example 2**: Wire identifier XXX-FIT-0004-A –Flow Meter

a. XXX -process/sub-process code

b. FIT -Flow transmitter, device code

c. 0004 -Loop number

d. A -First wire in the instrument loop

e. B -Second Wire in the instrument loop

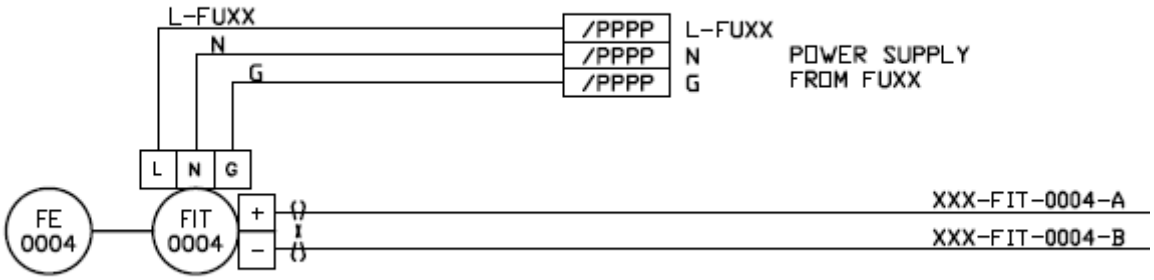


Figure 3- Wire Identifier-Instruments to Analog Input

.4 **RPU Internal Wiring:** Use rack, slot, point/terminal to identify internal RPU panel wiring for I/O modules. Follow "xyyzz" format where: x is rack number, yy is slot number and zz is point/terminal number.

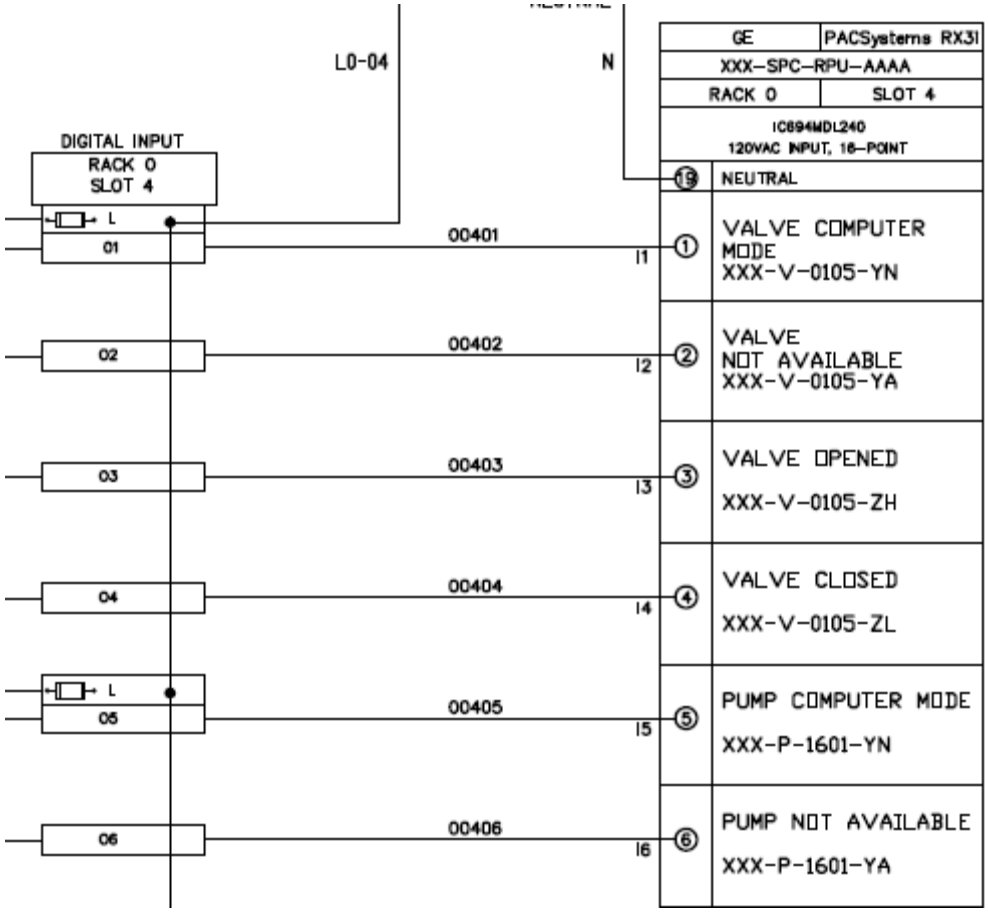


Figure 4 – RPU Internal wiring (00401)

.5 **RPU Module Power Supply:** Use rack, slot to identify RPU modules power supply wires. Follow the format Lx-yy for AC and DCx-yy for DC and analog modules, where x is rack number and yy is slot (module) number. Refer to Table 1 for various examples:

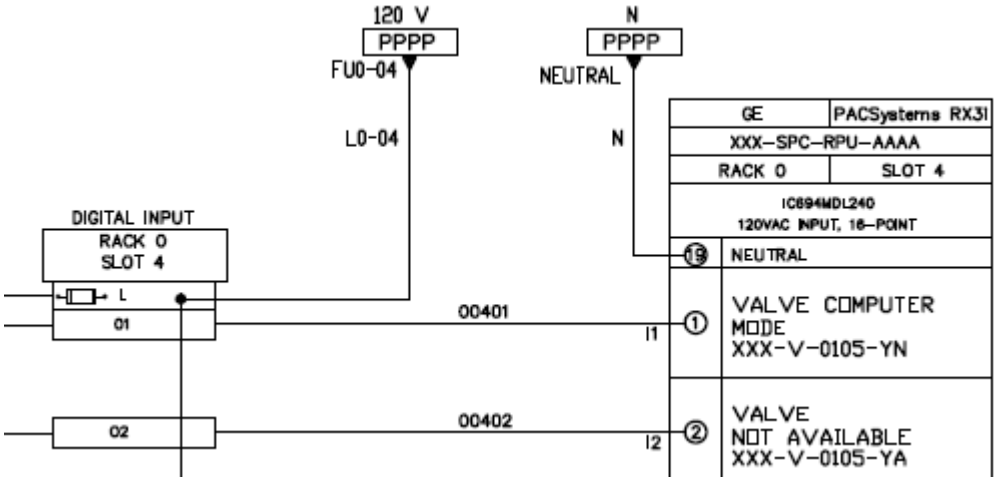


Figure 5 – RPU Module Power Supply (L0-04)

.6 Wire Markers

.1 All instrumentation and control wiring is to be identified with markers as specified. The identification is to consist of the coding as detailed on the drawings and as specified herein.

.2 All control panel and field wire markers are to be white with indelible black laser or Dot Matrix printing, not handwriting.

.3 Markers must be resistant to smearing or smudging in the presence of water, grease, or fuel residue.

.4 Maintain phase sequence and colour coding throughout.

.5 Colour code to applicable CSA standard:

a. Phase A - Red

b. Phase B - Black

c. Phase C - Blue

d. Neutral - White Only.

.6 Use colour codes wires in communication cables, matched throughout system.

.7 Generally, keep the wire tag to 18 characters or less. For longer tags, use smaller font.

.8 For field wiring, wire markers must be of sufficient width to accommodate the full wire tag name on one line of text as per the Standards.

.9 Wire markers available from Brady amongst others allow more than one line of characters if required but only one line should be used. Two lines is not acceptable.

.10 Wire markers should be PermaSleeve heat shrink, or approved equivalent.

.11 Wire markers should be kept to a minimum for ease of installation and readability. A single line of text should be used, minimizing the characters as much as possible.

.12 Wire markers to be oriented in panels and at terminal blocks so that printing can be read clearly without the need to manipulate the wire position.

.13 Upside down wire markers are not acceptable.

.14 All wire markers are to be heat shrunk at the end of the project.

END OF SECTION

TORONTO

SECTION 13310

PANEL CONSTRUCTION

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 Comply with the requirements of Division 1 and Section "13010-Process Control General".

.2 Control panels (CP) house the control system at each of the basic levels of operator interface. Requirements apply to field panels, area control panels, PLC panels and all other panels used to house control and monitoring equipment.

.3 This section is a specification for custom-built panels. It does not cover any control panel supplied as part of packaged equipment such as a variable frequency drive.

.4 Use enclosures which conform to the requirements of the NEMA type specified or shown on panel drawings and requirements in Section "13311-Enclosures".

.5 Ensure that the panels selected are large enough to contain all required equipment, with 25% of space for expansion.

1.2 SHOP DRAWINGS

.1 Comply with the requirements of Section "01300-Submittals".

.1 Provide internal and external layout drawings as part of shop drawings showing exact dimensions of the equipment provided.

.2 The internal and external layout drawings included in the Contract Drawings are based on typical equipment and are not to be used for fabrication.

.3 The Contract Administrator may increase panel size by up to 10% during shop drawing review.

.4 Provide calculations for sizing the cooling fans, air conditioners, heaters and heat exchangers.

.5 Provide colour chart for selection of the exterior colour where other than the standard colour is specified.

.6 Provide one additional set of panels "As-Built" drawings and all RPU documents to place in the door pocket.

.7 Submit all final "As-Built" drawings and documents in native CAD, DOC, or XLS version format and in PDF.

PART 2 PRODUCTS

2.1 CONSTRUCTION

.1 Panels must carry CSA/UL label.

.2 Use enclosures that conform to the requirements of Section "13311-Enclosures".

.3 Provide 304 SS screws, bolts, fasteners, and wall spacers.

.4 Panel Knockouts and Penetrations

.1 Place knockouts for the wiring of free-standing panels either at bottom or sides of the panel. Cover holes for future devices with plugs suitable for specified NEMA classification.

.2 Watertight connections shall be provided for any penetration or knockouts placed on the panel where wire or cable entry into the panel is required.

.3 For indoor installations, any exception for top entry knockouts requires written approval from the City of Toronto.

.4 For outdoor installations and areas with high precipitation or moisture, knockouts shall be on the lower side of panels whenever possible and bottom entry as the next preferred alternative. Top entry knockouts require written approval from the City of Toronto.

.5 Cut, punch, or drill cut-outs for face-of-panel mounted instruments and smoothly finish with rounded edges.

.6 Leave the space in the bottom 500mm of the panel free of equipment for future use.

.7 Use panel fabrication techniques that allow for removal and maintenance of all equipment after installation.

.8 Install door mounted equipment flush mounted and properly sealed. Internal mounted panels to be at least 1.6 mm sheet steel, uniform size, with spare removable panels for future use.

.9 Fabricate panels, install instruments, plumb and wire in the factory. Arrange wiring and tubing terminations in the control panel to match floor (and or ceiling) openings. Test wiring and plumbing prior to shipment.

.10 For NEMA type 3R and type 4 panels, mount face-of-panel mounted devices such as indicating meters, controllers, etc. that are not weatherproof on a hinged inner door, provide a NEMA rated viewing window on the enclosure door.

.11 Locate face-of-panel mounted device higher than 0.8 m and lower than 2.0 m from the floor.

.1 Arrange status lights above corresponding pushbuttons or selector switches.

.2 Arrange digital and analog indicators above corresponding controls.

.12 Arrange back-of-panel devices in a neat and orderly fashion. Allow 20% continuous space for future additions. Use mounting plate for mounting all components.

.13 Environmental Protection

.1 See Section "13312-Enclosure Accessories" for detailed requirements.

.2 Provide internal condensation protection on all panels.

.3 Provide freezing protection with thermostat control on outdoor panels.

.4 Provide louvers, forced ventilation, or air conditioners as required to prevent temperature build-up and protect equipment, with ambient temperatures of up to 50°C. Provide louvers, forced ventilation, or air conditioners as required to limit temperature build-up to a maximum of 40°C to protect equipment.

2.2 ELECTRICAL

.1 Provide a single 208/120VAC supply circuit to the panel. Provide internal branch circuits via fused terminal blocks.

.2 Provide signal conditioning in accordance with requirements of Section "13320-Panel Wiring".

.3 Wire in accordance with requirements of Section "13320-Panel Wiring".

.1 Use numbered terminal blocks for external connections.

.2 Provide instrument loop power supplies, mounting hardware, terminal blocks, control circuit breakers, and other items required for a fully operable panel.

.3 Furnish termination panels, if required. Include terminal blocks, interface hardware, wiring, and cabling necessary for a complete operational system.

.4 See Section "13340-Panel Services" for panel service.

.5 See Sections "13350-Selector Switches Push Buttons and Status Lights" through "13369 for panel mounted instruments.

2.3 NAMEPLATES AND LABELS

.1 Follow ISA-RP60.6-1984, Recommended Practice for Nameplates, Labels and Tags for Control Centres.

.2 Furnish face-of-panel mounted nameplates to identify systems and equipment.

.1 Use engraved gravoply laminate nameplates having black letters on white background.

.2 Include device identification number as well as a descriptive name.

.3 Center lettering on each line.

.4 Use minimum 6 mm high characters.

.5 Mount nameplates with 2 stainless steel self-threading screws.

.6 Follow "13040-Equipment and Data Tagging" Standard for the panel identification nameplate (asset tag)

.7 Name plate describing contract name and number if requested to be installed inside the panel.

.3 In the panel interior, furnish surface mounted nameplates to identify each device mounted on the panel exterior and interior.

.1 Use engraved gravoply laminated nameplates with black letters on a white background.

.2 Place the tags above, but not on the device.

.3 Do not obstruct visibility by wire bundles or other equipment.

.4 Include device identification number as well as a descriptive name to match identification shown on drawings.

.5 Mount nameplates with 2 stainless steel machine screws.

.4 Label all front and internal mounted devices with the following information:

.1 Manufacturer, model, and serial number

.2 Input and output ranges

.3 Power supply limits

.4 Pressure rating if applicable

.5 Enclosure classification

PART 3 EXECUTION

3.1 INSTALLATION

.1 Where two or more enclosures are shown mounted immediately adjacent to one another, install both securely together with their front faces parallel.

.2 After setting panel in place, remove the lifting rings and fill the lifting ring holes.

END OF SECTION

TORONTO

SECTION 13311

ENCLOSURES

TABLE OF CONTENTS

PART 1 GENERAL

.1 This section covers the fabrication of panel enclosures.

.2 Panel enclosures are distinct from panel cabinet construction.

.3 See "13310-Panel Construction" for additional general requirements and panel construction requirements.

PART 2 PRODUCTS

2.1 ALL ENCLOSURES

.1 Provide enclosures which conform to the requirements of the NEMA type specified in the schedule or panel drawing.

.2 Paint steel enclosures. Prime with one coat and finish with two coats of factory finished, epoxy-based paint. Paint the panel interior white. Paint the exterior colour ANSI/ASA61 – standard gray, if not otherwise specified.

.3 Maximum height of the panel (not including plinth) is less than 1900mm.

.4 Provide each enclosure with full height, fully gasketed access doors where shown.

.1	Construction:	3.43mm (10 gauge) thickness, single piece with edges turned back and rounded for rigidity
.2	Latches:	three-point latching mechanism
.3	Hinge:	continuous piano hinge with removable stainless steel pin
.4	Gasket:	secured resistant neoprene gasket
.5	Door handle:	key lockable with recessed handles. Key locks alike

.5 Provide a 25 mm wide print pocket within each enclosure.

.6 Use 304 SS screws, bolts, fasteners and wall spacers.

.7 Manufacturers: Hammond or Rittal.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section "13310-Panel Construction" for general execution requirements.

END OF SECTION

TORONTO

SECTION 13320

PANEL WIRING

TABLE OF CONTENTS

PART 1 GENERAL

.1 See "13310-Panel Construction" for general requirements.

PART 2 PRODUCTS

2.1 INTERNAL WIRING

.1 Size and install all wire and cable in accordance with CSA, Ontario Electrical Safety Code, IEEE and other applicable electrical safety codes.

.2 Terminate all internal panel wiring to external devices at the terminal strips. Connect all field wiring to one side of the terminal strip, maintaining consistency with field wiring on the right-hand side of the terminal block or overcurrent protection device. Connect all panel wiring to the left side. Arrange terminals for external connects in consecutive order for conductors within a given cable. Any deviation requires written approval by the City of Toronto.

.3 Provide continuous wire between the power supply point and the load point without splices.

.4 Use flexible, stranded, copper TEW wiring. Run wires in continuous lengths from terminal to terminal. Do not splice wires.

.5 For analog signal wiring:

.1 use uniformly twisted shielded pairs not smaller than CSA 0.823 mm^2 (18 AWG) with a minimum of six twists per 300mm (one foot).

.2 Separate analog signal wiring at least 150mm (six inches) from power wiring.

.3 Provide continuous foil or metalized plastic shields with 100 percent coverage.

.4 Include a drain wire in continuous contact with the shield.

.5 Multiple cables must have an overall shield and individual shields for each signal cable.

.6 Use CSA= 1.3mm^2 (16 AWG) if approved under the local electrical authority or larger for control signal wiring.

.7 Use power wiring with insulation rated at 600V. Use CSA = 3.31mm^2 (12 AWG) or larger for power wiring.

.8 Segregate signal wiring from control power wiring: group functionally and arrange neatly to facilitate tracing of circuits.

.9 Use plastic wiring wraps to bundle wires, outside of wiring ducts. Securely fasten the bundles to the steel structure at intervals not exceeding 300mm (12 inches). Each bundle contains 30 conductors maximum. Use Panduit, or equal wiring ducts and size to provide a minimum of 20 percent spare space not less than 5 per terminal block.

.10 Do not intermix signals within the same bundle or duct.

.11 Use twisted unshielded wire for other DC signals and segregate from wire conducting AC signals.

.12 Colour code wiring as follows:

.1 Colour coding for D/C controls and Intrinsically Safe wiring are to conform to the City Standard.

a.	Line and load circuits AC or DC power	Black
b.	AC control circuits	Red
c.	DC control circuits	Blue
d.	Interlock control circuits on the panel energized from external source	Yellow
e.	DC signal grounding conductors	Green/White Stripes
f.	Equipment grounding conductors	Green
g.	Current carrying grounded conductor (neutral)	White
h.	Intrinsically safe	

.13 Use PVC crimped sleeve type wire tag identifications with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

.14 In RPU panels, wire each I/O module to a separate termination block strip. Rack and Slot information should be on a separate tag at the top of the respective terminal block strip.

.15 Identify wires with markers by rack, slot, point/terminal in "**xyyzz**" format where:

.1 **x** is rack number, **yy** is slot number and **zz** is point/terminal number. Label wires on both ends.

.16 Identify RPU modules 120VAC power supply wires as **Lx-yy** where:

.1 **x** is rack number and **yy** is slot (module) number. Label wires on both ends.

.17 Identify RPU modules 24VDC power supply wires as **DCx-yy** where:

.1 **x** is rack number and **yy** is slot (module) number. Label wires on both ends.

.18 Minimum spacing between 2 rows of terminal blocks shall be 80mm (3” inches).

2.2 TERMINAL BLOCKS

.1 Provide DIN style high density, rail mount type terminal blocks.

.2 Provide mounting rails as required with one end stop at each end of rail.

.3 Space terminal block strips no closer than 150mm center to center.

.4 Provide a continuous marking strip with the terminals.

.5 Provide a separate terminal for terminating each shield wire.

.6 Provide terminal block barriers to separate 24VDC instrument loops, 120VAC power, 120VAC control wiring, 24VDC control wiring and grounding.

.7 Reserve one side of each terminal strip for field incoming conductors. Do not make common connections and jumpers required for internal wiring on the field side of the terminal. Terminate no more than one wire at any one terminal except where jumper wires are needed for internal wiring in which case two wires may be connected.

.8 Provide a minimum of 25 percent spare terminals on each rail, minimum 4 spares per rail.

.9 Provide 208/120VAC cover plate for power terminals.

.10 Provide jumper bars to connect common wires and terminals. All common terminals to have the same number.

.11 For each instrument or piece of equipment, group all field wiring together at the terminal strip. Provide a common group marker for each set.

.12 Provide fused terminal blocks for 120VAC power feed to field instruments. Label the fuse voltage and amperage rating on top of the terminal block.

.13 Provide fused terminal block for each instrument or piece of equipment, requiring 120VAC power supply from RPU panel for DIs (digital inputs). Label the fuse voltage and amperage rating on top of the terminal block.

.14 Manufacturers: Allen -Bradley, Entrelec, Phoenix, Wieland, Weidmuller.

2.3 GROUNDING

.1 Provide two (2) ground buses in each cabinet or panel, one for shield and cabinet grounding and one for signal grounding.

.2 Provide grounding lugs for connection to the external grounding system.

.3 Provide CSA 13.3mm2 (AWG 6) size stranded copper grounding for DC signals.

.4 Connect the ground buses with a removable cross connector located near the panel ground

2.4 SIGNALS AND INTERFACES

.1 Analog signals are 4 to 20mADC and conform to the compatibility requirements of ISA Standard 50.1. Provide the signal conversion necessary for compatibility with panel mounted instruments and the interface to the digital controllers.

.2 Provide interposing relays, if required, for retransmission of isolated discrete (digital) signals to digital controllers. Relays shall be 6A, 120VAC, SPDT or DPDT, pin-base, plug-in style with neon indicator.

.3 Supply and install timers as shown on drawings. Timers to be DPDT with 5A and 120VAC unless otherwise noted. Timers shall be Omron H3BA type or equal.

.4 Furnish, mount, and wire control components such as relays, timers, and other equipment to provide the interfacing and interlocking between the motor starters and associated protective circuits, or other type of control circuit function applicable to a particular final control element. Use sealed and plug-in type components.

.5 The Drawings show the interface for equipment. The Drawings are typical for the equipment expected to be furnished and are provided to show the intended control functions and interfaces. Provide intended panel functional interfaces.

END OF SECTION

TORONTO

SECTION 13340

PANEL SERVICES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See "13310-Panel Construction" for general requirements.

PART 2 PRODUCTS

2.1 PANEL SERVICE

.1 Provide for feeder circuit conduit entry and provide a terminal board for termination of the wires.

.2 Provide a master circuit breaker and branch circuit breakers on each individual circuit distributed from the power panel. Group the circuit breakers on a single subpanel. Place subpanel so that there is a clear view of and access to the breakers when the door is open. Use branch circuit breakers rated as required. Coordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker.

.3 Place no more than 5 devices on any single circuit, as required. Avoid common mode power loss. Subject to project review.

.4 Where multiple units perform parallel operations, do not group all devices on the same branch circuit. This will prevent failure of any single branch circuit from shutting down the entire operation.

.5 Do not exceed 12 amperes continuous on the branch circuit.

.6 Protect power supply from damage due to external failure.

.7 Provide output over voltage and over current protective devices to protect instruments from damage due to power supply failure.

2.2 FUSE

.1 For Analog inputs, provide DIN-style fuse without LED failure indicator, Entrelac or Phoenix, Weidmuller.

2.3 CIRCUIT BREAKER

.1 See Division 16

2.4 TERMINAL BOARD

.1 See Division 16

2.5 OVER-VOLTAGE AND OVER-CURRENT PROTECTIVE DEVICES

.1 See Division 16

PART 3 EXECUTION

3.1 GENERAL

.1 Install output fused terminal blocks, mounted alongside terminal blocks.

.2 Mount fuses to be easily seen and replaced.

.3 Provide 120VAC plug mold for panel components with line cords.

.4 See "13310-Panel Construction" for general execution requirements.

END OF SECTION

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SECTION 13352

COMBINATION HORN AND BEACON

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general requirements.

PART 2 SPECIFICATIONS

2.1 COMBINATION HORN AND BEACON

.1 Service:

.1	Tag Number:	FHA-ELS-LTG-0101
.2	Service:	Methane, CO, and flame detection
.3	Operating Temperature:	0°C to 49°C
.4	Humidity:	10 to 93% non-condensing
.5	Mounting:	Wall mount
.6	Power Supply:	24VDC

.2 Strobe:

.1	Type:	Xenon flash tube
.2	Candela:	Field selectable 15 to 185 CD
.3	Flash rate:	1 Hz over entire operating voltage

.3 Horn:

.1	Volume:	88+ dBA at 16 volts, 2 settings
.2	Tone:	Adjustable

.4 Electrical:

.1	Approval:	CSA, UL1972, UL464
.2	Enclosure:	Indoor rated
.3	Class/Div/Group:	As noted

.5 Manufacturers:

.1 See Section 13105 – General Instrumentation Requirements for approved manufacturers.

PART 3 EXECUTION

3.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general execution requirements.

END OF SECTION

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SECTION 13361

POWER QUALITY METER

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 See Section 13105 – General Instrumentation Requirements for general requirements.

PART 2 SPECIFICATIONS

2.1 POWER QUALITY METER

.1 Service:

.1	Tag Number:	FHA-ELS-JIT-0300E, FHA-ELS-JIT-0400E
.2	Service:	As noted
.3	Temperature min/max:	-0°C to 50°C
.4	Humidity:	0-95% RH non-condensing

.2 Performance:

.1	Current:	±0.2% of full scale
.2	Voltage:	±0.2% of full scale
.3	kW, kvar, kVA, kWh, kvarh, kVAh:	±0.4% of full scale
.4	Power Factor:	±1% of full scale
.5	Frequency:	±0.02% Hz

.3 Functions:

.1	Programmable Functions:	Through the local keypad and display or remotely
		Configure analog output
		Configure output relays
.2	Data Monitor and Display Functions:	Power quality
		Voltage harmonics 2nd to 63rd and THD
		Current harmonics 2nd to 63rd and THD
		Voltage crest factor
		Telephone Interference Factor (TIF)
		Current K factor
		Voltage unbalance factor U_unbl
		Current unbalance factor I_unbl

			Max./min. statistics with time stamps
	.3	Power Analysis:	Data logging, time of use, waveform capture, power quality event logging, automatic frequency adaptation
.4	Monitor Unit:		
	.1	Input/Output Modules:	Up to two digital outputs, form C, 5A relays, User configurable
			Minimum one digital input, User configurable
			Minimum one analog output 4-20mA, User configurable
	.2	Communications:	Built-in or optional communications module. 10M/100M BaseT, Modbus RTU, Modbus TCP/IP, and EtherNet IP to enable communication of each power quality meter with PLC/PC.
	.3	Power supply:	120VAC, unless otherwise noted.
	.4	Set up Software:	When indicated in the contract documents, provide software that will install on a personal computer to enable configuration and reading of each power quality meter over communications line.
	.5	Design:	Microprocessor based non-volatile memory feature stores all system set up and calibration data to save critical information during power outage.
	.6	Display:	Panel mount remote LCD/LED display.
	.7	Enclosure:	EEMAC/NEMA 1, Draw-out Type
.5	External Hardware:		
	.1	Phase current transformers inputs:	1A and 5A, secondary
	.2	Voltage Input Range:	40 to 600VAC
.6	Electrical:		
	.1	Approval:	CSA
	.2	Class/Div/Group:	N/A
.7	Manufacturers:		
	.1	See Section 13105 – General Instrumentation Requirements for approved manufacturers.	

PART 3 EXECUTION

3.1 GENERAL

.1 Mount Protection relays and PQM meters on the front door of the enclosure.

.2 Mount door mounted devices between 900 – 1700 mm above floor, wherever possible. Where not possible request written approval from the contract administrator of the project.

.3 Allow sufficient clearance for wiring and maintenance access.

.4 See Section 13105 – General Instrumentation Requirements for general execution requirements.

END OF SECTION

TORONTO

DIVISION 15

MECHANICAL

TORONTO

SECTION 15050

MECHANICAL MATERIALS, METHODS AND REQUIREMENTS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Supply and installation of standby generators – Division 16.

.2 Provision of concrete work, including reinforcing and formwork, for mechanical Work – Section 03300 – Cast-In-Place Concrete.

.3 Cutting and patching, for mechanical work – applicable Sections of other Divisions.

.4 Flashing for mechanical Work penetrating the roof – Section 07620 – Copper Batten Roofing and Flashing.

1.2 APPLICATION

.1 This Section specifies requirements, products, common criteria and characteristics, and methods and execution that are common to one or more Sections of Division 15, and it is intended as a supplement to each Section and is to be read accordingly.

1.3 PLANNING AND LAYOUT OF WORK

.1 The exact locations and routing of mechanical and electrical services are to be properly planned, coordinated and established with all affected trades prior to installation such that the services will clear each other as well as any obstructions. Generally, give the right-of-way to piping requiring uniform pitch and locate and arrange other services to suit.

.2 All shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings, must be located for easy access for servicing and/or removal. Products which do not meet this location requirements are to be relocated at no cost.

1.4 WORK WITHIN HERITAGE STRUCTURES

.1 Work shall be planned in such a manner so as to reduce the overall aesthetic impact that new equipment will have on the overall facility. All new anchors installed within walls must be attached to the mortar between bricks.

.2 Any materials removed shall be done in such a manner so as to allow for the reuse of removed materials. At no additional cost, turn over salvaged materials to City for their use.

.3 All reasonable efforts shall be taken to avoid causing damage to the existing facility, and the Contractor shall be responsible for returning any damaged areas to the condition that they were at prior to the start of the Work.

1.5 DOCUMENTS

.1 The Mechanical Drawings are performance Drawings, diagrammatic, and show approximate locations for equipment and materials. The Drawings are intended to convey the scope of work and do not necessarily show architectural and structural details. The locations of materials and equipment shown may be altered (when revised

layouts have been submitted and approved), to meet requirements of the material and/or equipment, other equipment and systems being installed, and of the building. Provide all fittings, offsets, transformations, and similar items required as a result of obstructions and other architectural or structural details but not shown on the Mechanical Drawings.

1.6 ACCEPTABLE PRODUCT MANUFACTURERS

.1 Refer to the Instruction for Bidders and Division 1 for Specified Products.

.2 Products scheduled and/or specified on the Drawings and in Sections of Division 15 have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, acceptable manufacturers are stated for any product specified by manufacturer's name and model number.

.3 If products supplied by a manufacturer named as acceptable are used in lieu of the manufacturer specified, be responsible for ensuring that the substituted product is equivalent in performance and operating characteristics (including energy consumption if applicable) to the specified product, and, it is to be understood that any additional costs, and changes to associated or adjacent Work resulting from provision of products supplied by a manufacturer other than the specified manufacturer is included in the tender price. In addition, in equipment spaces where products named as acceptable are used in lieu of specified products and the dimensions of such products differ from the specified products, prepare and submit for review, accurately dimensioned layouts of rooms affected.

1.7 WORK STANDARDS

.1 All Codes and Standards referred to in this Section are the latest edition of the Codes and Standards in effect at the time of tendering this project.

.2 All mechanical piping system Work, including equipment, must comply in all respects with requirements of the Ontario Technical Standards and Safety Authority, and CSA Standards, Boiler, Pressure Vessels and Pressure Piping Code. Where required, fittings, valves, equipment, etc., must bear a CRN number.

.3 All electrical items associated with mechanical equipment are to be CSA (or equivalent agency certified electrically), or bear a stamp to indicate special Electrical Safety Authority approval.

1.8 SHOP DRAWINGS

.1 It is understood that the following is to be read in conjunction with the wording on the Engineer's shop drawing review stamp applied to each and every mechanical work shop drawing submitted:

.1 "This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication

processes or to techniques of construction and installation, and for coordination of the work of all subtrades."

1.9 SUBMITTALS

.1 Submit the following for review:

.1 Shop drawings for all products specified in this Section.

.2 Location drawings (marked-up white prints) for all required sleeves and formed openings in new poured concrete or precast concrete construction.

.3 Samples of materials and any other items as specified in succeeding Sections of this Division of the Specification.

.4 WHMIS MSDS – Material Safety Data Sheets for all products where required, and maintain one copy at the site in a visible and accessible location and available to all personnel.

.5 A list of equipment identification nameplates indicating proposed wording and sizes.

.6 A list of pipe and duct identification colour coding and wording.

.7 A proposed valve tag chart and a list of proposed valve tag numbering and identification wording.

.8 A clean "reviewed" copy of each shop drawing for insertion into the operating and maintenance instruction manual.

1.10 WORKPLACE SAFETY

.1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

.2 Comply with all requirements of Ontario Regulation 213/91, Occupational Health and Safety Act and Regulations for Construction Projects.

1.11 EQUIPMENT AND SYSTEM STARTUP AND COMMISSIONING

.1 Include for all labour to physically perform start-ups and performance testing, supply of equipment manufacturer's representatives and technicians on-site, services, etc., which are indicated as being supplied by the Contractor, including:

.1 Data and shop drawings for operation and maintenance manuals.

.2 Marked-up white print "As-Recorded drawings" prepared on site during construction.

.3 All test data and certificates.

.2 The majority of the Commissioning Work must be complete prior to Substantial Performance of Work.

1.12 DEFINITIONS

.1 The following are definitions of words found in Sections of Division 15 of the Specification and on associated Drawings:

.1 “concealed” – means Work hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.

.2 “exposed” – means Work normally visible, including Work in equipment rooms and similar spaces.

.3 “provide” (and tenses of “provide”) – means supply and install complete.

.4 “install” (and tenses of “install”) – means install and connect complete.

.5 “supply” – means supply only.

.6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished.

.2 Wherever the words “indicated”, “shown”, “noted”, “listed”, or similar words or phrases are used in the Specification they are understood, unless otherwise defined, to mean that the product referred to is “indicated”, “shown”, “listed”, or “noted” on the Drawings.

.3 Wherever the words “approved”, “satisfactory”, “as directed”, “submit”, “permitted”, “inspected” or similar words or phrases are used in the Specification they are understood, unless otherwise defined, to mean that Work or product referred to is “approved by”, “inspected by”, etc., the Engineer.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

.1 Minimum 0.635mm thick (16gge) galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.

.2 Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

.3 Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint.

2.2 FIRE STOPPING AND SMOKE MATERIALS

.1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding construction.

.2 Materials are to be compatible with abutting dissimilar materials and finishes.

2.3 WATERPROOFING SEAL MATERIALS

.1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size. Acceptable products are:

.1 Thunderline Corp. (Power Plant Supply Co.) “LINK SEAL” Model S.

.2 The Metraflex Co. “MetraSeal” type ES.

2.4 MECHANICAL WORK IDENTIFICATION MATERIALS

.1 **Equipment Nameplates:** Minimum 1.6mm (1/16 inch) thick 2-ply laminated coloured plastic plates, white background – black lettering, minimum 12mm x 50mm (½ inch x 2 inches) for smaller items such as damper motors and control valves, minimum 25mm x 65mm (1 inch x 2½ inch) for equipment, and minimum 50mm x 100mm (2 inches x 4 inches) for control panels and similar items. Each nameplate is to be complete with bevelled edges and engraved wording to completely identify the equipment with no abbreviations. Wording is generally to be as per the Drawings but must be reviewed prior to engraving. Supply stainless steel screws for securing nameplates in place.

.2 **Valve Tags:** Coloured, 40mm (1½ inch) square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match the piping classification colour, each complete with a 3.2mm (1/8 inch) diameter by 100mm (4 inches) long brass plated steel bead chain, and four lines of engraved maximum size identification in wording i.e.:

.1 VALVE V12
200mm
CHILL. WATER
NORMALLY OPEN

.3 **Standard Pipe Identification:** Standard pipe identification is to be:

.1 For pipe to and including 150mm (six inches) diameter, Smillie McAdams Summerlin Ltd. "Coil-Mark", consisting of coloured, coiled, semi-rigid vinyl plastic of a length to wrap completely around the pipe, and indoor/outdoor type vinyl ink lettering and directional arrows and for pipe larger than 150mm (six inches) O.D., the markers are saddle style with two rows of wording and are installed using nylon tie wraps provided with the marker or approved alternative.

.4 **Duct Identification:** Custom made Mylar stencils with 50mm (2 inches) high lettering to accurately describe the duct service, i.e., “AHU-1 SUPPLY”, complete with a directional arrow, and coloured inks with ink pads and roller applicators. Ink colours are to contrast with the lettering background.

.5 **Identification Material Manufacturers:** Acceptable manufacturers of identification materials are:

.1 Smillie McAdams Summerlin Ltd.

.2 W.M. Brady of Canada Ltd.

.3 Revere-Seton Inc.

.4 Embree Marking Systems.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

.1 Install all wall anchors into grout between bricks. In order to preserve the heritage aspects of the structure, the Contractor shall not drill or fasten directly to bricks within the wall.

.2 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.

.3 Unless otherwise specified, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.

.4 Install all pipes and ducts parallel to building lines.

.5 Neatly group and arrange all exposed Work.

.6 Locate all valves, dampers and any other equipment which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.

.7 Make all connections between pipes of different materials using proper approved adapters. Provide cast brass dielectric type adapters at connections between steel and copper pipe.

.8 Ensure that equipment and material manufacturers' installation instructions are followed unless otherwise specified herein or on the Drawings, and unless such instructions contradict governing codes and regulations.

.9 Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.

.10 Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation to be applied continuously and unbroken around the pipe or duct, except at fire barriers, in which case the insulation will be terminated at each side of the fire barrier.

.11 Inspect surfaces and structure prepared by other trades before performing your Work. Verify that surfaces or the structure to receive your Work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your Work will constitute acceptance of such surfaces as being satisfactory.

.12 Ensure that exposed ferrous metal products, except ductwork and piping, have at least one factory prime coat, or paint such ferrous metal products with one prime coat on the job.

.13 Clean and wire brush ferrous metal products before applying the prime coat. For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction Work.

3.2 INSTALLATION OF PIPE SLEEVES

.1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:

.1 in poured concrete slabs, unless otherwise specified - minimum 0.635mm thick (16gge) flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves.

.2 in concrete or masonry walls – Schedule 40 galvanized steel pipe.

.2 Sleeves in waterproofed slabs are to be lengths of Schedule 40 mild galvanized steel pipe in accordance with the Drawing detail. Provide waterproof sleeves in the following locations:

.1 in mechanical room floor slabs, except where on grade.

.2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets.

.3 in all floors equipped with waterproof membranes.

.4 in the roof

.3 Size sleeves, unless otherwise specified, to leave 12mm (½ inch) clearance around the pipes, or where pipe is insulated, a 12mm (½ inch) clearance around the pipe insulation.

.4 Pack and seal the void between the pipe sleeves and the pipe or pipe insulation for the length of the sleeves as follows:

.1 Use only if firestopping is specified in Div. 15.

.2 Pack sleeves in fire rated construction as specified in the article entitled "INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS".

.3 Pack sleeves in non-fire rated interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound.

.4 Pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified.

.5 Seal sleeves in exterior walls (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.

.5 Sleeves in fire rated construction will be packed and sealed as part of the works specified in Division 7.

.6 Where sleeves are required in masonry work, accurately locate and mark the sleeve position, and turn the sleeves over to the trade performing the masonry work for installation.

.7 Terminate sleeves for piping which will be exposed so that the sleeve is flush at both ends with the wall, partition or slab surface so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to extend 100mm (four inches) above the finished surface.

.8 "Gang" type sleeving will not be permitted.

.9 Where sleeves are provided for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of the sleeved opening.

3.3 INSTALLATION OF WATERPROOFING SEAL MATERIALS

.1 Provide watertight link type mechanical seals in exterior wall openings where shown and/or specified.

.2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.

.3 Periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

3.4 DUCT OPENINGS

.1 Ensure that openings for fire dampers to 600mm (24 inches) high are sized to suit the damper arrangement with the folding blade out of the air stream.

3.5 INSTALLATION OF FASTENING AND SECURING HARDWARE

.1 Provide all fastening and securing hardware required for mechanical Work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and 2-M85.

3.6 INSTALLATION OF PIPE HANGERS AND SUPPORTS

.1 Provide all required pipe hangers and supports. Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from the structure only.

.2 For insulated pipe, size the hanger support to suit the insulated pipe and install the hanger or support on the outside of the insulation and covering.

.3 Provide hangers in accordance with Section 15101 – Supports, Anchors and Seals.

.4 Isolation for Bare Copper Tubing: Each hanger or support for bare copper tubing is to be plastic coated to prevent direct contact between the pipe and the ferrous hanger. Site application of tape or other types of isolation is not acceptable.

3.7 INSTALLATION OF EQUIPMENT DRIVE GUARDS AND ACCESSORIES

.1 Protect all exposed accessible rotating parts on all mechanical equipment with a guard.

.2 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.

3.8 MECHANICAL WORK IDENTIFICATION

.1 Exposed Piping & Ductwork: Identify exposed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at every end of every piping or duct run.

.2 adjacent to each valve, strainer, damper and similar accessory.

.3 at each piece of connecting equipment.

.4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified.

.5 at 6m (20 feet) intervals on pipe and duct runs exceeding 6m (20 feet) in length.

.6 on each side of special valves, special fittings and branch connections.

.7 at least once in each room, and at least once on pipe and duct runs less than 6m (20 feet) in length.

.2 **Concealed Piping & Ductwork:** Identify concealed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas.

.2 at maximum 6m (20 feet) intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room.

.3 at each access door location.

.4 at each piece of connected equipment, automatic valve, etc.

.3 Equipment: Provide an identification nameplate for each piece of equipment, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate all nameplates in the most conspicuous and readable location.

.4 Valve Tagging and Chart: Tag valves and prepare a valve tag chart in accordance with the following requirements:

.1 Attach a valve tag to each new valve, except for valves located immediately at the equipment they control.

.2 Prepare a typed or computer printed valve tag chart to list all tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed).

.3 If an existing valve tag chart is available at the site, valve tag numbering is to be an extension of existing numbering and the new valve tag chart is to incorporate the existing chart.

.4 Frame and glaze one copy of the chart and affix same to a wall where later directed at the site.

.5 Include a copy of the valve tag chart in each copy of the operating and maintenance instructions.

.5 Ceiling Tacks or Stickers: Where shut-off valves, control dampers, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in the ceiling panel material, or stickers on the ceiling grid material to indicate locations of the items. Confirm colours prior to installation.

3.9 PIPE LEAKAGE TESTING

.1 Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage. Where tests are to be witnessed, arrange for the appropriate people to be present.

3.10 CUTTING AND PATCHING FOR MECHANICAL WORK

.1 Do all cutting and patching of the existing building for the installation of your Work. Perform all cutting in a neat and true fashion, with proper tools and equipment. Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.

.2 Where new pipes pass through existing construction, core drill an opening. Size openings to leave 12mm (.5 inch) clearance around the pipes or pipe insulation.

.3 Prior to drilling or cutting an opening, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray the walls or slabs if required.

.4 You will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of your cutting or drilling Work.

.5 Note that where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a pipe sleeve which is sized to leave 12mm (1/2 inch) clearance around the pipe or pipe insulation. Provide a pipe sleeve in the opening. Pipe sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100mm (four inches) above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.

3.11 INSTRUCTIONS TO CITY

.1 Instruct the City's designated representatives in all aspects of the operation and maintenance of systems and equipment specified in this Division of the Specification.

.2 Arrange and pay for the services at the site of qualified technicians and other manufacturer's representatives to instruct on specialized portions of the installation.

.3 Submit, prior to issue of a Certificate of Substantial Performance, a complete list of systems for which instructions were given, stating for each system:

.1 Date instructions were given to the City's staff.

.2 Duration of instruction.

.3 Names of persons instructed.

.4 Other parties present (manufacturer's representatives, etc.).

.4 Obtain the signatures of the City's staff to verify they properly understood the system installation, operation and maintenance requirements and have received operating and maintenance manuals and As-Recorded drawings.

END OF SECTION

TORONTO

SECTION 15090

SUPPORTS, ANCHORS AND SEALS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 This section covers the installation of:

.1 Piping hangers and supports.

.2 Duct hangers and supports.

.3 Flashing for mechanical equipment.

.4 Sleeving for mechanical equipment.

.5 Fire stop seals.

.2 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade and provide for expansion and contraction.

.3 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.4 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of five to one.

1.2 SUBMITTALS

.1 Firestop materials: Submit service limitations, installation instructions, ULC certification and FM listing.

.2 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, ULC certification and FM listing.

1.3 QUALITY ASSURANCE

.1 Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

1.4 ALTERNATIVES

.1 Obtain approval prior to drilling for inserts and supports for piping systems.

.2 Obtain approval prior to using percussion type fastenings.

.3 Use of existing piping or equipment for hangers supports is not permitted.

.4 Use of perforated band iron, wire or chain as hangers is not permitted.

1.5 FIRESTOP SEALANTS AND COLLARS

.1 Standard method of fire tests of firestop system CAN4-S115-M85.

.2 UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (ULc1479).

.3 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by FM and certified by UL or ULC for the service application.

PART 2 PRODUCTS

2.1 GENERAL

.1 All rods and anchors shall be 316 stainless steel.

.2 All hangers and other supports shall be galvanized steel or stainless steel.

2.2 INSERTS

.1 Inserts shall be stainless steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

.2 Size inserts to suit threaded hanger rods.

2.3 HANGER RODS

.1 Hanger rods shall be stainless steel, threaded both ends or continuous threaded, complete with lock nuts on both ends.

2.4 PIPE HANGERS AND SUPPORTS

.1 Hangers:

.1 Pipe Sizes 13mm to 38mm: Adjustable wrought steel ring, or plated strap.

.2 Pipe Sizes 50mm and over: Adjustable wrought steel clevis.

.2 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150mm and over.

.3 Wall Support:

.1 Pipe Sizes to 75mm: Cast iron hook or fabricated bracket of 25mm x 25mm x 3.125mm angle bar.

.2 Pipe Sizes 100mm and over: Welded steel bracket and wrought steel clamp.

.4 Vertical Support:

.1 Steel riser clamp.

.5 Floor Support:

.1 Fabricated stand and pipe clamp or saddle.

2.5 DUCT HANGERS AND SUPPORTS

.1 Hangers:

.1 Concealed - Round Duct: Galvanized steel band iron.

.2 Concealed - Rectangular Duct: Galvanized steel band iron or rolled angle and 9mm rods.

.3 Exposed - Round Duct: continuous galvanized steel band iron secured to single 9mm hanger rod.

.2 Wall Supports: Galvanized steel band iron or fabricated angle brackets.

.3 Vertical Support at Floor: Rolled angle.

.4 Support rectangular ducts 1530mm and less in width or depth with 25mm wide 1.3mm or heavier galvanized bent hangers fastened to the side and bottom of the duct at a spacing of not greater than 2240mm using bolts, rivets, or metal screws.

.5 Support duct over 1530mm in width or depth with 10mm vertical hanger rods, bolted to galvanized steel angles at 610mm intervals.

.6 Support round ducts up to 910mm with 25mm wide, 1.0mm thick single galvanized steel traps and 9mm diameter rods. Support larger ducts with 25mm wide, 1.6mm thick double, horizontally split galvanized steel strap and two 9mm diameter rods. Space support at 3600mm intervals.

.7 Where vertical ducts pass through floors, support with galvanized steel angles riveted and/or bolted to the cut and bearing on the structure.

2.6 FLASHING

.1 Steel Flashing: 26 gauge galvanized steel.

.2 Lead Flashing: 24.5 (5 lb/ft^2) sheet lead.

.3 Aluminum flashing: 26 gauge sheet aluminum.

2.7 SLEEVES

.1 Where pipes pass through floor, walls and roof provide Schedule 40 steel pipe sleeves. Provide sleeves through walls and floors for insulated piping of sufficient size to allow insulation to pass through unbroken, with 15mm clearance all around; otherwise allow for 25mm clearance all around. Terminate sleeves flush with walls and 25mm above floors or roof.

.2 Form sleeves for ductwork with galvanized steel.

.3 Pack annular spaces between sleeves and pipes in fire rated walls and floors and ceilings with ULC approved fire resistant products, in conformance with CAN4-S115-M85. In other walls and floors, seal annular space with waterproof, non-hardening mastic as approved by the Engineer. Also at exterior surfaces caulk plates to form a smooth and neat seal against wall. Below grade seal both exterior and interior of sleeve watertight using mastic.

.4 Provide split type floor and ceiling plates Grinnell Figures 1 and 2 for copper tubes or Grinnell Figures 10, 13 and 20 for steel pipe. For unfinished floors use Figure 400 special concrete floor plates. Where exposed pipe passes through finished floors, walls or ceilings, provide chrome plated with set screw. Terminate pipe sleeves at these locations, so that sleeve ends are covered by plates. Secure plates against finished surface. For pipe sleeves through basements and mechanical room floors provide watertight riser sleeve Figure 405 complete with gasket.

.5 Use factory made, threaded or toggle type inserts for supports and anchors, sized for load to be carried. Place inserts only in portions of main structure and not in any finishing material.

.6 Use factory made expansion shields where inserts cannot be placed but only where approved by the Engineer and only for light weights. Make holes for inserts using drill, no ram setting permitted.

2.8 FIRESTOP SEALANTS AND COLLARS

.1 Firestop Sealants and collars to provide mechanical fire protection for penetrations utilizing PVC or CPVC pipe, PVC conduit, polyethylene conduit or pipe, other non-metallic pipes, cables, and combustible pipe insulations as the penetrant.

.2 Intumescent insert: Flexible, elastomeric strip, two stage expansion, designed to firestop penetrations in fire-rated walls and floors and floor/ceiling assemblies.

.3 Provide a minimum of 15 time free expansion.

.4 Contain no water soluble expansion ingredients.

2.9 ROOF JACKS AND VENT CAPS

.1 Aluminum: Compatible with SBS torch down roofing materials and methods, 12 gauge aluminum, 12mm round flange, oversize tube neck TIG welded to flange, aluminum flashing cap.

.2 Vent Caps: Vandal Resistant; Heavy gauge aluminum, slotted vents, screw secured.

PART 3 EXECUTION

3.1 GENERAL

.1 Provide all frames and supports for the proper erection of the work. Fabricate from structural steel any supporting sections and frames required. Provide chamfered edges on all concrete bases. Use only approved type hangers

.2 Support hangers directly from structure. Do not support pipes or other equipment from other pipes, ducts, equipment, suspended ceilings or metal roof decks, etc.

.3 Suspend hanger rods from inserts in concrete or from beam clamps. Obtain the Engineer's approval prior to welding to steel structural members. Ensure that load imposed on structure does not exceed structural design load. Suspend from top chords of steel joists or top or bottom flange of steel beams using beam clamps.

.4 Include angle frames, anchor bolts, guy wires, platforms, braces, etc. required to support equipment, ductwork, piping, etc.

3.2 INSERTS

.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.2 Use factory made, threaded or toggle type inserts for supports and anchors, sized for load to be carried. Place inserts only in portions of main structure and not in any finishing material.

.3 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100mm or ducts over 1500mm wide.

.4 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

.5 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

.6 Expansion bolt type connections will be approved under certain conditions. Obtain approval from the Engineer. Generally, pipe 50mm or smaller, and ducts less than 600mm x 300mm will be approved, subject to adequate number of support points.

3.3 PIPE HANGERS AND SUPPORTS

.1 Provide pipe hangers with supports for piping in Division 15 with rods vertical, without bends or offsets such that finished piping is true, both with respect to line and grade.

.2 Fasten hangers and supports to building structure or inserts in concrete construction.

.3 Do not use pipe hooks, chains, or perforated straps.

.4 Use angle or channel welded frames for trapeze hangers.

.5 Hangers for uninsulated pipes to be Grinnel Fig. 65 adjustable clevis up to including 100mm and Grinnel Fig. 260 adjustable clevis for sizes 125mm and larger, or approved equal.

.6 For support of horizontal piping use round steel threaded rod having the following diameters and spaced at the following intervals:

STEEL PIPE		
PIPE DIAMETER (mm)	**HORIZONTAL SPACING OF SUPPORTS (mm)**	**THREADED ROD DIAMETER (mm)**
12	1500	10
20	1800	10
25	1500	10
32	2400	10
40	2700	10
50	3000	10
65	3300	13
75	3600	13
100	4200	16
150	5100	19
200	5100	22

COPPER TUBING, ANNEALED STEEL TUBING AND PVC PIPING AT MAXIMUM 40ºC		
PIPE DIAMETER (mm)	**HORIZONTAL SPACING OF SUPPORTS (mm)**	**THREADED ROD DIAMETER (mm)**
13	1500	10
20	1500	10
25	1800	10
32	2100	10
40	2400	10
50	2400	10
65	3200	13
75	3200	13
100	3600	16

.7 Install hangers to provide minimum 32mm clear space between finished covering and adjacent work.

.8 Place a hanger within 300mm of each horizontal elbow.

.9 Use hangers which are vertically adjustable 38mm minimum after piping is erected.

.10 Support vertical piping at every floor. Support vertical pipes with riser clamps or ring stays. Spacing of vertical pipe supports to conform with spacing of horizontal supports.

.11 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.12 Where practical, support riser piping independently of connected horizontal piping.

.13 Support horizontal soil pipe near each joint, with 1524mm maximum spacing between hangers.

.14 Where pipes change direction either horizontally or vertically provide pipe hanger not more than 300mm from elbows. Where pipes drop from branches of tees support main run in both directions not more than 900mm on each side of tee. Where changes in direction are used for expansion, use linked eye hanger rods.

.15 Exposed piping, with less than 2600mm clearance to floors shall be provided with two times the number of hangers normally required. Spacing shall be equal or adjusted for maximum benefit.

.16 Provide copper plated hangers and supports for copper piping or provide nonferrous packing between hanger or support and piping.

.17 Large capacity piping with vibration potential shall not be suspended from any building structure that will allow transfer of vibrations to the occupied spaces.

.18 Pack annular spaces between openings and piping in walls with waterproof, non-hardening mastic as approved by the Engineer. At exterior surfaces caulk to form a smooth and neat seal against wall. Apply a layer of denso tape to the gas piping to protect same prior to filling the void.

3.4 DUCT HANGERS AND SUPPORTS

.1 Hanger minimum sizes:

.1 Up to 750mm wide or 330mm diameter: 1¼ inch x 16 gauge at 3000mm spacing.

.2 750mm to 1200mm wide, or over 450mm diameter: 1½ inch x 16 gauge at 3000mm spacing.

.3 Over 1200mm wide: 1½ inch x 16 gauge at 3000mm spacing.

.2 Horizontal duct on wall supports minimum sizes:

.1 Up to 450mm wide: 32mm x 16 gauge or 25mm x 25mm x 3.125mm at 3000mm spacing.

.2 450mm to 1000mm wide: 32mm x 32mm x 50m at 1800m spacing.

.3 Vertical duct on wall supports minimum sizes:

.1 Riveted or screwed to duct:

a. Up to 1500mm wide: 32mm x 32mm x 75mm.

b. Over 1500mm wide: 50mm x 3.175mm.

.4 Vertical duct floor supports minimum sizes:

.1 Riveted or screwed to duct:

a. Up to 1500mm wide: 32mm x 32mm x 75mm.

b. Over 1500mm wide: 50mm x 3.175mm.

3.5 EQUIPMENT HANGERS AND SUPPORTS

.1 Erect structural work required for support of mechanical equipment. Supports to have ample strength to carry equipment under testing and operating conditions. In addition, supports must meet normal acceptable engineering practices and be approved by the Engineer.

.2 Include suitable bases or mounting brackets with mechanical equipment.

3.6 EQUIPMENT BASES AND SUPPORTS

.1 Concrete housekeeping pads are specified under other divisions. Bases shall be 100mm thick minimum, extended 150mm minimum beyond machinery bedplates. This Division will provide templates anchor bolts and accessories required for mounting and anchoring equipment.

.2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

.3 Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

.4 Suspend mechanical equipment from structure with adjustable length steel rods. Provide spreader beams to distribute weight.

3.7 NOISE AND VIBRATION CONTROL

.1 Use the type of isolation equipment to obtain optimum results, consult with the isolator manufacturer to provide installation instructions for his product.

3.8 PRIMING

.1 Prime coat all steel hangers and supports.

3.9 FLASHING

.1 Where mechanical equipment passes through weather or waterproofed walls and roofs, counter flashing shall be provided under this Division. Roof flashing is specified under other divisions of this specification.

.2 Curbs for mechanical roof installations shall be supplied with equipment. Curbs must be minimum 300mm (12 inch) higher than the top of the roof, unless noted otherwise. Note that if manufactured curbs do not comply with this requirement, pressure treated wood blocking will be required, under the curbs, to raise the lip to the specified clearance. Coordinate with General Contractor for flashing and counter-flashing with galvanized steel, to make waterproof.

3.10 SLEEVES

.1 Provide and set sleeves required for equipment, including openings required for placing equipment.

.2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.

.3 Extend sleeves through potentially wet floors 50mm (two inch) above finished floor level. Caulk sleeves full depth and provide floor plate.

.4 Where ductwork passes through floor, ceiling or wall, close off space between duct and sleeve with non-combustible insulation. Provide tight fitting metal caps on both sides.

.5 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with non-combustible insulation or approved non combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.

.6 Install chrome plated escutcheons where piping passes through finished surfaces.

.7 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.11 FIRESTOP SEALANTS AND COLLARS

.1 Clean all concrete, masonry and stone penetrations of all contaminants and impurities, concrete form release agents, water repellents, oils, surface dirt and rust, scale, all old sealants and other surface treatments.

.2 Metal surfaces shall be cleaned by wiping them with an oil- free absorbent cloth saturated with solvent such as xylol or toluol. Do not use alcohols.

.3 Do not apply to polycarbonates or to building materials that bleed oils, plasticizers or solvents, or where sealant is not exposed to atmospheric moisture, or to surfaces which have been or will be painted.

.4 Collars are to be installed with steel fasteners or steel expansion anchors. Low melting temperature anchors of lead, plastic or aluminum are not approved.

.5 Installation only when temperatures are between 4°C and 37°C.

3.12 EXPOSED DUCT SUPPORT

.1 The threaded rod shall be secured to trusses or to steel angle bars spanning the building trusses. The steel spanning bars are to be provided by this Division.

3.13 LABELLING AND PAINTING

.1 Painting of all ductwork, piping and hangers is by Division 9.

END OF SECTION

TORONTO

SECTION 15101

INSTALLATION OF PIPEWORK

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01741 – Final Cleaning.

.2 Section 15111 – Valves.

.3 Section 15050 – Mechanical Materials, Methods, and Requirements.

.4 Section 15142 – Water Piping – Copper.

.5 Section 15181 – Piping and Equipment Insulation.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181 - Ready-Mixed Organic Zinc-Rich Coating.

PART 2 PRODUCTS

2.1 PIPE WORK

.1 All pressurized water systems shall be designed for a minimum of 1034kPa (150 psi) cold water working pressure.

.2 For cooling water supply, and cooling water discharge service Piping refer to Section 15142 –Water Piping – Copper.

PART 3 EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment is mounted on vibration isolation and when piping is subject to movement.

3.2 CLEARANCES

.1 Provide clearance around all systems, equipment and components for observation of operation, inspection, servicing, and maintenance.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated or specified otherwise.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to floor drain. Discharge to be visible.

.4 Drain valves: NPS 19mm gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 DIELECTRIC COUPLINGS

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 50mm and under: isolating unions or bronze valves.

.4 Over NPS 50mm: Isolating flanges.

3.5 PIPEWORK INSTALLATION

.1 All pipework installation shall be in accordance with the OBC.

.1 Provide all required valves, drains, and appurtenances required, even if not indicated on the drawings, to meet the requirements of the OBC.

.2 Provide clearances and access for maintenance of equipment, valves, fittings as specified and as per manufacturer's installation instructions.

.3 Install so that equipment can be isolated and removed without interrupting the operation of any other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.6 Install so as to minimize furring space, maximize headroom and conserve space.

.7 Except where indicated, install so as to permit separate thermal insulation of each pipe.

.8 Group piping wherever possible and as indicated.

.9 Ream pipes, remove scale and other foreign material before assembly.

.10 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.11 Valves: Install with stems above the horizontal position unless otherwise indicated.

3.6 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Sizes: 6mm minimum clearance all round between sleeve and uninsulated pipe or between sleeve and insulation.

.4 Installation:

.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

.2 All other floors: Terminate 25mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.5 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, or waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tubing and sleeve.

3.7 ESCUTCHEONS

.1 Install on all pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: Two piece type with setscrews. Chrome or nickel plated brass or stainless steel as approved by the Contractor's Engineer and acceptable to the Owner.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.8 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to be properly firestopped.

.2 Uninsulated, unheated pipes not subject to movement: No special preparation.

.3 Uninsulated, heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.

.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.9 FLUSHING OUT OF PIPING SYSTEMS

.1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01741 – Final Cleaning.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise the Engineer and the Owner's Consultant a minimum of two working days minimum prior to performance of pressure tests.

.2 Pipework: Test to specified pressures (1.5 x working pressure).

.3 Maintain specified test pressure without loss for two hours minimum unless specified for longer period of time elsewhere.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of the Engineer and the Owner's Consultant.

.6 Bear costs for repairs or replacement, retesting, and making good. The Engineer to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by the Engineer.

.8 Provide data and records of work for information purposes to the Owner's Consultant.

3.11 PIPE INSULATION

.1 In accordance with the requirements of Section 15181 – Piping and Equipment Insulation.

END OF SECTION

TORONTO

SECTION 15111

VALVES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01330 – Submittals.

.2 Section 01783 – Operation and Maintenance Manual

.3 Section 15050 – Mechanical Materials, Methods and Requirements.

.4 Section 15142 – Water Piping – Copper.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).

.1 ASME B1.20.1 – Pipe Threads, General Purpose (Inch).

.2 American Society for Testing and Materials (ASTM).

.1 ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal.

.3 ASTM B283 – Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-05e1 – Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS SP-25 – Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS SP-80 – Bronze Gate, Globe, Angle and Check Valves.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01330 – Submittals.

.2 Submit data for all valves specified in this section.

1.4 MAINTENANCE DATA

.1 Submit maintenance data for incorporation into manual specified in Section 01783 – Operation and Maintenance Manual.

PART 2 PRODUCTS

2.1 GENERAL

.1 Except for specialty valves, all valves are to be a single manufacturer.

.2 All wetted parts with water returning to process to be NSF61 certified.

2.2 END CONNECTIONS

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: Screwed ends.

.2 Copper tube systems: Solder ends.

2.3 GATE VALVES

.1 Requirements common to all gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: with hex. shoulders.

.3 Connections: with hex. shoulders.

.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Packing: high grade non-asbestos packing.

.6 Operator – Handwheel.

.2 NPS 2 and under, non-rising stem, solid wedge disc:

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 WP = 1.4MPa WOG.

.3 Operator: Handwheel

.3 Over NPS 2, non-rising stem, split wedge disc:

.1 Body: with long disc guides, screwed bonnet.

.2 WP = 1.4MPa WOG.

.3 Disc: split wedge, bronze to ASTM B 283, loosely secured to stem.

.4 Operator: Handwheel.

.4 Acceptable Supplier:

.1 Watts.

.2 Crane.

.3 Jenkins.

2.4 BALL VALVES

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class 125, 860kPa steam, WP = 1.4MPa WOG.

.3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders solder ends to ANSI B16.18.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel hard chrome solid ball and teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.2 Acceptable Suppliers:

.1 Contromatics/Watts.

.2 Worchester.

.3 Jamesbury.

.4 Appollo.

.5 Kitz.

.6 Bray Flow-Tek Series.

2.5 SOLENOID VALVES

.1 NPS 2 1/2 and under:

.1 Body Material: Brass, Stainless Steel, Lead-free Brass, 316 stainless steel on request

.2 Max Differential/Max Operating Pressure: Vacuum to 24 bar, Vacuum to 350 psi

.3 Port Type: NPTF, G (ISO 228/1)

.4 Function: 2 way - 2/2 Normally Closed, 2 way - 2/2 Normally Open

.5 Flow: From 1.3 to 39 Kv , 1.5 to 45 Cv

.6 Voltage: 24 AC, 110 AC, 115 AC, 12 DC, 12 to 24 DC Voltage Ranging, 120 AC, 120 DC, 125 DC Battery Charging, 208 AC, 220 AC, 230 AC, 24 DC, 24 to 120 AC/DC Voltage Ranging, 240 AC, 240 DC - 50/60, Uncommon voltages available upon request.

.7 Operating Environment: Corrosive, Hazardous, Indoor, Outdoor

2.6 VALVE TAGGING

.1 All valves to be provided with an identification tag in accordance with Section 15050 – Mechanical Materials, Methods and Requirements.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

END OF SECTION

TORONTO

SECTION 15142

WATER PIPING-COPPER

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01330 – Submittals.

.2 Section 01783 – Operation and Maintenance Manual

.3 Section 15050 – Mechanical Materials, Methods and Requirements.

.4 Section 15111 – Valves.

1.2 REFERENCES

.1 ASME B16.15 – Cast Bronze Threaded Fittings.

.2 ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ASME B16.24 – Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.

.5 ANSI/AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.6 ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

.7 ASTM B88M – Standard Specification for Seamless Copper Water Tube [Metric].

.8 CSA B242 – Groove- and Shoulder-Type Mechanical Pipe Couplings.

.9 MSS SP-67 – Butterfly Valves.

.10 MSS SP-70 – Cast Iron Gate Valves, Flanged and Threaded Ends.

.11 MSS SP-71 – Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.12 MSS SP-80 – Bronze Gate, Globe, Angle and Check Valves.

.13 MSS SP-85 – Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01330 – Submittals.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01783 – Operation and Maintenance Manual.

PART 2 PRODUCTS

2.1 PIPING

.1 Cold systems, within building.

.1 Above ground: If 75mm diameter and smaller piping shall be copper tube, hard drawn, type L: to ASTM B88M.

.2 Buried or embedded: Use copper tube, soft annealed, type L: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

.1 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.2 50mm and larger: roll grooved to CSA B242.

2.3 JOINTS

.1 Solder: 95/5 silver.

.2 Teflon tape: for threaded joints.

.3 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

.1 Acceptable Suppliers:

a. Victaulic 47.

2.4 VALVES

.1 Refer to Section 15111 – Valves.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with the Ontario Plumbing Code and local authority having jurisdiction.

.2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.

.3 Assemble all piping using fittings manufactured to ANSI standards.

.4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.

.5 Install CWS piping below and away from HWS and HWC and all other hot piping so as to maintain temperature of cold water as low as possible.

.6 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.

.7 Buried tubing:

.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

.2 Bend tubing without crimping or constriction. Minimize use of fittings.

.8 Isolate equipment, fixtures and branches with gate or ball valves as indicated.

.9 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.2 VALVES

.1 Isolate equipment, fixtures and branches with gate or ball valves as indicated.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

.1 Conform to requirements of Section 15050 – Mechanical Materials, Methods and Requirements.

.2 Test pressure: greater of 1.5 times maximum system operating pressure or 1035kPa.

3.4 DISINFECTION

.1 Flush out, disinfect and rinse system to approval of the Engineer.

.2 Upon completion, provide laboratory test reports on water quality for the Engineer's approval.

END OF SECTION

TORONTO

SECTION 15181

PIPING AND EQUIPMENT INSULATION

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 Provide piping insulation.

.2 Provide equipment insulation.

.3 Provide ductwork insulation.

.4 Provide adhesive, tie wires, tapes, jackets.

.5 Provide recovering.

.6 Provide insulation and patching where connecting to existing systems.

1.2 QUALITY ASSURANCE

.1 Have insulation installed by skilled persons regularly engaged in this type of work.

.2 Materials shall meet fire and smoke hazard ratings as stated in this section and as defined in the Ontario Building Code.

1.3 SUBMITTALS

.1 Submit shop drawings which indicate complete material data, a list of materials proposed for this project and indicate thickness of material for individual services.

.2 Submit, if requested by the Contract Administrator, samples or proposed insulating materials.

1.4 JOB CONDITIONS

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.5 ALTERNATIVES

.1 Alternative insulations are subject to approval. Alternatives shall provide the same thermal resistance at normal conditions as material specified.

PART 2 PRODUCTS

2.1 GENERAL

.1 Adhesive insulation materials and recovery jackets: composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed. Adhesives shall be waterproof.

2.2 MATERIALS

.1 Apply the following materials over the entire length of the system including valves, tanks and piping equipment etc.

.1 Piping: Fibrous glass insulation with factory applied general purpose jacket, moulded to conform to piping, "K" value at 24°C maximum 0.035W/m°C.

.2 Round Ductwork: Flexible blanket with factory applied reinforced and flame retardant Kraft facing. K value at 24°C maximum 0.042W/m°C. Vapour retarder jacket conforming to ASTM C 1136 Type II. Maximum allowable compression is 25%.

.3 Canvas Covers and Jackets:

a. Fire resistant 6-ounce canvas for covering mechanical insulation indoors. Plain weave cotton, no dyes, no odour, non-toxic the only canvas jacketing that's easy to tear both directions with no starting cut fabric is 1333 mm wide with ULC and ASTM 25/50 stamp, packaged in rolls. Acceptable manufactures: Robson Thermal Flamex FR Canvas; S. Fattal Canvas Inc.

b. HVAC duct and plenum sealant, low odour, silver coloured, elastomeric, fibre reinforced, high and low velocity for outdoor use, non-sagging, non-cracking, UV resistant.

c. PVC outer jacket:

.4 Hot Equipment: Rigid fibrous glass insulation, "K" value at 24°C maximum 0.035W/m°C.

PART 3 EXECUTION

3.1 PREPARATION

.1 Do not install covering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

.3 Do not install insulation with jacketing if air temperature in the work area is below -9°C or above 54°C.

3.2 INSTALLATION

.1 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation materials, properly sealed.

.2 Insulate fittings and valves. Do not insulate unions, flanges, strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.3 Finish insulation neatly at hangers, supports and other protrusions.

.4 Locate insulation or cover seams in least visible locations.

.5 Provide recovering jacket on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, pipe shafts and suspended spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.

.6 Cover insulation exposed to outdoors with 14kg coated glass base sheet with aluminum bands on 200mm centres. Lap joints 75mm minimum and seal with compatible waterproof lap cement.

.7 Cold piping: Cover fittings and valve bodies and stems, elbows, and interior storm piping system with equivalent thickness of insulation material. Cover with open mesh glass cloth sealed with vapour barrier sealant and adhesive. Seal butt joints with 100mm wide strips or vapour barrier sealed with vapour barrier adhesive. All cold water piping shall have a PVC outer vapour retarder jacket. For exposed fittings, elbows and valves, apply hydraulic setting cement paste over insulation material before applying recovering.

.8 Hot piping: Cover fittings and valve bodies and stems with equivalent thickness of insulation material. All hot water piping shall have a PVC outer vapour retarder jacket. For exposed fittings and valves, apply hydraulic setting cement paste over insulating material before applying recovering.

.9 Equipment: Apply insulation with edges tightly butted, joints staggered and secured in place by steel bands. Where necessary weld on suitable anchors. Provide sufficient clearance around openings for normal operation of equipment. Finish hot surface insulation with 25mm galvanized hexagonal mesh and coat with hydraulic setting insulation cement. Finish cold surface insulation joints with 100mm wide strips of vapour barrier sealed with vapour barrier adhesive finish insulation with heavy coat of vapour barrier adhesive finish over whole body. Finish with a final coat of cement containing 25 per cent by weight of Portland cement. Recover and provide an extra coat of lagging adhesive.

3.3 INSULATION THICKNESS SCHEDULE

		Pipe Sizes	Insulation Thickness
.1	Service water and non-potable water piping	Up to 25mm Over 25mm	12mm 25mm
.2	Hot Service water piping (including heat exchanger discharge line, recirc. Lines, service water and non-potable water piping)	Runouts up to 50mm Up to 50mm Over 50mm	12mm 25mm 40mm
.3	Equipment including water meters, valves, etc.		25mm
.4	Fresh Air Ducts and Plenums		25mm, c/w canvas jacket

.1 Note that Runouts are defined by ASHRAE Standard 90.1 as piping to individual terminal units not exceeding 3600mm in length.

END OF SECTION

TORONTO

SECTION 15190

NATURAL GAS PIPING SYSTEM

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 Supply and install all appurtenances, fittings, and accessories necessary for a complete functional system as shown, but not limited to, the drawings and specifications.

.2 All work in this section shall be in accordance to the Natural Gas and Propane Installation Code, CSA, and Ontario Gas Utilization Regulation.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance to this section.

.2 Shop drawings shall indicate:

.1 All products specified in this section except piping and unions.

.2 Submit pipe leakage and flow test sheets.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Material shall be stored and handled in accordance with manufacturer's instruction.

PART 2 PRODUCTS

2.1 GENERAL

.1 Conform to the latest edition of reference standards.

2.2 PIPE, FITTINGS AND JOINTS

.1 Coated black steel – Welded Joints:

.1 "Yellow Jacket" Schedule-40 mild black carbon steel, grade B ASTM A53, factory coated with yellow plastic. Mill or site bevelled, and complete with forged steel butt-welding fittings and welded joints. All bare metal surfaces are to be cleaned and corrosion protected with a suitable primer and tape corrosion protection system.

2.3 SHUT OFF VALVES

.1 Ball Valves:

.1 CSA Certified for use with natural gas, 3100 kPa WOG rated full port ball valve, each complete with a forged brass of bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable level handle. Acceptable Manufacturers include: Toyo Valve Co. Fig 5044A; Neo Valves #525; Nibco #T-FP-600.

.2 Plug Valves:

.1 CSA certified for use with natural gas, Class 125, 1380 kPa rated ¼ turn cast iron lubricated plug valves, each wrench operated and complete with cylindrical plug with lubricated grooves, screw and receptacle, Acceptable Manufacturers: Neo Valves #1AS40114; Newman Hattersley #171M.

.3 Solenoid Valve

.1 Provide a solenoid shut-off valve located on the exterior of the building immediately downstream of the main pressure regulator. Valve shall be power close.

.2 Acceptable Manufacturer: ASCO Series 8210 2-way Solenoid, or equivalent.

2.4 PRESSURE REDUCING VALVES

.1 CSA certified for use with natural gas, designed to operate without the need for a separate vent to the exterior, threaded connections, designed to operate and perform within the range of the pressures noted on the Drawings.

PART 3 EXECUTION

3.1 GENERAL

.1 All work and installations shall be done in accordance with the latest version of the Ontario Natural Gas Code, CSA B149, and in compliance with the requirements of the Authority.

3.2 PIPING INSTALLATION

.1 Provide all required natural gas distribution piping as indicated on drawings.

.2 For underground piping, coated schedule 40 black steel.

.3 Provide shut-off valves to isolate new service main from remainder of gas system. Valves in piping to and including 50 mm diameter are to be ball type. Locate all valves so that they are easily accessible. Wherever possible, install valves at uniform height.

END OF SECTION

TORONTO

SECTION 15445

SUMP PUMPS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

.1 Section Includes:

.1 Packaged drainage-pump units.

.2 Related Section:

.1 Section 15050 – Basic Mechanical Materials and Methods.

1.3 SUBMITTALS

.1 Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.2 Wiring Diagrams: For power, signal, and control wiring.

.3 Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.4 DEFINITIONS

.1 HI: Hydraulic Institute

1.5 QUALITY ASSURANCE

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Retain shipping flange protective covers and protective coatings during storage.

.2 Protect bearings and couplings against damage.

.3 Comply with pump manufacturer's written rigging instructions for handling.

PART 2 PRODUCTS

2.1 PACKAGED DRAINAGE-PUMP UNITS

.1 Packaged Submersible Drainage-Pump Units:

.1 Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Zoeller Company

b. Goulds Water Technology

c. Liberty Pumps

d. Little Giant Pump Co

e. Bell and Gossett/Xylem

f. Or Approved Equal

.2 Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sump-pump unit.

.3 Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.

.4 Casing: Metal.

.5 Impeller: Brass.

.6 Pump Seal: Mechanical.

.7 Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.

.8 Power Cord: Three-conductor, waterproof cable of length required but not less than 72 inches (1830 mm), with grounding plug and cable-sealing assembly for connection at pump.

.9 Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings.

.10 Control: Motor-mounted float switch.

.11 Basin: Plastic.

.2 Capacity and Characteristics:

.1 Refer to Drawings.

2.2 MOTORS

.1 Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

.2 Motors for submersible pumps shall be hermetically sealed.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 INSTALLATION

.1 Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.3 CONNECTIONS

.1 Drawings indicate general arrangement of piping, fittings, and specialties.

.2 Install piping adjacent to equipment to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

.2 Perform tests and inspections.

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

.3 Tests and Inspections:

.1 Perform each visual and mechanical inspection.

.2 Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

.3 Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

.4 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.4 Pumps and controls will be considered defective if they do not pass tests and inspections.

.5 Prepare test and inspection reports.

3.5 STARTUP SERVICE

.1 Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

.1 Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

.2 Adjust control set points.

3.7 DEMONSTRATION

.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION

TORONTO

SECTION 15472

SEISMIC RESTRAINT

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the work of this section.

.2 This section includes, but is not limited to, the following:

a. Design, selection and provision of materials, installation instructions, installation and inspection of seismic restraint of mechanical piping, ductwork, fire protection and equipment under mechanical Division 15.

b. Design, selection and provision of materials, installation instructions, installation and inspection of seismic restraints of electrical conduits, cable trays, equipment and lighting fixtures under electrical Division16.

.3 The requirements under this section are in addition to the requirements for equipment, piping and duct supports and vibration isolation specified in other sections.

.4 Where Specifications of materials of this section differ from those in other sections of the mechanical divisions, this section governs, including but not limited to vibration isolation devices.

1.2 REFERENCE STANDARDS

.1 Comply with the latest edition of the following:

.1 SMACNA - “Seismic Restraint Manual Guidelines for Mechanical Systems”

.2 NFPA 13 - “Installation of Sprinkler Systems”

.3 ASHRAE - “HVAC Applications, Seismic and Wind Restraint Design”

1.3 DESIGN CRITERIA

.1 Design seismic restraint systems to conform to the Ontario Building Code for the Project location:

Item	Value
Location: [Toronto, ON]	Sa (0.2) = 0.219
Foundation factor Site Class	[C], Fa = E
Importance factor	IE = 1.5

.1 Note: above data to be confirmed with structural drawings and specifications. Should there be any difference with the structural design parameter, the structural drawings and specifications shall govern.

.2 Building Data

.1 Calculate SMACNA SHL Class for location, site factor and importance factor indicated above.

.2 The vertical uplift force is restrained by the systems as identified in SMACNA standard.

.3 For fire protection systems: in accordance with NFPA 13.

1.4 SUBMITTALS

.1 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01330.

.2 Submit test certificates for each seismic restraint device, identifying maximum tested load capacities.

.2 Calculations

.1 Submit calculations for each piece of restrained equipment, piping, ductwork and conduit, including seismic forces and restraint selection.

.2 Include worst case combination of tension and shear loads at each snubber and restraint location.

.3 Include anchor bolt diameters, embedment depth, full welding details including type and length for field welds, and required housekeeping base dimensions.

.4 Calculations to be sealed by a Professional Engineer licensed in the province of Ontario.

1.5 QUALITY ASSURANCE

.1 Pre-Construction Meeting

.1 Request and arrange a meeting with the Engineer to review seismic restraint approach, prior to any restraint insulation. Obtain approval from the Engineer before commencing Work.

.2 Testing and Review

.1 Install the first three lateral and three longitudinal braces, for each of the fire protection, one building service piping system and one ductwork system, and request and arrange for a review of the installation by the Engineer. Obtain approval of the installation before commencing remainder of the Work.

.2 Provide services of the manufacturer's technical representative to conduct site inspections of the Work in progress, and to conduct a final inspection of the Work. Provide a copy of the final inspection report to the Engineer for review.

.3 Request and arrange for a construction review by the Engineer of the completed seismic restraint installation, before any ceilings are installed.

PART 2 PRODUCTS

2.1 GENERAL

.1 Manufacturer to be a member of VISCMA (Vibration Isolation and Seismic Control Manufacturers Association).

.2 Acceptable Manufacturers

.1 Kinetics Noise Control Inc.

.2 Vibro Acoustics

.3 Cooper B-Line

.4 GRIPPLE

2.2 SEISMIC RESTRAINTS

.1 Seismic Snubber Restraints

.1 Impact surfaces: High quality elastomeric facing to prevent metal-to-metal contact.

.2 Easily accessible resilient material, for inspection and replacement.

.3 Resilient material, snubber assemblies: Minimum 6 mm¼" thick.

.4 Resilient material, snubber grommets: Minimum 3 mm1/8" thick.

.5 Restraint axis: All three principle directions unless otherwise specified or shown.

.6 Maximum clearance between resilient material and restrained equipment surface: 6 mm¼".

.7 Verify seismic restraint capacities by independent test laboratory, or certified by a Professional Engineer licensed in the province of Ontario.

.2 Type "S-OSA" – Restrained Spring Isolator – Constant Load

.1 Colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm¼" neoprene pad.

a. Removable coil spring element without having to disturb supported equipment.

b. Lateral stiffness greater than 1.2 times rated vertical stiffness.

c. Minimum 50% overload capacity

d. Non-welded spring elements: Epoxy coated, with a minimum one thousand hour rating when tested in accordance with ASTM B-117.

.2 Steel housing design to limit lateral and vertical movement of the supported equipment.

.3 Neoprene snubber to limit maximum equipment movement in any direction to 6 mm¼".

.4 Adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

.5 Kinetics Noise Control model FHS.

.3 Type "S-OSB" – Restrained Spring Isolator – Variable Load

.1 Colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm¼" neoprene pad.

a. Removable coil spring element without having to disturb supported equipment.

b. Lateral stiffness greater than 1.2 times rated vertical stiffness.

c. Minimum 50% overload capacity.

d. Non-welded spring elements: Epoxy coated, with a minimum one thousand hour rating when tested in accordance with ASTM B-117.

.2 Steel housing design to limit lateral and vertical movement of the supported equipment.

a. Top load plate with adjustable and leveling bolts.

b. Adjustable vertical restraints.

c. Isolation washers.

d. Bottom load plate with internal non-skid isolation pads and anchor holes.

e. Hot dipped galvanized for outdoor installations.

.3 Neoprene snubber to limit maximum equipment movement in any direction to 6 mm¼".

.4 Adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

.5 Kinetics Noise Control model FLSS.

.4 Type “S-OSC” – Modular Spring Isolator with Integral Seismic Restraint

.1 Colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm¼” neoprene pad.

a. Integral lateral and vertical seismic restraints.

b. Removable coil spring element without having to disturb supported equipment.

c. Lateral stiffness greater than 1.2 times rated vertical stiffness.

d. Minimum 50% overload capacity.

e. Non-welded spring elements: Epoxy coated, with a minimum one thousand hour rating when tested in accordance with ASTM B-117.

.2 Steel housing design to limit lateral and vertical movement of the supported equipment.

a. Designed to accept coil springs of different sizes and capacities.

b. All spring forces isolated from seismic housing under non-seismic events.

c. Replaceable elastomeric elements at all dynamic contact points.

.3 Neoprene snubber to limit maximum equipment movement in any direction to 6 mm¼”.

.4 Adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

.5 Kinetics Noise Control model FMS

.5 Type “S-SA” – All Direction Neoprene Isolator

.1 Molded, oil resistant neoprene compound, with encapsulated cast-in-place top steel load plate, and steel base plate with anchor holes.

.2 Designed for seismic loads in all directions with no metal-to-metal contact.

.3 Kinetics Noise Control model RQ.

.6 Type “S-SB” – Multi-Axis Limit Stop Snubber Assemblies

.1 Interlocking steel construction, attached to equipment structure and equipment, maximum of 6 mm¼" seismic movement.

.2 Designed to restrict movement in two or three axis.

.3 Minimum 6 mm¼" thick resilient neoprene pads to prevent metal-to-metal impact.

.4 Minimum two snubbers for each piece of equipment.

.5 Kinetics Noise Control model HS series.

.7 Type "S-SC" – Single-Axis Limit Stop Snubber Assemblies

.1 Steel construction, attached to equipment structure and equipment, maximum of 6 mm¼" seismic movement.

.2 Designed to restrict movement in one axis.

.3 Minimum 6 mm¼" thick resilient neoprene pads to prevent metal-to-metal impact.

.4 Minimum four snubbers for each piece of equipment.

.5 Kinetics Noise Control model HS-1.

.8 Type "S-CR" – Cable Restraints for Suspended Piping and Ductwork

.1 Steel wire strand cables.

a. Rope connections: Overlap wire "U" clips or tool-less wedge insert lock connectors.

b. Connector strength rating equal to 90% of cable breaking strength rating.

c. Kinetics Noise Control model KSBC / KWRC / KWGC

.2 Building and equipment attachment brackets: Designed to permit free cable movement in all directions up to a forty-five degree misalignment.

a. Protective thimbles at sharp corners to protect against cable wear.

b. Selected to exceed the cable working design load by 50%.

c. Single sided "C" beam clamps are not acceptable.

d. Kinetics Noise Control model KSCA / KCAB Wedge / KUAB Undercut.

.3 Vertical Suspension Rods

a. Braced to avoid potential for buckling due to vertical up-lift forces.

b. Structural steel angle or formed channel brace selected to prevent support rod buckling.

c. Brace attached to support rod with a series of adjustable clips, without the use of hand-tools.

d. Kinetics Noise Control model KHRC.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install seismic restraint devices in accordance with manufacturer's instructions.

.2 Install snubber devices only after equipment is installed and operating, to ensure no metal-to-metal contact.

.3 Seismic restraint manufacturer to provide training to the Installation Contractor on installation methods.

.4 Anchors on piping systems used for thermal expansion may be used as both a lateral and longitudinal restraint where they are designed for concurrent thermal and seismic loadings.

.5 Pipe and duct penetrations through floors are acceptable as a lateral restraint, provided sleeves and firestopping materials are installed correctly.

.6 Racked piping systems may have the rack braced (laterally, longitudinally, or combination thereof), provided each pipe supported by the rack is restrained to the rack.

.7 Each lateral or longitudinal brace must be secured to the building structure, and not any other building service.

.8 Pipe and duct penetrations through masonry and poured concrete wall partitions are acceptable as a lateral restraint, provided sleeves and firestopping materials are installed correctly.

.1 Drywall partitions, including demountable partitions, are not to be used for lateral restraint.

3.2 SYSTEMS

.1 Seismically restrain the following systems:

.1 Piping

a. Natural gas, vacuum, petroleum based liquids and compressed air, NPS 1 and larger.

b. Piping located inside of mechanical equipment and service rooms, NPS 1¼ and larger.

c. All other piping NPS 2½ and larger.

.2 Fire protection piping – sprinkler systems

a. Design and install systems in accordance with NFPA 13.

.3 Ductwork

a. Rectangular and oval ductwork with cross sectional area 0.55 $m^2$6 ft^2 and greater.

b. Round ducts with diameters 710 mm28" and larger.

.4 Electrical conduit

a. Conduit 64 mm2½" I.D. and larger.

b. Cable trays supporting conduit which is sized 64 mm 2½" I.D. and larger.

.5 Static equipment (both mechanical and electrical)

a. Anchor equipment to equipment supports. Anchor equipment supports to structure.

b. Suspended equipment, including lighting fixtures:

(a) Use one or more of following methods depending upon Site conditions:

(i) Install tight to structure.
(ii) Cross brace in every direction.
(iii) Brace back to structure.
(iv) Cable restraint system.

(b) Seismic restraints:

(i) Cushioning action gentle and steady.
(ii) Never reach metal-like stiffness.

.6 Vibration isolated equipment (both mechanical and electrical)

a. Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

b. Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.7 Roof Mounted Equipment (both mechanical and electrical)

a. Installed on a structural frame, a seismically-rated roof curb, or a structural curb/frame mechanically anchored to the building structure.

3.3 EXEMPTIONS

.1 The following systems do not require additional seismic restraint other than as specified for regular piping and duct supports:

.1 Piping

a. Natural gas, vacuum, petroleum based liquid, and compressed air piping less than NPS 1 size.

b. Piping inside of mechanical service rooms less than NPS 1¼ size.

c. All other piping less than NPS 2½ size.

d. Piping suspended from hangers at a distance of 305 mm12" or less, measured from the top surface of the pipe, to the underside of the supporting structure above.

.2 Ductwork

a. Rectangular and oval ductwork with cross sectional area less than 0.55 $m^2$6 ft^2.

b. Round ducts with diameters less than 710 mm28".

c. Ductwork suspended by hangers at a distance of 305 mm12" or less, measured from the top surface of the duct to the underside of the supporting structure above.

.3 Electrical conduit

a. Conduit less than 64 mm2½" I.D.

b. Cable trays supporting conduit which is sized less than 64 mm2½" I.D.

c. Electrical conduit or cable trays suspended by hangers at a distance of 305 mm12" or less, measured from the top surface of the conduit / tray to the underside of the supporting structure above.

3.4 INSPECTION

.1 Provide services of the manufacturer's technical representative to conduct site inspections of the Work in progress, and to conduct a final inspection of the Work. Provide a copy of the final inspection report to the Engineer for review.

END OF SECTION

TORONTO

SECTION 15550

GENERATOR ENGINE EXHAUST SYSTEM

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 Supply, install, and commission a complete exhaust systems for the new natural gas generator engine as indicated on Contract Drawings and as specified herein.

.2 The required work includes but is not limited to the following:

.1 Furnishing of labour, materials, and equipment required for installation of the exhaust system associated with the Standby Generator. The Standby Generator is supplied by Division 16 – Electrical.

.2 Provide flexible connections, and all required piping, and exhaust silencer from the natural gas engine to the generator stack as indicated on the drawings.

1.2 RELATED SECTIONS

.1 Section 15050 – Basic Mechanical Materials and Methods.

.2 Section 16500 – Natural Gas Engine Indoor Generator.

1.3 SUBMITTALS

.1 Submit shop drawings according to the requirements in Section 01330 – Submittals including but not limiting to the following:

.1 Technical literatures of thimbles, expansion joints, flexible connectors, and all necessary components forming the part of the exhaust system.

.2 Submit pipe leakage and flow test data.

.3 Plan and section drawings of exhaust piping and breechings. Include information on materials of construction, performance and dimensions.

.4 Sound attenuation details for the exhaust silencer.

.5 Submit technical literature for fuel tank, and all related accessories to be installed.

.2 Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and centre of gravity. Indicate unit shipping, installation and operating weights including dimensions.

1.4 REGULATIONS

.1 Conform to all codes, by-laws, etc. of Provincial and City authorities having jurisdiction.

.2 No additional compensation will be awarded for carrying out any conditions embodied in such regulations.

.3 When the work as shown and as specified exceeds the minimum requirements of such regulations, the Drawings and/or Specifications shall govern.

.4 Provide all permits, inspections, and certificates required for this Section.

1.5 GENERAL ARRANGEMENT

.1 Co-ordinate the work under this Section with all other trades, in particular the structural work.

.2 Install the systems and apparatus in a practical and first-class manner and guarantee all work and apparatus against defects of workmanship and material and make good any and all defects that may develop.

.3 Exhaust layout, position of equipment, etc., specified herein and shown on the Drawings indicates the general arrangement.

1.6 WORKING DRAWINGS AND EQUIPMENT MANUALS

.1 Submit working Drawings for review for all items included in this Section.

.2 Submit all manuals required under this Section.

1.7 APPURTENANCES, FITTINGS, CONNECTING PIPING AND DUCTING, AND ACCESSORIES

.1 Supply and install all appurtenances, fittings and accessories necessary for the proper functioning of the system or reasonably inferable from the Drawings with the equipment, whether indicated on the Drawings or specified herein or not.

PART 2 PRODUCTS

2.1 NATURAL GAS GENERATOR EXHAUST SYSTEM

.1 The chimney shall be listed for temperatures of 1000°F under continuous firing and 1400°F in brief forced firing according to UL-103, ULC-S604, and ULC/ORD-C959.

.2 The factory built breeching system shall be made in accordance with NFPA 211. This stack system shall be designed and installed to be gas tight. It shall be listed in accordance with UL103 to withstand up to 60 inch internal water column pressure.

.3 Each section shall be made of two steel cylinders separated by 2 inch of high temperature fiber insulation. The published clearance of 1 inch to combustible shall be the result of UL/ULC standard.

.4 The inner wall (flue) shall be constructed from 316 stainless steel, 0.035 inch thick. The outer wall (casing) shall be constructed from galvalume, 0.018 inch thick for diameter 5 inch to 24 inch and 0.024 inch for diameter 26 inch to 36 inch.

.5 Non-stainless steel surfaces exposed outside shall be protected by a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for high

temperature. All primer and paint must be supplied by the Contractor and shall be equivalent to series 4100 or 9400 as manufactured by Rust-Oleum or approved equal.

.6 The inner wall (flue) shall be laser or plasma welded.

.7 All section joints shall be self-centering to ensure proper spacing between the inner wall (flue) and the outer wall (casing).

.8 All section joints are connected and sealed with factory supplied locking bands at the outer wall (casing) only. Use appropriate sealant as specified in the manufacturer's installation manual.

.9 The chimney shall be designed to compensate for thermal expansion.

.10 The chimney shall be electrically grounded; provide two aerial terminals at the top of the chimney and two connecting points for #4/0 copper grounding wires.

.11 Approved Manufacturers:

.1 Sommers Environmental.

.2 Cheminee Lining.

.3 Selkirk Canada Corporation.

.12 Confirm to the latest edition of reference standards:

.1 Ontario Installation code for Oil-Burning Equipment CSA B149.

.2 The Ontario Fire Code and National Fire Code.

.3 The Ontario Building Code.

2.2 ENGINE EXHAUST SILENCER

.1 Provide a cylindrical exhaust silencer as indicated on the Contract Drawings.

.2 Silencer shall be Hospital Plus Grade, with a minimum as detailed in the following chart:

Selected 1/3 Octave Bands Frequency (Hz)							
63	125	250	500	1,000	2,000	4,000	8,000
18	40	50	46	28	26	27	28

.3 Shall include any insulation blankets, and any other accessories required in order to meet installation requirements outlined in CSA B149, and to suit site conditions.

.4 Silencer shall be selected to meet the flow restriction requirements of the Engine; coordinate with engine supplier.

.5 Acceptable Manufacturers:

.1 SMS Silencers.

.2 Vibron Ltd.

.3 Nelson Global.

.4 Maxim Silencers.

PART 3 EXECUTION

3.1 INSTALLATION

.1 The installation shall be in accordance with the manufacturer's installation instructions and recommendations.

.2 Provide all necessary labour, equipment, tools, supports, etc., for complete installation.

.3 All section joints are to be held in place by a mechanical locking band.

.4 All piping to be installed in plumb and aligned horizontal and vertical orientation.

.5 Apply sealant as recommended by the manufacturer's installation instructions and recommendations.

.6 Coordinate exhaust pipe routing with other equipment

.7 Adjust piping to remove weight from bellows-type flexible connection at engine.

.8 Provide flanges on piping as required.

3.2 EXHAUST SYSTEM INSTALLATION

.1 The installation shall be in accordance with the manufacturer's installation instructions and recommendations and shall conform to all applicable state and local codes.

.2 All section joints are held in place by one mechanical locking band and sealed with appropriate sealant.

.3 Coordinate installation of exhaust system with generator and generator weather enclosure.

.4 For Positive Pressure applications, apply the sealant as recommended by the manufacturer's installation instructions and recommendations.

.5 All 90° turns shall be made by using two 45° elbows. The 45° tee at the base of the chimney shall have a drain type tee cap.

.6 The entire stack system from the appliance to the termination, including all accessories, except as noted, shall be from one manufacturer.

3.3 MATERIALS

.1 Safely deliver materials to site. Ensure materials do not get damaged during unloading, storage or erection. Damaged equipment shall be made good prior to installation.

.2 Protect equipment against weather, damage and theft to the satisfaction of the Engineer.

3.4 TSSA INSPECTION AND PERMIT COSTS

.1 The Contractor is responsible for all TSSA inspections and permit costs associate with the project.

3.5 COMMISSIONING

.1 Ensure that all systems have been cleaned, tested (including pressure tested) and that all operations have been tested and verified prior to arranging for a commissioning session. The Commissioning session shall be to verify proper operation of components only.

.2 Provide manufacturer-supplied commissioning checklists or sheets upon completion.

.3 The Contractor shall commission the installation in presence of a City's Representative.

3.6 WARRANTY

.1 The manufacturer shall warranty the chimney for fifteen (15) years from date of delivery for functional failure and failure due to condensate in the vent system. See manufacturer's warranty for details.

.2 The sizing of the complete vent system shall be guaranteed by the manufacturer and a copy of the sizing calculations submitted to the Engineer for review and approval prior to the Contractor placing an order and release.

.3 The manufacturer shall submit a venting drawing for approval showing all vent system components. The Contractor must position all venting components, equipment, water and gas piping to accommodate the vent system design.

END OF SECTION

TORONTO

SECTION 15760

CONVECTION HEATING AND COOLING UNITS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this Section.

a. Cold water unit cooler

1.2 REFERENCE STANDARDS

.1 Comply with the latest edition of the following:

.1 ASHRAE Latest Edition

1.3 SUBMITTALS

.1 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01330.

.2 Operation and Maintenance Data

.1 Submit printed operation instructions and maintenance data in accordance with Section 01330.

PART 2 PRODUCTS

2.1 HYDRONIC CABINET COOLER

.1 General

.1 Cabinet cooler is intended to absorb the convective heat associated with operation of the 300KW genset. The heat flux is 100KW. The cooler will be connected to plant utility water and discharge to the decant tanks below the pipe gallery. The unit will circulate air within the generator room to maintain the temperature at 21C

.2 Temperature of the plant utility water is estimated to be 8C year round

.3 Type, model, size and capacity: as shown on Drawings and as specified herein.

.2 Construction

.1 Capacity

a. Unit connected to cold water source in plant

.2 Cabinets:

a. Minimum 1.6 mm (16 gauge) steel, with removable front panel, vandal proof fastenings for access to motors, blowers and heating element.

b. Factory finished with rust-resistant baked-on primer inside and outside (and baked-on final coat on outside to later colour selection).

.3 Coils:

a. Non-ferrous type with aluminum fins mechanically bonded to seamless copper tubing.

b. Tubes: rolled or brazed into cast iron or steel headers, and tested for 862 kPa (125 psig) working pressure.

.4 Blowers:

a. Forward curved multi-blade centrifugal type and dynamically balanced to eliminate vibration.

.5 Motors:

a. TEFC industrial type with thermal overload, ball bearings, resilient mounting, direct or belt drive,.

.6 Controller:

a. VFD type mounted within unit, in location accessible through access panel and with built-in thermostat, wired to permit installation of an external thermostat.

.3 Acceptable Manufacturers

.1 Trane

.2 Dunham-Bush

.3 Engineered Air

PART 3 EXECUTION

3.1 GENERAL

.1 Support from housekeeping pad with spring isolators.

.2 Install space thermostats and provide control wiring between thermostats and unit cooler.

.3 Provide local override control stations where detailed on Drawings, including wiring, door contact switches, selector switches, and panel enclosures and provide wiring to unit cooler control panel.

.4 Install miscellaneous steel framing, supports, braces, etc. as required to support equipment and ductwork as specified herein, and as shown on Drawings.

.5 Install units as per manufacturer's instructions and as shown on Drawings.

.6 Install and wire all accessories shipped lose with units for fully operating systems.

END OF SECTION

TORONTO

SECTION 15810

DUCTWORK AND ACCESSORIES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Supply, install, and satisfactorily operate a complete ventilating system to the full intent of the Drawings and Specification. All exposed ductwork shall be aluminium as specified below.

1.2 RELATED SECTIONS

.1 Section 15050 – Basic Mechanical Materials and Methods.

.2 Section 15181 – Piping and Equipment Insulation.

1.3 SHOP DRAWINGS

.1 Action Submittals: Product description, capacity, weight, electrical requirements, nominal and operating performance, and manufacturer's installation instructions.

.2 Informational Submittals:

.1 Louvers.

1.4 REFERENCES

.1 The following documents form a part of these specifications to the extent stated herein. Bring any conflicts between specifications, drawings, and the referenced documents to the attention of the Engineer in writing, for resolution before taking any related action.

.1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

a. ASHRAE Handbook Series Fundamentals: Ch. 2. Duct Design.

b. ASHRAE Handbook Series Equipment: Ch 6. Duct Construction.

.2 National Fire Protection Association (NFPA).

.3 Sheet Metal and Air Conditioning Subcontractors National Association (SMACNA).

.4 Underwriters Laboratories Inc. (UL).

.5 American Society for Testing and Materials (ASTM).

.6 Ontario Building Code (OBC).

1.5 REGULATIONS

.1 Conform to all codes, by-laws, etc. of Provincial and Municipal authorities having jurisdiction.

.2 No additional compensation will be awarded for carrying out any conditions embodied in such regulations.

.3 When the work as shown and as specified exceeds the minimum requirements of such regulations, the Drawings and/or Specifications shall govern.

.4 Provide all permits, inspections, and certificates required for this Section.

1.6 GENERAL ARRANGEMENT

.1 Ductwork, position of equipment, etc., specified herein and shown on the Drawings indicates the general arrangement.

.2 Co-ordinate the work under this Section with all other trades, in particular the structural work and make all necessary changes or additions to the runs to accommodate structural conditions, piping, ductwork, mechanical equipment, etc.

.3 Install the systems and apparatus in a practical and first-class manner and guarantee all work and apparatus against defects of workmanship and material and make good any and all defects that may develop.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Protect ductwork from dirt, water, and debris. During storage on jobsite, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.

.2 Deliver sealant materials to site in original unopened containers labelled with manufacturer, product name and designation, colour, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

.3 Store and handle sealant materials in compliance with manufacturers' recommendations to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

.4 Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

1.8 WORKING DRAWINGS AND EQUIPMENT MANUALS

.1 Submit working Drawings for review for all items included in this Section.

.2 Submit all manuals required under this Section.

1.9 QUALITY ASSURANCE

.1 Industry Standards:

.1 Unless otherwise indicated or specified, sheet metal ductwork shall be constructed and installed in accordance with SMACNA duct construction standard relevant to ductwork system being provided. These standards are herein referenced as the SMACNA Manual, unless otherwise indicated.

.2 Comply with ASHRAE Fundamentals Handbook recommendations, except as otherwise indicated.

.3 NFPA Compliance: NFPA 90A and NFPA 90B.

.2 Manufacturers: Firms regularly engaged in manufacture of ductwork products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.

.3 Suppliers of duct and fitting components shall provide on request the following information:

.1 Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.

.2 Laboratory performance data for fittings, including zero-length dynamic losses.

.4 Installer shall be a firm with at least 3 years' experience of successful installation on ductwork systems similar to that required for this Project.

.5 Changes or alterations to layout or configuration of duct system shall be:

.1 Specifically approved in writing by Engineer.

.2 Proposed layout shall provide original design results, without increasing system total pressure.

1.10 APPURTENANCES, FITTINGS, CONNECTING PIPING AND DUCTING, AND ACCESSORIES

.1 Supply and install all appurtenances, fittings, ductwork and accessories necessary for the proper functioning of the system or reasonably inferable from the Drawings with the equipment, whether indicated on the Drawings or specified herein, or not.

PART 2 PRODUCTS

2.1 DUCTWORK GENERAL

.1 Ductwork shall be aluminium unless otherwise specified.

.2 Install ductwork as shown on the Drawings. Duct sizes shown on the Drawings are clear internal dimensions whether internal insulation is installed or not.

.3 Ductwork to be adequately strong and sufficiently rigid to resist all normal shocks, reinforced at all points where necessary to prevent vibration or movement, and securely fastened in place.

.4 Ensure ducts are airtight and all joints gasketed or caulked and made in accordance with the best standards of the trades.

.5 Elbows and other changes in ductwork direction to have centreline radius at least equal to the duct depth or diameter. Where possible, all transitions in duct size will be made

with an angle not exceeding 15 degrees. Supply and install dampers in all ducts as indicated.

.6 Install a canvas sleeve where the ductwork connects to the ventilating units such that the unit is isolated from the ductwork. Do not insulate the sleeve.

.7 Exposed Ductwork: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials that are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those that would impair painting.

.8 Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.2 DUCTWORK

.1 For rectangular ductwork, aluminium construction to ASTM B 209, Alloy 3003, H14 temper with mill finish.

.2 Unless specified otherwise, adhere to the following gauge sizes:

.1 U.S. Standard Gauge for Low, Medium and High Pressure Duct:

Duct Diameter (mm)	Low	Medium	High
up to 305	26	24	22
305 to 760	24	22	20
760 to 1370	22	20	18
1370 to 2130	20	18	16
2130 to over	18	16	14

2.3 DUCT SEALING MATERIALS

.1 General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

.2 Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.

.3 Solvent-Based Sealants:

.1 Ultraviolet light resistant.

.2 Mildew resistant.

.3 Flashpoint: Greater than 21°C, SETA CC.

.4 Manufacturers and Products:

a. Hardcast, Inc.; Versagrip 102.

b. Rectorseal; AT-33.

.4 Water-Based Sealants:

.1 Listed by manufacturer as nonflammable in wet and dry state.

.2 Manufacturer and Product: Rectorseal; Airlok 181.

2.4 DUCTWORK FASTENERS

.1 General:

.1 Rivets, bolts, or sheet metal screws.

.2 Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.

.2 Self-Drilling Screws:

.1 Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.

.2 Aluminium Ductwork System:

a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated Type 410 stainless steel, complete with bonded metal and fibre washer for dielectric separation.

b. Manufacturers:

(a) DB Building Fasteners Inc., Santa Fe Springs, CA.

(b) Clark Craft Fasteners, Tonawanda, NY.

(c) UCAN Fastening Products.

.3 UCAN Fastening Products.

2.5 DUCTWORK PRESSURE CLASS

.1 Construct duct systems to pressure classifications indicated in Ductwork Schedule.

.2 Where no specific duct pressure designations are indicated in Specifications or on Drawings, 500 Pa pressure class shall be basis of Contract.

2.6 RECTANGULAR DUCTWORK

.1 Fabricate rectangular ducts in accordance with SMACNA, unless specified otherwise.

.2 Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 480 mm and larger and are 20-gauge or less, with more than 1.0 square meter of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.7 RECTANGULAR DUCTWORK FITTINGS

.1 Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA.

.2 Elbows:

.1 Fit square-turn elbows with vane side rails.

.2 Shop fabricate double-blade turning vanes of same material as ductwork.

.3 Fabricate with equal inlet and outlet.

.4 Rectangular radius elbows with inside radius of 3/4 of duct width in direction of turn.

.5 Manufacturers and Products:

a. Elgen.

b. All-Tight.

2.8 DUCTWORK HANGERS AND SUPPORTS

.1 General:

.1 Refer to Section 15090 – Supports, Anchors and Seals.

.2 Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.

.3 Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.

.4 Wire hangers are not acceptable.

.2 Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Paragraph 2.5 DUCTWORK FASTENERS.

2.9 FLEXIBLE CONNECTIONS

.1 Materials:

.1 Flame-retarded or non-combustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

.2 Outdoor flexible connectors coated with Hypalon for UV protection.

.2 Metal Edged Connectors:

.1 Construct from same material as ductwork, unless otherwise noted.

.2 Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.

.3 Standard Metal Edged Connectors: Factory fabricated with strip of fabric 90 mm wide attached to two strips of 70 mm wide sheet metal.

.4 Extra Wide Metal Edged Connectors: Factory fabricated with strip of fabric 146 mm wide attached to two strips of 70 mm wide sheet metal.

.5 Transverse Metal Edged Connectors: Factory fabricated with strip of fabric 90 mm wide attached to two strips of 111 mm wide sheet metal.

.3 Manufacturers and Products:

.1 Duro-Dyne; Durolon

.2 Dynair.

.3 Papco Industries Inc.

2.10 LOUVERS

.1 Aluminium Stationary Louvers:

.1 Furnish and install stationary drainable louvers of the size and shape indicated on the drawings. The louvers shall be constructed entirely of epoxy coated extruded aluminium; alloy 6063-T5 extruded 150 mm aluminium blades positioned at a 35 degrees angle.

.2 Louver performance shall be based on test and procedures in accordance with AMCA publication 511 and comply with the requirements of the AMCA Certified Rating Program

.3 Louvers shall be designed to withstand a 25-psf-wind load.

.4 Each louver shall be fitted with 12.7mm x 1.6mm diameter aluminium bird screen. Bird screen shall be expanded aluminium construction and suitable for interior mounting.

.5 Architect shall select the finish.

.6 Louvers shall be supplied with continuous blade section to give the appearance of invisible mullions.

.7 Acceptable Manufacturers:

a. Arrow United.

b. Carnes.

c. Ruskin.

2.11 WIRE MESH (BIRDSCREEN)

.1 Heavy-gauge galvanized steel or aluminium mesh, 12mm x 12mm (1/2” x 1/2”) secured in a rigid galvanized steel or aluminium framework and sized as indicated on the Drawings.

.2 Birdscreens shall be 316 stainless steel for chemical storage rooms, classified areas and corrosive areas.

PART 3 EXECUTION

3.1 MATERIALS

.1 Safely deliver materials to the site.

.2 Handle materials at all times with care to avoid damage.

.3 Load, unload, and move materials into place by means of hoists, ropes or skid ways in such a manner as to avoid shock.

.4 Do not drop or roll materials against one another.

.5 Properly store equipment on site.

.6 Protect equipment against weather, damage and theft to the satisfaction of the Engineer.

3.2 DUCTWORK

.1 Contractor must coordinate location of all ductwork with process piping, structural and electrical divisions. The general contractor shall approve the route of the ductwork prior to manufacturing.

.2 Install ducts straight and plumb, following building lines.

.3 Do not install in front of equipment or controls in such manner as to interfere with operation, servicing or repairs.

.4 Provide ductwork adequately strong and sufficiently rigid to resist all normal shocks, reinforced at all joints where necessary to prevent vibration or movement, and securely fastened in place.

.5 All ducts to be airtight and all joints caulked and made in accordance with the best standards of the trade.

.6 Where possible make all transitions in ductwork size with an angle not exceeding 15 degrees.

.7 Provide elbows and other changes in ductwork direction having centreline radius at least equal to 1.5 times the duct depths.

.8 Provide fire dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion-resistant springs, bearings, bushings, and hinges. Refer to architectural drawings for location of fire rated walls.

.9 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

.10 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated on the drawing.

.11 Provide duct test holes where indicated on the drawings and required for testing and balancing.

.12 Penetrations:

.1 Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls and ceilings.

.2 Clearances:

a. For un-insulated ducts, allow 25 mm clearance between duct and sleeve, except at grilles, registers, and diffusers.

b. For insulated ducts, allow 25 mm clearance between insulation and sleeve, except at grilles, registers, and diffusers.

.3 Closure Collars:

a. Minimum 102 mm wide on each side of walls or floors where sleeves or prepared openings are installed.

b. Fit collars snugly around ducts and insulation.

c. Same gauge and material as duct.

d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapour barrier.

e. Use fasteners with maximum 152 mm centres on collars.

.4 Packing: Mineral fibre in spaces between sleeve or opening and duct or duct insulation.

.13 Concealment:

.1 Wherever possible in finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction, or above suspended ceiling.

.2 Do not encase horizontal runs in solid partitions, except as specifically shown.

.3 Limit clearance to 25mm where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.

.14 Coordination with Other Trades:

.1 Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of ductwork system.

.2 Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on Drawings.

.3 Coordinate ductwork layout with suspended ceiling, lighting and sprinkler head layouts and similar finished work.

.4 Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.

3.3 DUCTWORK SUPPORT

.1 Support all ductwork at intervals not exceeding 2300mm.

.2 Do not use perforated straps or similar hangers for the support of ductwork or equipment installed under this Section.

.3 Do not use explosives to insert anchors.

.4 Brace vertical ducts to walls with steel straps finished as required.

3.4 EQUIPMENT SUPPORTS

.1 Mount equipment supported above floors on approved welded galvanized structural steel framework with diagonal bracing and floor and wall plates.

.2 Unless otherwise shown on the Drawings, construct framework of 75 x 75 x 6mm angles.

.3 Hang suspended equipment on 13mm minimum diameter galvanized hanger roads attached to the building structure.

3.5 EXTERNAL DUCT INSULATION

.1 Refer to Section 15181 – Piping and Equipment Insulation.

END OF SECTION

TORONTO

SECTION 15820

HVAC DUCT ACCESSORIES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this Section.

1.2 RELATED SECTIONS

.1 Division 25: Integrated automation:

.1 Automatic control damper operators

.2 Automatic control dampers

1.3 SUBMITTALS

.1 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01330.

PART 2 PRODUCTS

2.1 DUCT WORK ACCESSORIES

.1 Flexible Duct Connections

.1 Material:

a. Heavy glass fabric double coated with neoprene and attached to 0.6 mm (24 ga) metal strips 75 mm3" wide.

b. Fabric length between metal strips:

(a) Minimum 75 mm3" for ducts of maximum size in either dimension or diameter of 750 mm30" or less

(b) 150 mm6" for ducts of 775 mm31" size and larger.

.2 Acceptable Manufacturers:

a. Duro-Dyne "Grip-Loc Type SMFN"

b. Ventfabrics "Ventglas"

.2 Turning Vanes

.1 Material: Hollow airfoil type, fabricated of same material as duct in which they are installed.

.2 Acceptable Manufacturers:

a. Duro-Dyne

.3 Access Doors in Duct Work and Plenums

.1 Hand door:

a. Construction: 0.7 mm (24 ga) galvanized steel, double flanged frame and insulated door complete with insulation backing plate.

b. Fasteners: Zinc plated cam-lock fasteners, minimum two per door, with safety retaining chain.

.2 Equipment and man doors:

a. Minimum size, equipment: Where motors are installed within unit or duct, use an access door large enough to permit removal of motor.

b. Minimum size, man door: 450 mm x 1.2 m18” x 48” or as shown on Drawings.

c. Construction: 0.8 mm (22 ga) thick galvanized steel sheet double panel construction with approved 25 mm1" thick insulating filler, mounted in flanged die-formed collar flush with face of finished insulation, with flanged door frames welded in place.

d. Hinges: Heavy zinc plated continuous hinge.

e. Fasteners: Three heavy sash fasteners and neoprene gaskets.

.4 Probe Inlets

.1 Material:

a. Ventlok No. 699 or Duro-Dyne IP-1 or IP-2 Test Opening Enclosures complete with locking cap, chain, gaskets, insulating plug and extensions for insulated duct work.

2.2 OPERATING DAMPERS

.1 Automatic Control Dampers

.1 General:

a. Modulating control dampers: Opposed blades.

b. Two position control dampers: Parallel blades.

.2 Damper blades and frames:

a. Extruded aluminum 6063-T5

b. Maximum blade length: 1.2 m48" without internal frame support.

c. Maximum blade length: 1.2 m48" without internal frame support.

d. Blade edge seals: EPDM gaskets.

e. Frame side seals: Extruded TPE or cambered stainless steel.

f. Frame style: Flanged to duct.

g. Jack shaft: Extendable, combination of aluminum, and zinc/nickel coated steel.

h. Damper leakage: 50 L/s per m²10 cfm per ft² damper face area at 1 kPa4" w.c. differential static pressure.

.3 Bearings:

a. Thermal plastic resin copolymer, nylon or oil impregnated bronze.

b. At blade axles, linkage devices, etc.

.4 Damper blades and frame for outside exhaust and intake air applications:

a. As above.

b. Operating temperature: -40°C to +100°C (-40°F to +212°F).

c. Thermally broken and insulated blades; expanded polyurethane foam insulation.

d. Damper leakage: 21 L/s per m²4.1 cfm per ft² damper face area at 1 kPa4" w.c. differential static pressure.

.5 Acceptable Manufacturer:

a. Tamco - Series 1000

b. Nailor Industries - Series 2000

c. Tamco - Series 9000 (exhaust and air intake applications)

d. Nailor - Series 2000IBF (exhaust and air intake applications)

e. Ventex Alumavent

.2 Manual Balancing Dampers

.1 Rectangular duct work:

a. Galvanized channel type frames, non-binding pre-lubricated type interconnecting and operating linkages.

b. Blades: Minimum 1.6 mm (16 ga) thick material, opposed blade style.

c. Manual operator and locking type quadrant as required for synchronous operation and setting of blades.

d. Blade width: Maximum 200 mm8".

e. Blade length: Length coinciding with frame opening on horizontal plane to maximum length of 1.2 m48".

f. Locking quadrant: Galvanized steel locking quadrant with “Open – Closed” labels, 50 mm2” insulation stand-off.

g. Acceptable Manufacturers:

(a) Nailor – Series 1810/1820 with HL2 quadrant

(b) Ventex Alumavent

.2 Round duct work - medium pressure butterfly damper:

a. Galvanized steel frame 0.9 mm (22 ga) with stiffening beads up to 300 mm12” diameter; 0.9 mm (20 ga) over 300 mm12” duct size.

b. Blade: Laminated galvanized steel 0.9 mm (22 ga), or single layer of 1.6 mm (16 ga), open and closed end stops, Celcon bearings, polyethylene blade edge seal, 13 mm½” diameter drive shaft.

c. Locking quadrant: Galvanized steel locking quadrant with “Open – Closed” labels, 50 mm2” insulation stand-off.

d. Acceptable Manufacturers:

(a) Nailor – Series 1000 with HL2 quadrant

.3 Round duct work - low pressure butterfly damper:

a. Galvanized steel frame 0.9 mm (22 ga) with stiffening beads up to 300 mm12” diameter; 0.9 mm (20 ga) over 300 mm12” duct size.

b. Blade: Galvanized steel 0.9 mm (22 ga) up to 300 mm12” diameter; 0.9 mm (20 ga) over 300 mm12” duct size, 6 mm¼” diameter drive shaft.

c. Locking quadrant: Galvanized steel locking quadrant with “Open – Closed” labels, 50 mm2” insulation stand-off.

d. Acceptable Manufacturers:

(a) Nailor – Series 1890 with HLQ-SB quadrant

.4 Splitter damper:

a. Material: Same material and thickness as ducts in which they are to be installed, minimum of 0.8 mm (22 ga).

b. Form splitters of double thickness of metal and with rounded surface at air entering edge.

c. Splitter length: At least one and one-half times width of smaller branch duct, but in no case less than 300 mm12".

d. Provide with locking type quadrant.

.3 Volume Extractors in Duct Work:

.1 Use where noted on Drawings

.2 Acceptable Manufacturers

a. Titus Model AG225 with #3 manual operator.

.4 Relief Dampers

.1 Acceptable Manufacturers:

a. Farr (American Warming and Ventilating Inc.) Model PR-10

b. Field

.2 Counterbalanced type of size shown on Drawings and as specified herein, vertical mounting and horizontal air flow, factory set for static pressure shown on Drawings.

.3 Dampers to have parallel blades, 50 mm x 13 mm x 3 mm2" x ½" x 1/8" steel channel frame, 1.6 mm (16 ga) aluminum blades, steel axles with ball bearings, adjustable counterbalances, counterweights, and inter-connecting linkage.

2.3 FIRE AND SMOKE DAMPERS

.1 Fire Dampers

.1 ULC labelled fire dampers of hinged, fusible link type with channel frames, blades and housing and conforming to NFPA 90A and UL555 requirements. Use "Type B" fire dampers for rectangular or square duct work and "Type C" fire dampers for round duct work.

.2 Dynamic dampers: Designed to close while the system fans are operating.

.3 Static dampers: Designed to close with no airflow through damper.

.4 Closure link: Fusible link which can be released, tested and relatched for testing.

.5 Construct fire dampers and frames of same material as duct in which they are installed.

.6 Acceptable Manufacturers:

a. Nailor – “D” series

b. Ruskin

c. Ventex Alumavent

.2 Smoke Dampers

.1 ULC labelled fire dampers of airfoil parallel blade type, with extruded aluminum channel frames and sleeve housing and conforming to NFPA 90A and 92A, and UL555S, leakage class I rating at 176°C (350°F).

.2 Blades: Extruded aluminum airfoil blade with concealed linkage outside of airstream, with self lubricating bronze type bearings, stainless steel camber style jamb seals, and mechanically locked in extruded edge seals

.3 Dampers designed to operate while the system fans are operating.

.4 Operator: Externally mounted, factory installed 120 VAC electric actuator with spring return, fail close position. Built-in high limit thermostat switch opens at 73°C (163°F).

.5 Accessories: 120 VAC proof-of-closure and proof-of-open end-switch, with two SPDT switches.

.6 Acceptable Manufacturers: Damper

a. Nailor – Series 1280

b. Ruskin

c. Ventex Alumavent

.7 Acceptable Manufacturers: Operator

a. Belimo – Model FSNF-120 US

.3 Combination Smoke and Fire Dampers

.1 ULC labelled fire dampers of airfoil parallel blade type, with extruded aluminum channel frames and sleeve housing and conforming to NFPA 90A and 92A, and UL 555 and UL555S, leakage Class I rating at 176°C (350°F).

.2 Blades: Extruded aluminum airfoil blade with concealed linkage outside of airstream, with self lubricating bronze type bearings, stainless steel camber style jamb seals, and mechanically locked in extruded edge seals

.3 Dampers designed to operate while the system fans are operating.

.4 Operator: Externally mounted, factory installed 120 VAC electric actuator with spring return, fail close position. Built-in high limit thermostat switch opens at 73°C (163°F).

.5 Accessories: 120 VAC proof-of-closure and proof-of-open end-switch, with two SPDT switches.

.6 Acceptable Manufacturers: Damper

a. Nailor – Series 1220

b. Ruskin

.7 Acceptable Manufacturers: Operator

a. Belimo – Model FSNF-120 US

2.4 ACOUSTIC TREATMENT

.1 Acoustic Duct Insulation

.1 Material:

a. Rigid coated duct liner conforming to NFPA 90A and 90B, 25 mm1" thick and 72 kg/m³4.5 lb/cu.ft density.

b. In duct work at velocities over 15 m/s3000 fpm, provide a perforated or expanded metal inner liner over acoustic insulation.

.2 Fasteners:

a. Fasten acoustic liner to inside of duct with plate type impaling pins and self-locking washers, by Eckels Industries "Stic-Klips", "Tactoo Series T", or Continental Stud Welding weld pins and self locking washers.

b. Use fasteners or securing pins of size and length as required by insulation weight, thickness, fastener spacing and design.

c. In addition to mechanical type fasteners, adhere insulation to inside of duct with Foster No. 81-99 or Henry No. 230-04 fire retardant adhesive. Seal all joints with Foster No. 30-36 or Henry No. 120-09 mastic sealant.

.3 Acceptable Manufacturers:

a. Owens Corning

b. Manson

c. Knauf

d. Manville

2.5 ACOUSTIC SILENCERS (S)

.1 Rectangular and Elbow Silencers

.1 Material:

a. Housing: Hot dip galvanized steel sheet, one gauge heavier than adjacent duct work but not less than 0.9 mm (20 ga).

b. Duct size: External silencer dimension to match adjacent duct dimensions, unless otherwise shown.

c. Inner liner: Hot dip galvanized perforated steel sheet, 0.8 mm (22 ga).

d. Insulation: Glass fibre or mineral wool to ASTM E-84, class 1.

.2 Performance

a. Silencers have been selected on basis of sound power levels of first listed equipment. Ensure that equipment of any other named manufacturer proposed for use has sound power levels equal to or lower than first listed equipment.

b. Be responsible for reducing noise levels to below acceptable maximum without additional cost to Owner.

.2 Circular Silencers

.1 Same as for rectangular silencers and as follows:

a. Internal bullet: Spun head and tapered tail, with airflow straightening vanes.

b. Duct size: Duct flange connection same size as adjacent duct size.

.3 Acceptable Manufacturers

.1 Vibron

.2 Vibro-Acoustics

.3 Woods

PART 3 EXECUTION

3.1 GENERAL

.1 Refer to and comply with applicable requirements specified in Section 15810.

.2 Install miscellaneous steel framing, supports, braces, etc. as required to hang or support equipment and duct work as specified herein, and as shown on Drawings.

3.2 FLEXIBLE DUCT CONNECTIONS

.1 Use flexible duct connections between fans and/or air handling units and connecting duct work, between unit components, in ducts at building expansion joints, and in other locations shown on Drawings

.2 Install flexible connectors with fabric in folds, not drawn tight.

.3 Install internal guides to prevent flexible connection from collapsing on suction side of fans.

.4 For installation between sections of air handling units, install flexible connectors suitable for connecting to flanges of casings where so provided.

3.3 TURNING VANES

.1 Provide hollow airfoil type turning vanes in duct work where shown on Drawings and in ninety degree square duct elbows, fabricated of same material as duct in which they are installed.

3.4 ACCESS DOORS

.1 Provide access doors in duct work and for plenums to allow servicing, maintenance, and inspection of:

.1 Control dampers

.2 Fire dampers

.3 Smoke dampers

.4 Fire detectors

.5 Control elements

.6 Sprinkler heads mounted in duct work

.7 Motors

.8 Bearings

.9 As shown on Drawings

.2 Provide “Hand Doors” in duct work of sizes as follows:

Access Type	Duct Dimension	Access Door Size
One hand and sight	Less than 400 mm16”	300x150 mm12” x 6”
Two hands and sight	Between 400 mm16” and 500 mm22”	450x250 mm18” x 10”
Head and shoulders	Between 500 mm22” and 760 mm30”	530x356 mm21” x 14”
Body plus ladder	Between 760 mm30” and 1320 mm52”	635x430 mm25” x 17”

.3 Provide “Equipment and Man Doors” as follows:

.1 In duct work with duct dimension over 1320 mm52”.

.2 In plenums.

.3 As shown.

3.5 BALANCING DAMPERS

.1 Use rectangular opposed blade dampers at the following locations:

.1 At floor connections to riser shafts/ducts.

.2 In supply and return duct work where main ducts are split into two more trunks.

.3 At rectangular branch duct connections to main or trunk ducts.

.4 As shown.

.2 Use splitter dampers only where specifically shown on Drawings.

.3 Use medium pressure butterfly dampers at the following locations:

.1 At floor connections to supply air riser ducts.

.2 In supply and return duct work where main ducts are split into two more trunks.

.3 At branch duct connections to main or trunk ducts.

.4 At branch duct upstream of terminal box.

.5 As shown.

.4 Use low pressure butterfly dampers at the following locations:

.1 At branch connections on the downstream side of terminal boxes.

.2 At individual branch outlets serving grilles or diffusers.

.5 Dampers supplied with diffusers or grilles are to be used to balance ±10% of indicated airflow, are NOT in lieu of branch dampers.

3.6 VOLUME EXTRACTORS IN DUCT WORK

.1 Use where noted on Drawings.

3.7 FIRE AND SMOKE DAMPERS

.1 Install fire dampers in accordance with Suppliers instructions, and with retaining angles on both sides of wall or floor and fastened to damper collars.

.2 Install fire dampers with adjacent access door as required to permit re-opening of damper and replacement of fusible link.

.3 Provide dynamic fire dampers on all systems, unless otherwise shown on Drawings and specified below.

.4 Provide static dampers on return air transfer openings.

3.8 RELIEF DAMPERS

.1 Install steel angle or channel frames at wall openings as required to mount relief damper (complete with fire damper) as shown on Drawings.

3.9 PROBE INLETS

.1 Install probe inlets in duct work at locations as follows:

.1 In main supply and return ducts.

.2 Inlet and outlet side of fans.

.3 Other locations as required by testing and balancing trade, to permit testing, balancing and measurement of air quantities and static pressure in air handling systems.

.2 Locate probe inlets a sufficient distance from elbows or transition sections to ensure stable readings of non-turbulent air and install 75 mm3" from corners and at 150 mm6" centres across long side of duct.

3.10 ACOUSTIC DUCT INSULATION AND SILENCERS

.1 Install internal acoustic insulation in specific sections of duct work and/or plenums as shown on Drawings as follows:

.1 Adhere insulation to duct work or plenums by bedding in strips of adhesive supplemented by impaling clips or weld pins spaced at 300 mm12" centres with self-locking washers.

.2 Apply adhesive at 50% coverage, in 150 mm6" strips.

.3 Cut off ends of welded impaling pins after application of self-locking washers.

.4 Seal butt joints of insulation with mastic sealant applied to edges of insulation.

.5 Coat joints and self-locking washers after installation with two coat application of mastic sealant, and with open mesh glass fabric embedded in mastic between first and second coat.

.6 In high velocity duct work install perforated or expanded metal inner liner over acoustic lining.

.2 Use silencers in duct work where shown on Drawings, to attenuate airborne noise generated in air distribution systems.

.3 Fabricate cross talk silencers:

.1 Housing: Galvanized steel, to SMACNA pressure class 1" standard.

.2 Liner: Rigid coated duct liner.

.3 Size: As shown on drawings.

.4 Shape: As shown on drawings.

.5 Provide a sheetmetal nosing at open ends of duct to close off cut edge of liner.

END OF SECTION

TORONTO

SECTION 15850

DIFFUSERS, REGISTERS AND GRILLES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this Section.

PART 2 PRODUCTS

2.1 DIFFUSERS, REGISTERS AND GRILLES

.1 General

.1 Neck size, dimensions and capacity as shown on Drawings. Catalogue numbers of first named Supplier are listed on Drawings to show required type and style.

.2 Acoustic and airflow performance is based on catalogued information of the indicated manufacturer and model as shown on Drawings or schedules. Other named manufacturer Products must match these implied performance criteria.

.3 Border and frame as required to suit wall and ceiling construction.

.2 Linear Diffusers and Grilles

.1 Extruded aluminum construction, unless otherwise shown on Drawings.

.2 Linear supply and return diffusers to have either natural anodized aluminum finish or baked enamel finish as listed on Drawings.

.3 Complete with engineered distribution plenum and internal opposed blade damper. Black finish on inside of plenums.

.4 Curved and custom shapes and finishes as detailed on Drawings.

.3 Square and Circular Pattern Diffusers

.1 Steel construction with baked white enamel finish, unless otherwise shown.

.2 True imperial or metric sizes.

.3 Radial opposed blade damper.

.4 Grilles

.1 Steel construction with baked white enamel finish, unless otherwise shown.

.2 Blade orientation parallel to the long dimension.

.3 Opposed blade damper in black finish.

.5 Door Grilles

.1 Door grilles will be supplied and installed by general trades.

.6 Acceptable Manufacturers:

.1 E.H. Price

.2 Nailor Industries Inc.

.3 Titus

.4 Carnes

.5 Tuttle & Bailey

PART 3 EXECUTION

3.1 GENERAL

.1 Supply diffusers and registers to deliver indicated air quantities shown with throw to reach intended space limits without increasing the sound level of room. Provide blank-off baffles where required and equalizing deflectors on diffusers and in other locations as shown or required.

.2 Coordinate placing of diffusers, registers and grilles in ceilings with electrical and ceiling installation trades and exact location to final approval of Engineer.

.3 For connection to specific light-air troffers in flat ceilings provide boots to connect flexible duct to lighting fixtures.

.4 For connection of air supply to coffered ceilings provide boots suitable for attachment to air slot on coffered ceilings as required and where shown on Drawings. Connect flexible supply air duct to neck of boot.

END OF SECTION

DIVISION 16

ELECTRICAL

TORONTO

SECTION 16010

ELECTRICAL GENERAL REQUIREMENTS

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PART 1 GENERAL

1.1 GENERAL

.1 Read and conform to the General Requirements (Division 1), which applies to and forms part of all sections of the work. The general instructions are intended to supplement and not to replace Division 1 requirements.

.2 The specification is divided into divisions of work and a division may consist of the work of more than one (1) sub-Contractor. The responsibility as to which sub-Contractor provides labour, materials, equipment and services required to complete the work rests solely with the Contractor.

.3 The existing Water Treatment Plant must remain in full and uninterrupted operation during this contract.

.4 The Contractor is required to visually inspect the existing site conditions, including below grade tunnels, prior to submitting a Bid, to suit the installation of the new standby natural gas generators, power and controls distribution. The contractor is required to coordinate the installation of the new power/control infrastructure with the existing services. The Contractor shall verify all existing conditions including building services that are in close proximity to the proposed cable installations as shown on the drawings.

.5 All new electrical wiring, equipment, and new local control panels are to be supplied to meet the electrical and environmental classifications of areas in which they are to be installed.

.6 All wiring to suit retrofit of existing main motor control centres (MCC/PDP) and control panels and/or instrumentation that will remain in service shall be new.

.7 All exposed indoor or outdoor conduits shall be rigid PVC.

.8 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in the Tender documents. Install and connect all electrical and instrumentation equipment, controls and devices supplied under other sections. The word “provide” shall be defined to mean supply and install.

.9 The Contractor is required to remove all power distribution, conduit and control wiring for any items that are identified for demolition on the contract drawings. The Contractor shall correlate the demolition requirements on the electrical drawings with all other drawings and disciplines to ensure that all power and control wiring distribution is removed for any equipment identified for demolition.

1.2 SUMMARY

.1 The Electrical scope of work to be provided at the R.C. Harris Water Treatment Plant includes but is not limited to the following:

.1 Provision of installation, testing, commissioning, and placing into operation of one (1) new Standby generator system, complete with new automatic transfer

switches, new cables, wiring, cable trays, conduits and supports as required along with the transferring of loads from the main existing system buses to the new standby system buses, as indicated in the contract documents, specifications and drawings, meeting all applicable CSA Standards and Codes.

.2 Provision of a new and complete short circuit, protection coordination and arc flash study for the single line works under this Project. The Plant existing studies will be provided to the successful bidder. The new studies shall include the Standby generators side, and Normal utility side systems including the existing buildings main 13.8 kV switchgears down up to the 600V distribution system. This new study shall be signed and sealed by a Professional Engineer licensed in the Province of Ontario to be hired by the Contractor, and shall be provided, reviewed and approved, prior to shop drawing submittals and approval of any relevant electrical equipment.

.3 It is made clear that the Contractor shall provide products, and perform installations, start-up, testing, commissioning procedures, as well as training services and warranty, and all other requirements as indicated in the contract documents, specifications and drawings according to all applicable CSA Standards and Codes. The Contractor shall include all required costs to do so into the tender price. The Contractor shall submit Factory and Site Acceptance Test procedures for all new electrical equipment for review and approval.

.4 Provision of one (1) new indoor (pad-mounted) natural gas generator system, one (1) remote annunciator panel for remote generator monitoring and annunciation, and associated materials and connection for portable load bank (load back excluded), complete as indicated in the contract documents, specifications and drawings according to all applicable CSA Standards and Codes. Including delivery the customized generator set to the designated indoor generator room from the building entrance via existing vertical chute and horizontal wall openings, and assemble the generator parts on site.

.5 Provision of new Automatic Transfer Switches (ATS's), Low Voltage Switchboards, Panelboards, breakers and associated materials, complete as indicated in the contract documents, specifications and drawings meeting all applicable CSA Standards and Codes.

.6 Provision of all required power distribution, including retrofit of existing 600V Motor Control Centres as a result of the removal of existing cable feeder as required and all control components and connections from the new Low Voltage Switchboard to the devices.

.7 Provision of all control components and connections from existing specified RPU's to new natural gas standby generators, new automatic transfer switches, new Low Voltage Switchboards and new Panelboards as specified.

.8 Provision of new cables/wiring, conduit runs and cable trays for critical and essential circuit protection, and associated installation hardware, materials and supporting systems where required for a complete functional system, are to be completed for wiring as indicated in this specification and/or shown in the

Contract documents and drawings according to all applicable CSA Standards and codes.

.9 Provision of a Sequence of Construction by the Contractor for the installation of the new Standby generator/ATS system, taking into account minimizing required plant shutdowns/isolations, at all times throughout construction.

.10 Testing and Commissioning of all equipment installed shall be completed as per all required procedures and requirements mentioned and indicated in this specification and in the contract documents and drawings according to all applicable CSA Standards and Codes. The Contractor shall also submit Factory and Site Test procedures for review and approval.

.11 Provision of two-year (2) minimum warranty on all equipment provided under this project on labour and material unless otherwise indicated in this specification.

.12 Demolition and Removal of all existing cables, and associated materials complete as specified and /or shown in the contract documents, specifications and/or drawings according to all applicable CSA Standards and Codes. Demolition of cables and wiring of existing electrical equipment shall be subsequent to the successful testing and commissioning of the overall new generator systems including generators/ATS's performance and new Low Voltage switchboards/panelboards and circuit connections. Demolition work shall be incorporated into the Contractor's Sequence of Construction documentation.

.13 All other work and coordination effort required (with other works: Mechanical, Structural and Enbridge Utility), to deliver a complete functional system to satisfy the intent of the design, whether or not detailed on the Contract documents, drawings and/or described in this specification.

.14 Provision of all cable tray/conduit systems as specified complete with supporting material and hardware.

.15 Provision of all grounding and bonding required by the Ontario Electrical Safety code – latest edition whether or not shown explicitly in the Contract documents, specifications and drawings. This includes all required grounding and bonding to the generator, new exhausts and metal parts.

.16 Provision of Operation and Maintenance Manual, City Training sessions and Record Drawings.

.17 Provision of replacement of existing cable trays as indicated inside underground tunnel linking pumping station building and RMF building hydro vault

.18 Any other work specified in the Contract documents.

1.3 RELATED SECTIONS

.1 Division 1 – General Requirements.

1.4 CODES AND STANDARDS

.1 Perform complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Perform overhead and underground systems in accordance with CSA C22.3 No.1-1993 except where specified otherwise.

.3 Abbreviations for electrical terms: to CSA Z85.

.4 Ontario Electrical Safety Code latest edition and Latest Bulletins of Electrical Safety Authority (ESA).

.5 Building Code of Ontario, O.Reg. 413, Latest Revision.

.6 Local applicable codes and regulations.

.7 Perform grounding to CSA C22.3 No.2.

.8 IEEE 519 for total harmonic distortion, Latest Revision.

1.5 DEMONSTRATION AND TRAINING

.1 Instruct City's personnel in the operation, care and maintenance of equipment. Perform demonstration and training in accordance with Section 01820 - Demonstration and Training.

1.6 CONTRACT DRAWINGS AND SPECIFICATIONS

.1 Follow the Contract Drawings to become familiar with all conditions affecting the work, and verify spaces in which the work will be installed.

.2 The drawings for electrical work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and approximate sizes and location of equipment and outlets. The electrical drawings do not show architectural, mechanical, process and structural details. Contractor to cross-reference for details.

.3 Do not scale the drawings to determine dimensions, but obtain information for accurate dimensions by referring to architectural and structural drawings, or by site measurements.

.4 Review existing drawings as available at the site during the tender period. Become familiar with the condition of the existing drawings and related equipment. Allow for errors and omissions in the existing drawings and ensure that the tender price includes the provisions to make the necessary field reviews, field verifications, field changes, and drawing changes to suit the intent of the modification required.

.5 Work which is indicated, but not completely detailed shall be installed by common practice or as directed by the Engineer.

.6 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).

.7 Alter, at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation and do not necessitate additional material.

.8 Leave space clear and install work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or material supplied by other trades. Verify spaces in which work is to be installed. Install conduit and cable runs to maintain headroom and clearances to conserve space.

.9 Confirm on the site the exact location of outlets and fixtures. Confirm location of outlets for equipment supplied by other trades.

.10 The drawings, specifications, and standards are complimentary to one another, meaning that, that which is called for on one is meant to be called for on all. Where conflict exists between the Sections, Standards and/or Drawings, it shall be referred to the Engineer for clarification and rectification before any material is purchased or electrical work commences. Code requirements shall be considered a minimum standard. When materials shown on drawings as indicated in the specifications exceed code requirements, the plans and specifications shall govern. If, having examined all documents pertaining to Division 16, concerning the nature and extent of the work being performed under other sections, clarification of the item and/or items in question will come from the Engineer.

.11 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.12 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Engineer for clarification before submitting tender.

.13 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.7 CONSTRUCTION/SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 Submit shop drawings for review prior to commencement of manufacturing or installing with the exception of conduit, standard conduit fittings and low voltage wiring.

.3 Prior to submitting the shop drawings, the Contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.

.4 Assume responsibility for accuracy of equipment dimensions related to available space and accessibility for maintenance and service, and compliance with codes and inspection authorities.

.5 Show all details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment or material.

.6 Obtain manufacturer's installation directions to aid in properly executing the work. Submit two copies of such directions to the Engineer prior to installation, for use in inspecting the work.

.7 Prepare composite construction drawings, fully dimensioned of cables, conduit, cable tray, sleeves, clearances, pipes, ducts, etc., and equipment in mechanical and electrical equipment rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base drawings on manufacturer's shop drawings. Drawings should be developed from consultation with and agreement of all trades involved.

.8 Prepare drawings of equipment bases, anchors, slabs, floor and roof curbs, for the electrical work. CAD drawing files can be provided to the Contractor to assist with this requirement.

.9 In addition to the requirements of Section 01330, provide working drawings with, but not necessarily limited to, the following additional information:

.1 Manufacturer's and Supplier's name.

.2 Manufacturer's bulletins, leaflets and specifications of major electrical equipment.

.3 Catalogue model number.

.4 Number identifying item on the drawings and/or in the specifications such as equipment, item number, panel identification letters, etc.

.5 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.6 Where applicable, include wiring, single line and schematic diagrams.

.7 Include wiring diagrams or diagrams showing interconnections with work of other sections.

.10 The Contractor shall be responsible for providing shop drawings showing the integration between supplied control panels and control panels supplied with equipment. These drawings are to be a single drawing for each specific device, showing interconnection between the device and all associated panels and terminal blocks. Engineer reserves the right to request more detailed drawings if those provided are deemed insufficient.

.11 Submit samples of material and equipment where specified or as may reasonably be requested by the Engineer for review before ordering same in accordance with Division 1. The Engineer may retain the samples until the completion of the contract.

.12 Complete all work in accordance with reviewed shop drawings.

.13 Where conduits, cable trays and lay-in ducts are not detailed, submit conduit, cable tray and wiring layout drawings. Show conduit/tray and cable sizes including number of

cables/conductors in each conduit/tray. Drawings shall be on the same size sheets as the contract drawings.

.14 Mark-up single line electrical diagrams to include any modifications to the electrical distribution system.

.15 Update lighting panel schedules to include any modifications to the electrical distribution system.

.16 Indicate the equipment tag used as per 13040 – Toronto Water Tagging Standard on the drawings/specifications as an identification symbol on product data for Switchboards, transformers, panelboards, light fixtures, and other equipment submitted.

.17 Bind one complete set of construction/shop drawings showing “as built” conditions in each operating and maintenance instruction manual.

1.8 RECORD DRAWINGS

.1 Comply with requirements for record drawings stated in 01330 – Submittals.

.2 Before commencing work, obtain two sets of electrical drawings for showing “As Built” conditions. As job progresses, mark on field set of prints to indicate accurately all installed work. At completion stage, transfer all information onto master set of drawings and indicate “Contractors Certified Approval of Accuracy” before submitting to Engineer for review and record use.

.3 Contractor to comply with City of Toronto Tagging standards as per Division 13 and update “as-built” drawings accordingly.

.4 Indicate on record drawings “As Built” stamp.

.5 Show on the record drawings as-built, all outlets and equipment such as runs of conduit, locations of pull boxes, outlets, motors, panels, etc., as well as all services entering the building and on the property.

.6 Dimension underground services and concealed main and sub-feeder conduits at key points of every run in relation to structure and building. Record all elevations for underground services in relation to the ground floor level of the building. Indicate on record drawings, location of all buried services. This information is to be certified correct by Engineer before backfilling commences.

.7 Indicate exact location of all services left for future work.

1.9 OPERATIONS AND MAINTENANCE MANUALS

.1 Comply with requirements for operating and maintenance manuals stated in 01330 – Submittals.

.2 In addition to the requirements of 01330 – Submittals, include in the Operations and Maintenance Manuals:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.3 Wiring and schematic diagrams and performance curves.

.4 Names and addresses of local suppliers for items included in Maintenance Manuals.

.5 Copy of test data.

.6 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.

.7 A motor list showing each motor number, name, horsepower, full load amps, overload settings, nameplate, current rating, heater size and type, and current being drawn, etc.

.8 Copy of final inspection certificate.

.9 Copy of the purchase order, showing equipment make and model numbers issued to the manufacturer complete with all addenda. All cost details may be hidden.

.10 Copy of all warranty certificates.

.11 Set of final reviewed Shop Drawings.

1.10 WORK INCLUDED

.1 The Contractor shall provide all labour, materials and equipment necessary to complete all electrical work as shown on the drawings and in the specification.

.2 The Contractor shall be responsible for all electrical wiring and terminations required for equipment supplied in other Divisions, irrespective whether or not it is shown or mentioned on the drawings and specifications respectively so as to supply a complete working system.

.3 Where special wiring (cables supplied with instruments, etc.) is supplied by other Divisions, the Contractor shall be responsible for the installation of this wiring in coordination with the Division supplying said wiring.

.4 Where spare wiring is installed, all spare wiring shall be identified (tagged) at both ends and shown on record drawings.

.5 Where equipment is supplied by other Divisions and installed under this Division:

.1 The Contractor shall be responsible for the proper installation of all panels, enclosures, switches, fixtures, etc., as shown on the drawings.

.2 The Contractor shall be responsible for coordination with other Divisions supplying equipment, as to the exact location for installation of said equipment.

.3 The Contractor shall request from other Divisions supplying equipment for installation and/or wiring under this Division, all pertinent instruction manuals, diagrams, specifications sheets, etc., required for the proper installation of the equipment.

.4 The Contractor shall be responsible for verifying that the equipment's electrical specifications are suitable for the intended application as per Division 1. Check all voltage ratings, wiring terminations, current ratings and other electrical characteristics so as to supply a complete working system.

1.11 WIRING - GENERAL

.1 Unless otherwise indicated on the drawings all power and control conduit shall be surface mounted.

.2 Power and control wiring to suit all the new SCADA communications, PLC and/or remote I/O control panels, as follows.

.1 All power and control wiring to be in rigid PVC.

.2 Control wiring terminations to be in Liquid tight, steel armoured flex to suit the transition from conduit or junction box to the respective process equipment and instrumentation. Liquid tight flex shall not exceed 2m in length.

.3 All control and communication wiring shall be installed in rigid PVC.

.4 All control wiring should use wire ferrule.

.5 Provide 20% spare control wiring capacity in each control-wiring conduit.

.6 Provide 20% spare control wiring capacity in each multi-conductor Teck style cable.

.3 Refer to Division 13 Specifications for additional control wiring requirements.

.4 Wiring General:

.1 "Wiring" shall include wiring of power and control conductors to lighting, receptacles, and any controlling or controlled devices associated with them.

.2 All wiring to be copper conductors.

.3 All conductors to be stranded copper.

.4 All surface wiring in non-classified indoor areas to be in rigid PVC. Connection to electrical equipment not wall mounted will be from a conduit terminal box then via a liquid tight flex to equipment. The conduit terminations will be placed to minimize the length of the liquid tight flex. Liquid tight flex length not to exceed 1.5m.

.5 Provide a dedicated green jacket bond conductor in all raceways.

.6 Under no circumstances will more than one (1) conductor or ground be installed in a screw type connector, lug or terminal block.

.7 Where stranded conductors terminate on a screw, the conductor will be terminated with a full ring terminal.

.8 All wiring installed under this contract shall be in conformance with the Ontario Electrical Safety Code – Latest Edition.

.9 Provide a ground/bond conductor to suit all power distribution wiring applications. Unless otherwise indicated on the drawings the ground conductors are to be sized in accordance with the Ontario Electrical Safety Code – Latest Edition and applicable Bulletins.

.10 #12 AWG min imum wire size – power.

.11 Provide 20% spare control conductors in each control wiring conduit.

.12 All below grade and/or concrete encased wiring applications to be in rigid PVC Type DBII conduit.

1.12 MISCELLANEOUS ELECTRICAL COMPONENTS

.1 Control Relays (Instantaneous):

.1 General purpose plug-in type relays, low coil current heavy duty contacts with multi-contact poles, minimum 2PDT, or as indicated.

a. Coil rating (VAC systems): 120V, 60 Hz.

b. Coil rating (VDC systems): 125V.

c. Contact rating (VAC systems): 120V, 10A.

d. Contact rating (VDC systems): 125V,10A.

.2 All general-purpose control relays should be with ON induction.

.3 Acceptable Manufacturers:

a. Omron.

b. Eaton C-H.

c. Allen-Bradley.

.2 Relay Accessories:

.1 Overlap contact cartridges: supplied in pairs having NO contact that closes before NC contact opens (early make -late break).

.2 Mounting strips: indexed strips easily cut to required length and bolted in place. Relays are installed in rows on strip with captive mounting screws. Rows of relays on mounting strip form their own wiring trough.

.3 Timing Relays:

.1 General purpose plug-in type relays, low coil current heavy duty contacts with multi-contact poles as indicated. Coil rating: 120V, 60Hz. Contact rating: 120V, 10A.

.2 Potentiometer: self-contained to provide time interval adjustment. Timing range as indicated.

.3 Acceptable Manufacturers:

a. Omron.

b. Eaton C-H.

c. Allen-Bradley.

.4 Pushbuttons:

.1 Momentary contact type: Heavy duty – oil tight, 30mm operator flush type, colour as indicated, 1-NO and 1-NC contacts rated 10A at 120V AC, labels as indicated.

.2 Push-pull contact type: Heavy duty – oil tight, operator mushroom head type, red colour, provision for padlocking in “OFF” position, 2-NO and 2-NC contacts rated 10A at 120V AC, labels as indicated.

.3 Pushbutton ratings:

a. NEMA type 12 for indoor control panels.

b. NEMA type 4X for outdoor control panels.

.4 Acceptable Manufacturers:

a. Allen-Bradley 800H.

b. Schneider Square D.

c. Eaton Cutler Hammer.

.5 Selector Switches:

.1 Maintained contact type, 2 or 3 positions (as indicated), heavy duty – oil tight, 30mm operators standard knob, contact arrangement as indicated rated 10A at 120V AC, labels as indicated.

.2 Switch Ratings:

a. NEMA type 12 for indoor control panels.

b. NEMA type 4X for outdoor control panels.

.3 Acceptable Manufacturers:

a. Allen-Bradley 800H.

b. Schnider, Square D.

c. Eaton Cutler Hammer.

.6 Indicating Lights:

.1 Heavy duty – oil tight, 30mm, LED cluster Push-To-Test type, lens colour: as indicated, supply voltage: 120V, labels as indicated.

.2 Indicating Light Ratings:

a. NEMA type 12 for indoor control panels.

b. NEMA type 4X for outdoor control panels.

.3 Acceptable Manufacturers:

a. Allen-Bradley 800H.

b. Schneider, Square D.

c. Eaton Cutler Hammer

1.13 VOLTAGE RATINGS

.1 Operating voltages: to CAN2-C235-83.

.2 Control and distribution devices and equipment to operate satisfactorily at 60Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.14 PERMITS, FEES AND INSPECTION

.1 The Engineer shall submit to the Electrical Safety Authority (ESA) necessary number of drawings and specifications for examination and review prior to commencement of work.

The Contractor is required to comply with all recommendations and comments provided by the ESA in the plan review report, at no additional cost.

.2 Submit all necessary documentation to the ESA during the construction period. The Contractor shall abide by all comments and recommendations provided by the ESA based on the submitted information, at no additional cost.

.3 Pay associated fees, for all permits, inspections, and power outages to suit supply authority/utility requirements.

.4 Notify the Engineer of changes required by Electrical Safety Authority (ESA) prior to making changes.

.5 Furnish Certificates of Acceptance from the Electrical Safety Authority (ESA) on completion of work to the Engineer.

.6 Arrange for inspection of all work by the Authorities having jurisdiction over the work. On completion of the work, present to the City the final unconditional certificate of approval of the Inspection Authorities.

.7 Comply with the requirements of the latest edition of the Ontario Electrical Safety Code (OESC) and ESA latest bulletins, applicable CSA Standards, the requirements of the Authorities, Federal, Provincial and Municipal Codes, the applicable Standards of the Underwriters' Association and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these specifications. In case of conflict, the more stringent requirement will take precedence. Otherwise follow the standards established by the contract drawings and specifications.

.8 Before starting any work, submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Engineer immediately of such changes for proper processing of the requirements. Prepare and furnish any additional drawing details for information as may be required.

1.15 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 16010 – Electrical General Requirements.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the ESA.

1.16 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish to ANSI C57.12.28.

.2 Paint indoor switchgear and distribution enclosures light grey ANSI-ASA 61 to EEMAC 2Y-1-1958.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.4 Provide finish and colour of retrofit components to match the colour and finish of the existing switchgear.

1.17 ELECTRICAL EQUIPMENT IDENTIFICATION

.1 To meet the requirements of CSA and Electrical Safety Authority.

.2 Supply and install identification nameplates on all equipment such as generators, switchgears, MCCs, transformers, safety switches, panelboards, pushbutton stations, control. Equipment tagging to be as per 13040 – Toronto Water Tagging Standard.

.3 Non corroding, visible and legible after equipment is installed.

.4 Provide “Asbestos Free” labels on switchgear.

.5 Nameplates are to be provided in accordance with 13040 – Toronto Water Tagging Standard. Provide the type, material, color, and letter sizing in accordance with the City standard. Nameplates are to be 3 mm thick laminated plastic engraving sheet, white face, black letters, mechanically attached with stainless steel screws.

.6 Wording on nameplates to be approved by the Engineer prior to manufacture.

.7 Identification to be English.

.8 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.9 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.10 Terminal cabinets and pull boxes: indicate equipment being controlled and voltage.

.11 Transformers: indicate capacity, primary and secondary voltages.

.12 Issue nameplates lists for review prior to manufacture.

.13 Lighting panels: Plates shall be mounted on the front door and identified as per 13040 – Toronto Water Tagging Standard.

.14 Disconnect switches and starters: Plates shall be mounted externally on switch box cover and identified as per 13040 – Toronto Water Tagging Standard.

.15 Plates shall be installed after all painting has been completed and shall be secured with self-tapping screws except on the inside of panel doors where gluing will be accepted.

.16 Have the manufacturers' nameplates affixed to each equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, cycle phase, horsepower, etc., and the name of the manufacturer and his address. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Do not paint over nameplates and where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.

.17 Wording on nameplates to be approved by the Engineer prior to manufacture.

.18 Disconnect switches, starters and contactors: Plates shall be mounted externally on switch box cover and identified as per 13040 – Toronto Water Tagging Standard.

.19 Terminal cabinets and pull and junction boxes: indicate system and voltage.

.20 Transformers: indicate tag number, capacity, phases, primary and secondary voltages.

.21 Panelboards: provide a typewritten circuit directory with clear plastic cover for each panelboard in a suitable holder on the inside of each panel door. Indicate breaker circuit number, rating, load description, and associated load data. Provide identification nameplate as per 13040 – Toronto Water Tagging Standard.

.22 Plates shall be installed after all painting has been completed and shall be secures with self-tapping screws except on the inside of panel door where gluing will be accepted.

.23 Have the manufacturers' nameplates affixed to each equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, cycle, phase, horsepower, etc. and the name of the manufacturer and his address. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Do not paint over nameplates.

.24 Identify all equipment with the corresponding remote controls.

1.18 CITY EQUIPMENT TAGGING

.1 In addition to the nameplates and labelling described in clause 1.19, equipment tagging on separate labels are required for all Switchgear cells, MCC sections, metering equipment, motor starters, control panels, new pumps and motors. Nameplate physical characteristic: in conformance with TW Tagging standard (latest version) provided in Section 13040 – Toronto Water Tagging Standard.

.2 Nameplate wording to be reviewed by the Engineer during shop drawing review and in conformance with City, TW Tagging standard (latest version) provided in Section 13040 – Toronto Water Tagging Standard.

1.19 WIRING AND CONDUIT IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Control wiring to have same tag at both ends.

.5 Provide wire tag and/or circuit identification in all junction boxes.

.6 Colour code conduits, boxes and metallic sheathed cables.

.7 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 10m intervals.

1.20 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminium conductors.

1.21 MANUFACTURERS AND CSA LABELS

.1 Visible and legible after equipment is installed.

1.22 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department and Engineer.

.2 Decal signs, minimum sized 175 x 250mm.

.3 Protect exposed live equipment during construction for personnel safety.

.4 Shield and mark live parts “LIVE 600 VOLTS”, or with appropriate voltage in English.

1.23 LOCATION OF OUTLETS

.1 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.

.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

1.24 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400mm.

.2 Wall receptacles:

a. General: 300 mm.

b. Above top of continuous baseboard heater: 200mm.

c. Above top of counters or counter splash backs: 175mm.

d. In mechanical rooms: 1400mm.

.4 Panelboards: Install 1200mm above finished floor to underside of panel.

.5 Telephone and interphone outlets: 300mm.

.6 Wall mounted telephone and interphone outlets: 1500mm.

.7 Disconnect switches: 1400mm.

1.25 LOAD BALANCE

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

.4 Record and update lighting panel schedule accordingly.

1.26 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.27 INSERT, SLEEVES, FASTENINGS AND SUPPORTS

.1 Provide all necessary inserts, hangers, fastenings, sleeves and curbs for electrical equipment, suspended from or passing through structural walls or floors, to suit the specific location, and as approved by the Engineer.

.2 Sleeves: allow 12mm clearance over the O.D. of all cables and conduits, 25mm horizontally and vertically for rectangular openings.

.3 Finish sleeves flush with wall finish (each side) or the ceiling to curb top.

.4 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields, properly sized for the load to be carried.

.5 Secure equipment to poured concrete with expandable inserts, properly sized for the load to be carried.

.6 Secure equipment to hollow masonry walls or suspended ceilings with factory made threaded or toggle type inserts, properly sized for the load to be carried.

1.28 CUTTING, PATCHING AND WELDING

.1 Conform to the requirements of Division 1 in respect to cutting, patching, and fitting electrical equipment.

.2 Where installation of equipment by this section requires cutting or patching of new or existing work, the work shall be performed by, and under direction and supervision of, this section. Make good surface finishes to satisfaction of the Engineer.

.3 Locate and provide holes and sleeves required for electrical work. Relocate improperly located holes and sleeves at no cost.

.4 No cutting or welding of beams, columns or structural surfaces is permitted without approval of the Engineer and all damage to finished or unfinished surfaces shall be made good to the satisfaction of the Engineer.

.5 Pay all costs for cutting and patching resulting from failure to co-ordinate timely installation of electrical inserts, sleeves, etc., into masonry structures.

.6 Provide fire rated ULC transits to suit any raceway, conduit and/or cable tray transitions through fire rated walls, floors or ceilings.

1.29 FIELD QUALITY CONTROL (TESTING)

.1 General:

.1 Comply with requirements of 16080 – Electrical Testing.

.2 All equipment and electrical systems which are provided under this Division shall be performance tested for electrical and mechanical defects and all defects and adjustments made, prior to requesting inspection by the Engineer.

.3 Submit original copies of letters from the manufacturers of auxiliary systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the methods of installation, wiring and operation.

.4 Prior to the City's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests

supervised by the Engineer to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.

.5 Refer to specific equipment sections for additional details and requirements.

.6 Ensure that the system and its components are ready prior to the inspection and test for acceptance.

.7 Conduct all testing by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Engineer. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the City. Submit two copies of the test certificates to the Engineer.

.8 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

.9 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.

.10 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Engineer.

.11 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.

.12 Ensure circuit protection devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

.13 Replace at no additional cost all fuses, relays, or other devices destroyed during field quality control (testing).

.14 Supply all instruments, meters and personnel required for the tests.

.15 Clean equipment by vacuum. Clean, wax and polish all new exterior surfaces, check and tighten all electrical connections.

.16 All testing shall be scheduled and coordinated through the Engineer. No testing of any kind shall be done without this clearance.

.17 Single phase loads shall be connected so that there is the least possible imbalance of the supply. Common neutral shall be used for maximum three (3) single phase circuits, each circuit on a different phase.

.18 Furnish labour, materials, instruments and bear all costs for tests as requested by the Engineer.

.19 Conduct and pay for tests identified in this Section.

.20 Carry out tests in presence of Engineer. Give two (2) weeks' notice of proposed tests.

.21 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.22 Submit two (2) copies of test results for Engineer's review in addition to copies included in maintenance data.

.2 Cable and Wire – 1000 Volt and Below:

.1 Limit all tests on cables in this voltage range to insulation resistance measurements using a megger: 500V instrument for circuits up to 350V systems; 1000V instrument for 351-600V systems.

.2 Record all test results in a log book and submit to the Engineer for reference. Replace or repair all circuits which do not meet minimum requirements specified in the governing Electrical Safety Code or 2 Mega Ohms, which ever is the greater value. Measure insulation resistance of the following circuits:

a. Power and lighting feeders (with equipment disconnected): phase-to-phase, and phase-to-ground.

b. Control circuits: measure to ground only.

.3 Do not perform megger tests on control circuits containing transistorized or solid-state components.

.4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

.5 Disconnect sensing and protection equipment from the respective circuits to be megger tested including PT's and Surge Protectors.

.6 Conduct tests in accordance to NETA standards.

.3 Instrumentation and Thermocouple Wiring:

.1 Check continuity of each wire using ohm meter or DC buzzer. Megger or 120 V filament lamp testing is not acceptable.

.2 Test thermocouple wiring for continuity and polarity in accordance with manufacturer's recommendations.

.3 All instrumentation and Thermocouple wiring use ferrule.

.4 Conduits and Ducts:

.1 Conduits or ducts which are required to be installed but left empty shall be tested for clear bore using a ball mandrel of approximately 85% of the conduit or duct inside diameter. Any conduit or duct which rejects the ball mandrel shall be cleared at no additional cost to the City. These tests shall be witnessed by the Engineer. Two (2) weeks' notice shall be given to the plant prior to scheduled testing date.

1.30 COORDINATION OF PROTECTIVE DEVICES AND ELECTRICAL TESTING

.1 The Contractor shall implement all protective settings as recommended by the Short Circuit Coordination and Protection Study. The Study is not part of the Contractors scope, however, implementation and verification of all protective settings and testing is.

.2 Ensure circuit protective devices such as over-current trips, relays and fuses, are installed to correct values and settings.

.3 Ensure all protective devices ratings and settings are set to the recommended settings as identified in the Electrical coordination Protection.

.4 Record and submit to Engineer all protective devices settings as left.

.5 Provide current injection tests for all breakers and relays and provide full and complete data sheets on as found settings, as tested settings, and as left settings.

.6 Provide full data sheets for all settings of multifunction relays within the scope of this contract: Full data sheets to include:

.1 All protective settings.

.2 All relay input settings.

.3 All relay output settings.

.4 All communications settings.

.7 Make provision for field adjustment of protective settings to suit site conditions at time of equipment start-up and commissioning. This shall include but not be limited to both new and existing 5kV switchgear. These services to be provided at no additional cost.

.8 All protective relay settings to be documented and recorded by the Contractor.

1.31 TRIAL USAGE

.1 The City and City's representatives shall have the privilege of trial usage of the electrical system or parts thereof for the purpose of testing and verifying operational procedures.

.2 Trial usage by the City shall not waive the Contractor/Sub-Contractor of any responsibility because of trial usage.

.3 Trial usage shall not be construed as acceptance by the City.

1.32 FIRE TRANSITS

.1 All cable trays, conduit etc. transitioning thru building walls, floors, ceilings to be sealed with a two (2) hour fire rated caulking or fire transit.

.2 Fire transit to be ULC listed.

1.33 CLEANING

.1 Comply with Section 01741 - Final Cleaning.

.2 Before energizing any system, inspect and clean all the inside of switchgear, MCC, etc. to ensure that they are free from dust and debris. This shall be witnessed by Engineer.

.3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

.4 Clean all polished, painted and plated work brightly.

.5 Remove all debris, surplus material and all tools.

1.34 EXECUTION

.1 The use of permanent electrical system for temporary construction service shall be only with written permission of the Engineer.

.2 Maintain at the job site, at all times, qualified personnel and supporting staff, with proven experience in erecting, supervising testing projects of comparable nature and complexity.

.3 Provide an as build ‘D’ size electrical single line diagram in the electrical room in accordance with ESA requirements. Drawing shall be engraved on laminate . An Electrical Single Line Diagram shall be installed in the following areas:

.1 Residual Management Facility (RMF) Building – Generator Location.

.2 Each new Low Voltage Switchboard Location.

.4 Expedite the work as follows:

.1 Continuously check and expedite delivery of equipment and materials.

.2 If necessary, inspect at the source of manufacture.

.3 Continuously check and expedite the flow of necessary information to and from all parties involved.

.4 Inform the Engineer promptly where information is required.

.5 The work of this division shall be coordinated with other divisions in such a manner as not to interfere with other work. In areas where the ducts, pipes, wiring and equipment for other sections will be installed in proximity to pipes, wiring and equipment pertaining to

this division, cooperate to ensure that all pipes, ducts, wiring and equipment are installed to the best advantage.

.6 Equipment, conduit, etc., installed but not coordinated with the work of other trades shall be relocated as directed by the Engineer without extra cost to the City.

.7 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the Engineer. Install exposed conduit runs parallel and perpendicular to building planes. Install conduit concealed in chases, behind furring, or above ceiling, except in unfinished areas. Install exposed systems neatly and group to present a neat appearance.

1.35 TEMPORARY POWER

.1 The Contractor shall be responsible for all costs associated with servicing the site with temporary power (i.e.: Electricity) for the purpose of construction.

.2 Refer to Section 01510 – Temporary Utilities.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

TORONTO

SECTION 16012

EXISTING BUILDING - MODIFICATIONS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 GENERAL

.1 Modifications, demolition and installation of services within this building require utmost care due to vital operation of systems involved. Removal and installation of systems require constant communication with Engineer.

1.3 CO-ORDINATION BETWEEN NEW AND EXISTING INSTALLATIONS

.1 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

1.4 EXISTING SERVICES

.1 Ensure existing services remain undisturbed and energized except where indicated to be disconnected.

.2 Disconnect and remove abandoned wiring materials and devices.

.3 Cut raceways flush where embedded in structure.

.4 Retain abandoned embedded outlet boxes and close with pressed steel cover plates.

.5 Make safe all circuit wiring left for future use.

1.5 INTERRUPTION OF SERVICES

.1 Obtain Engineer's written approval before interrupting any service. Long outages are not acceptable.

.2 Provide temporary services to maintain continuity in the event that services must be interrupted.

1.6 PREMIUM TIME

.1 Include cost of premium time in Tender Price for work during nights, weekends or other time outside normal working hours necessary to do the Work and maintain electrical services in operation.

PART 2 PRODUCTS

2.1 USE OF EXISTING MATERIAL AND EQUIPMENT

.1 Unless noted otherwise, existing panels, boxes and wiring materials may be reused if acceptable to inspection authority.

.2 Unless noted otherwise, provide additional equipment of same type and manufacture to supplement existing equipment.

.3 Reused luminaires: Furnish new lamps.

PART 3 EXECUTION

3.1 EXISTING MATERIAL AND EQUIPMENT

.1 Equipment to be reused or relocated: Test for proper operation, and repair as necessary.

.2 Repair or replace existing equipment which is damaged in process of relocation.

.3 Reused luminaires: Install lamps, clean fixtures and touch up damaged finish.

.4 Relocate existing junction, pull or terminal boxes which become inaccessible due to new mechanical ductwork or equipment.

3.2 DEMOLITION

.1 Demolish existing work, where indicated, and remove from site.

.2 Execute all demolition work so as to create minimum vibration or dust within and outside the building. Obtain Engineer's approval of methods before proceeding.

3.3 WORK IN EXISTING TENANT FACILITIES

.1 Coordinate Work in tenant facilities with tenant. Ensure that no interruptions and/or interferences occur with tenant's normal operation.

.2 Be responsible for any damage created in existing tenant facilities when installing equipment and materials.

3.4 PENETRATIONS IN EXISTING STRUCTURE

.1 Perform cutting, patching and repairing. Before proceeding obtain Engineer's approval.

.2 Where necessary to penetrate existing floors, walls, ceiling, roof or structural members provide sleeve and follow Engineer's instructions.

.3 Restore surfaces to same finish and condition as existed prior to penetration.

.4 Core Drilling Procedure

.1 Examine locations to be core drilled where:

a. Diameter is greater than 25 mm

b. Multiple drillings required and where the distance between centres is less than ten times the diameter of the hole

.2 Examine by most suitable method including:

a. X-ray

b. Ferro scan

c. Cable detection

.3 Examine from both sides of the structure to be drilled.

.4 Examine proposed core drilling locations to determine:

a. Possible interference with

(a) Services

(b) Structural components

b. Possible presence of asbestos tile or other asbestos based material. Report any occurrence or suspected occurrence to the Engineer immediately.

.5 Select locations as suitable for core drilling and label them:

a. Uniquely number each drilling location and core so that markings will be legible after drilling

b. Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall

.6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.

.7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.

.8 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval, to Engineer, prior to drilling.

.9 Proceed with core drilling only after approval has been received from Engineer.

.10 Confine drilling operation to time-of-day as stipulated by Engineer.

.11 Position suitable warning notices of a type acceptable to Engineer and exercise caution to ensure safety and protection of personnel and property during drilling especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.

.12 Stop drilling immediately, and report to Engineer, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.

.13 Cover open holes with secured covers to guard against fall through of objects.

.14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Engineer.

.15 Store all cores or core fragments on site and make them available for inspection by Engineer. Dispose of the cores or core fragments after permission is received from Engineer.

3.5 SALVAGE MATERIALS

.1 Remove from site materials in renovated areas that are not to remain or be reused, unless noted as remaining property of Owner.

END OF SECTION

TORONTO

SECTION 16014

SHORT CIRCUIT AND PROTECTIVE DEVICE

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INTENT OF SECTION

.1 This section covers the minimum requirements for the preparation and submission of the short circuit, protection and coordination, and arc flash studies to provide a complete overall coordinated system, including recommended settings and arc flash recommendations. The short circuit, protective device evaluation and coordination, and arc flash studies shall be considered as shop drawings.

.2 Comply with the requirement listed in Division 1 – General Requirements and Section 16010 – Electrical General Requirements.

.3 The report containing short circuit and protective device evaluation and coordination studies shall be sealed and signed by a Professional Engineer licensed in the Province of Ontario and submitted to the Engineer for review. Each graph shall also be stamped by the Professional Engineer. Enclose in the studies all the supporting information on which the studies were based.

.4 The report containing arc flash study shall be sealed and signed by a Professional Engineer licensed in the Province of Ontario and submitted to the Engineer for review. Enclose in the studies all the supporting information on which the studies were based.

.5 Obtain from all local Hydro Authority, the City, and all relevant equipment suppliers, the appropriate information for performing the short circuit and co-ordination study as well as for the Arc Flash Study.

.6 Prior to the submission of these studies to Engineer for final review, the Contractor shall submit the copies of these studies to the following suppliers and contractors for their review

.1 600V Switchgear, distribution panels and Motor Control Centre supplier(s).

.2 600V Natural gas engine generator supplier.

.3 600V Automatic Transfer Switch supplier.

.4 Electrical Sub-contractor(s).

.5 General Contractor.

.7 The studies shall not be reviewed by the Engineer until the submission of the following equipment shop drawings is completed.

.1 600V Switchgears.

.2 600V Panelboards.

.3 600V Motor Control Centres.

.4 600V Automatic Transfer Switch.

.5 600V Natural Gas engine generator.

.6 Written comments regarding the studies from the Contractor, all Electrical Sub-Contractors, and all other suppliers listed in 1.1.6 above.

.8 The short circuit and protective device coordination and arc flash studies shall be updated prior to Substantial Performance of the Work. Utilize characteristics of as-installed equipment and materials.

.9 The studies shall be reviewed in conjunction with the shop drawings listed in 1.1.7.

.10 The Contractor shall submit copies of the studies to the Electrical Safety Authority for their review and approval.

.11 All changes requested by the Electrical Safety Authority shall be carried out by the Contractor.

.12 The studies shall be performed in accordance with latest applicable IEEE and ANSI standards.

.13 Perform studies using windows based software such as EDSA, SKM or CYME.

.14 Perform complete fault calculations for all switching scenarios.

1.2 OPERATIONS AND MAINTENANCE MANUALS

.1 Submit the following information in the manuals:

.2 Reviewed short circuit and protective device evaluation and coordination studies.

.3 Reviewed arc flash evaluation and recommendation study. Report containing the studies.

1.3 REFERENCES

.1 The following is a list of standards which may be referenced in this Section:

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

a. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

b. 399, Recommended Practice for Industrial and Commercial Power System Analysis.

.2 A preliminary power system report (Short Circuit Analysis, Protection Device Coordination and ARC Flash Study) is included as reference:

a. 16014A - RC Harris-Short-Circ-Coord-Study-Arc Flash _Version 01

1.4 SUBMITTALS

.1 Shop Drawings: Provide five (5) copies of study in hard cover (and also in electronic format), (3) three-ring binders to include:

.1 Short circuit study.

.2 Cable Short circuit damage curves.

.3 Cable voltage drops.

.4 Motor starting voltage drops.

.5 Protective Device Coordination Study.

.6 Neutral grounding resistor calculations.

.7 Arc Flash Study and PPE requirements.

PART 2 PRODUCTS

2.1 GENERAL

.1 The studies shall include all the portions of electrical distribution system including the normal and standby power sources down to and including the smallest adjustable trip circuit breaker in the 600V system. Normal and standby connections and those which result in actual and maximum fault conditions shall be adequately covered in the studies.

2.2 SHORT CIRCUIT STUDY

.1 The short circuit study shall include the following:

.1 Description of method for analysis and calculations.

.2 Statement of any assumptions and operating conditions.

.3 Base per unit quantities selected.

.4 Complete single-line diagrams indicating the interaction of the protection devices, protection device ranges and settings.

.5 Actual and Ultimate source impedance data including utility power system characteristics for normal and standby supply.

.6 Typical calculations, tabulations of calculation quantities and results, conclusions and recommendations.

.7 Information on fault levels and equipment as available from utility.

.8 Summary and calculations of data including system parameters used for calculations. Short circuit currents - 3 phase bolted faults, line to line faults, line to ground and double line to ground faults.

a. Instantaneous Asymm.

b. ½ Cycle Asymm.

c. Steady State.

d. Short Circuit 3 Phase AC RMS Bolted Faults.

.9 The above mentioned points shall include fault levels to be calculated at the:

a. Primary normal (high voltage at hydro) and standby supplies.

b. Existing 600V MCC.

c. 120V lighting panel.

d. 37kW and higher pump motors.

e. New 600V Panelboard.

.10 Include complete fault calculations as specified herein for each proposed and ultimate source combinations. Note that source combinations may include present and future supply circuits, large motors, and generators as noted on single line drawing.

.11 Include fault contribution of all motors in study. Notify the Engineer immediately in writing of any circuit protective devices not properly rated for fault condition.

2.3 PROTECTIVE DEVICE EVALUATION AND COORDINATION STUDY

.1 The Protective device Evaluation and Coordination Study shall be prepared on special transparent log-log graphs (KE485258) with 0.01 to 1000 on the y-axis time coordinate and 0.5 to 1000 on the current coordinate x-axis. Provide time current curves graphically indicating the coordination proposed for the overall electrical distribution system, centered on full sized log-log forms. Include with each curve sheet a complete title and single line diagram with a legend identifying the specific portion of the overall system covered by that particular curve sheet. Provide a table showing each protective device identifying its type, ANSI function, and range of all the settings for each device, manufacturer and time current characteristics including the recommended device tap, time dial, long time and short time pick-up, instantaneous and all time delay settings. The Protective device Evaluation and Coordination Study shall include the following:

.1 Information on fault levels and equipment as available from the Utility.

.2 Single line diagrams with device information pertaining to the Co- ordination Study, e.g.:

a. All supplied equipment.

b. Cable sizes.

c. Bus duct sizes and ratings.

d. Transformer ratings, configurations and characteristics.

e. Labels for equipment (transformers, switchboards, MCC's, panelboards, feeder names).

(a) All protective devices on Hydro systems including high voltage transformers and switchgears and the first relays and fuses upstream from the plant service entrance.

(b) 13.8kV Switchgear.

(c) 2.4kV switchgear

(d) High voltage transformers.

(e) 600V Motor Control Centres.

(f) 600V Panelboards.

(g) 600V Automatic Transfer Switches.

(h) 600V Variable Frequency Drives if any.

(i) Damage curves or points for transformers, cable, generators and all other equipment shown on single line diagram.

(j) Inrush points - transformers.

(i) Characteristics of all motors.
(ii) Time Current Curves for all fuses, circuit breakers, overload relays, motor circuit protectors, etc.
(iii) 3 Phase Symmetrical Fault levels.
(iv) 3 Phase Asymmetrical Fault levels from the Utility to show for co- ordination of devices.
(v) Clear indication of equipment and devices curves on each time/current curve sheet.
(vi) Separate sheets for voltages 600V and above. Scale multipliers at 0.1X, 1X, 10X, or 100X at each related voltage levels.
(vii) One (1) protective device on 120/208V System can be included on 600V distribution time current/curve sheet.
(viii) Each modified feeder from MCC with trip unit or fuse shall be shown on time/current sheets.

2.4 ARC FLASH STUDY

.1 Arc Flash Study is to be performed as per NFPA 70E and IEEE standard 1584.

.2 Provide lamacoid labels (to include arc flash boundary, incident energy and hazard/Risk category for Protective clothing) for all 600V equipment supplied and installed under this project (only).

.3 Suggest methods for reducing arc flash energy (i.e. reducing trip times for breakers at expense of coordination and replacement of incoming breakers.)

.4 Refer to section 3.2 for arc flash label requirements.

2.5 STUDY REPORTS

.1 The results of the short circuit, protective device evaluation and coordination studies and arc flash studies shall be summarized in a sealed and signed report(s).

.2 Six (6) bound copies of the report shall be submitted to the Engineer for review. (Refer to Section 01330 – Submittals).

.3 Report to list all mis-coordinations and discuss how to clear these mis-coordinations.

.4 Notify Engineer in writing of existing circuit devices and equipment improperly rated.

.5 The report shall be divided into the following sections and include all of the above mentioned information:

.1 Descriptions, purpose, basis and scope of study.

.2 Tabulations of each circuit breaker, fuse, overload relay and other protective device rating versus calculated short circuit duties and commentary regarding same.

.3 Protective device time versus current coordination curves, tabulations using spreadsheet format of the recommended overload relays settings for all the motors, all circuit breaker trip and relay settings, all fuse selections and commentary regarding the same. Tables to reflect the same terminology used by the manufacturers of each device settings.

.4 Fault current calculations including a definition of terms and guide for interpretation of computer printouts.

.5 Suggested methods for reducing arc flash energy (i.e. reducing trip times for breakers at expense of coordination and replacement of incoming breakers.

.6 Comments and Suggestions.

2.6 ACCEPTABLE SYSTEM STUDIES PROVIDERS

.1 Cutler Hammer Engineering Services.

.2 Rondar.

.3 GT Woods.

PART 3 EXECUTION

3.1 GENERAL

.1 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the reviewed short circuit and protective device evaluation and coordination studies shall be carried out by the Contractor at no extra costs. The settings shall be in accordance with reviewed short circuit and protective device evaluation and coordination studies.

.2 Make modifications to equipment as required to accomplish conformance with the short circuit, protective device coordination and arc flash studies.

.3 Field Quality Control:

.1 Test ground continuity and resistance prior to energizing electrical systems.

.2 Test grounding system efficiency for compliance with Electrical Safety Code and Supply Authority requirements.

3.2 ARC FLASH LABEL REQUIREMENTS

.1 Key requirements for an arc flash and shock warning label are detailed below:

.1 The arc flash hazard risk assessment report shall be based on “Canadian Standards Association (CSA) standard Z462 latest edition”, and IEEE standard 1584.

.2 Size: 4" x 6" (10 cm x 15 cm).

.3 Colours: Warning labels need to have the word “WARNING” in safety black letters on a safety orange background.

.4 Incident energy and Glove Class shall be in bigger and bold font, "Appropriate PPE Required" shall be mentioned at the top section of the label.

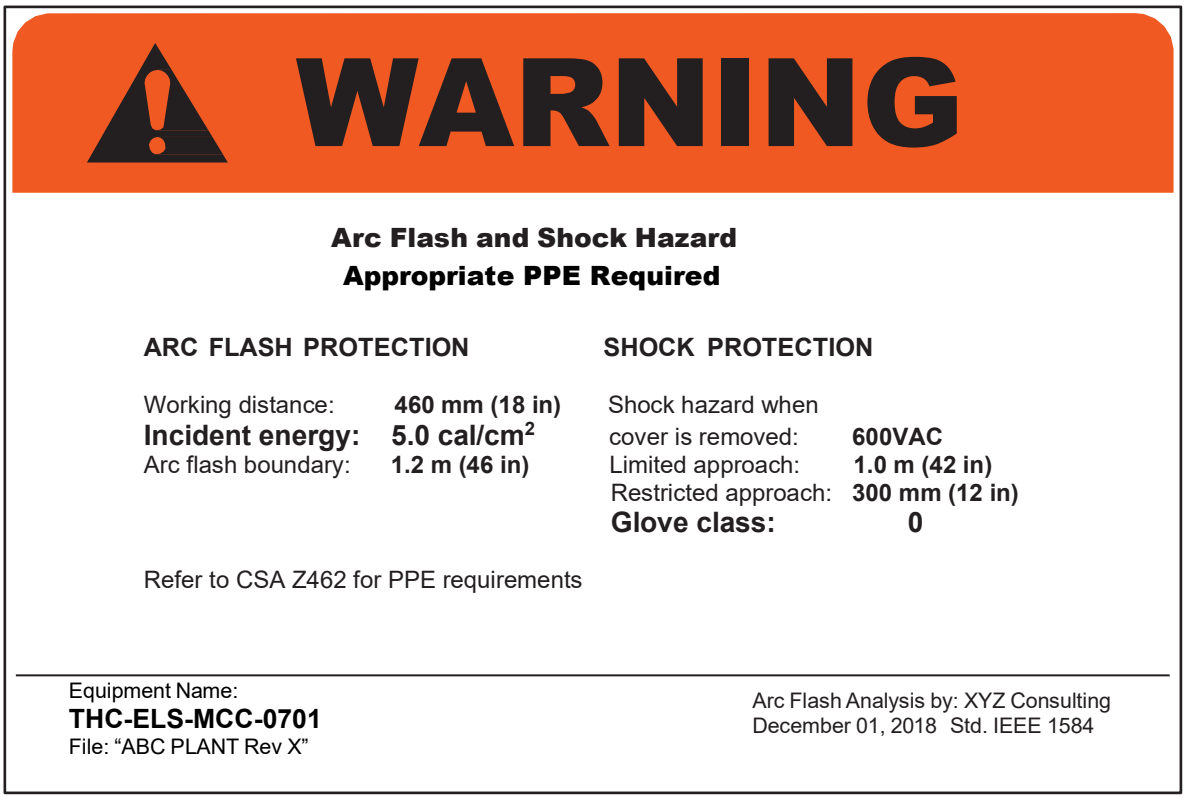
.5 Print the label on UV resistant vinyl labels with high quality self-adhesive back. The Person who will be producing and/or installing arc flash and shock warning labels should consult the latest edition of ANSI Z535.4, CAN/CSA-Z431, and CAN/CSA-Z321 to ensure that all applicable requirements are met.

.6 Location: A label needs to be readily visible to the worker and alert the worker to the potential hazard in time to take appropriate action.

.7 Affix arc flash Labels on each cubicle-section of the high voltage switchgear; on Main-Tie-Main section and each main breaker of low voltage MCC, Power Distribution Panel (PDP) / Switchgear; Disconnect Switch, Distribution / Lighting Panel, and Control Panel wherever applicable.

.2 Contractor to provide arc flash mitigation recommendations in case Hazard Risk incident energy is more than 8 cal/cm^2.

Figure – 1: Example of Arc flash and shock warning label



END OF SECTION

TORONTO

SECTION 16021

DEMOLITION OF ELETRICAL SYSTEMS

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PART 1 GENERAL

1.1 GENERAL CONDITIONS

.1 Comply with 01000 – General Requirement, 02200 – Demolitions and Removals, and 16010 – Electrical General Requirements.

.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

.3 Treat the demolishing equipment containing designated substances (e.g. PCB s, asbestos, etc.) in accordance with the Designated Substances Plan under this Contract and all applicable regulations and codes.

1.2 SCOPE OF DEMOLITION OF ELECTRICAL SYSTEMS WORK

.1 Furnish all labour, materials, equipment, transportation, services, facilities and supervision necessary to demolish all equipment, systems and materials specified herein and on the drawings.

.2 Furnish all labour, materials, equipment, transportation, services, facilities and supervision necessary to dispose of all equipment, systems and materials listed for removal from site herein and on the drawings.

.3 Furnish all labour, equipment and supervision necessary to surrender (hand over) to the City all equipment, systems and materials specified herein and on the drawings.

.4 Prepare drawings, stamped and signed by a licensed professional engineer, indicating temporary bracing and/or supporting structures required during the demolition of doors and/or walls as described herein.

.5 In general, the demolition of major electrical systems comprises, but is not limited to:

.1 Demolish of existing cables feeding the critical loads as shown on the engineering drawings.

.2 The above works are also specified in Sections 01110 and 16010.

1.3 SUBMITTALS

.1 Provide stamped and signed drawings for all structural demolition and temporary supporting works.

.2 Provide a written procedure for all lifting operations involving the existing facility cranes. Include weights and dimensions of items to be lifted and details of slings or other lifting tackle required.

.3 The Contractor shall inspect the cranes and provide inspection certificates before and after usage.

1.4 PROCEDURES AND STAGES

.1 Plant normal operation and life safety procedure (such emergency light, egress, fire alarm, PA, etc.) shall be maintained during demolition and construction period.

.2 Demolition and Demolish the existing electrical equipment will not begin prior to the installation and commissioning and satisfactory operation of all temporary MCC or existing equipment used as temporary during the construction.

.3 Demolition and/or Demolish equipment must follow the approved sequencing schedules.

.4 Perform the Demolish electrical systems such that availability and continuity of supply, monitoring and control of the common systems and auxiliaries are kept and secured.

.5 Demolish existing equipment shall not start unless all required new equipment is on site.

PART 2 PRODUCTS

2.1 GENERAL

.1 Supply and install the necessary temporary bracing, supporting structures, guards, warning signs, etc. necessary to complete the project safely and in accordance with all regulations and/or codes.

PART 3 EXECUTION

3.1 GENERAL

.1 Organize the work and provided sufficient labour and equipment to ensure safety at all times.

.2 All workers shall be competent in, and trained to perform, the tasks that they perform. Where applicable, workers shall be licensed or otherwise qualified for the tasks that they perform.

.3 Prior to starting demolition, the Contractor shall inspect with the city all facilities described to ascertain the limits of the works.

.4 All the demolition work shall be done in systematic and in such a manner as not to damage other services and equipment and not to affect the use and function of any process equipment and any services (electrical power, lighting, communication, heating, water supply) for the remaining facilities.

.5 There shall be no additional compensation for carrying out any condition embodied by the requirements stipulated under this section.

.6 When relocating equipment, should any circuit be abandoned, the conductors to these circuits must be removed. This also applies to all abandoned conductors that exist at the site.

.7 Co-ordination of work.

.1 Co-ordinate demolition work with the Contract Administrator, and city staff to ensure no disruption of station operation.

.2 Refer to section 16010 of this specification for co-ordination with all other trades.

.8 Demolition and disposal

.1 Remove the equipment or material from site and dispose in accordance with all applicable regulations and codes. Contractor to pay all associated fees for disposal.

.2 The Contractor shall take all reasonable steps to ensure that equipment removed from site is reused or recycled.

3.2 MODIFICATION PROCEDURE FOR THE 600V MCC LOADS

.1 Ensure that the equipment has been fully de-energized and locked-out prior to demolition.

.2 MCC cells to be left as spare for future use. New cell doors to be provided to match with the existing MCC construction. These cells to be labelled clearly as “SPARE”.

3.3 DEMOLITION PROCEDURE FOR THE LV CABLING

.1 The timing of cable Demolitions shall be in accordance with the approved sequence schedules.

.2 Ensure that all replacement cables have been run before removing existing cables. Remove existing cables from site.

.3 Remove all redundant wiring and cables that will not be used after this contract is completed.

3.4 DEMOLITION FOR UNUSED CONDUITS BURIED IN WALL

.1 Wherever the non-used conduits buried in the wall is not removable, cut the conduit back to the wall and cap it.

END OF SECTION

TORONTO

SECTION 16050

BASIC MATERIALS AND METHODS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 Comply with Division 1 – General Requirements and Section 16010 – Electrical General Requirements.

1.2 RELATED SECTIONS

.1 Section 01330 – Submittals.

.2 Section 16010 – Electrical General Requirements.

1.3 REFERENCES

.1 CSA C22.2 No. 0 General Requirements – Canadian Electrical Code – Part 2.

.2 CAN3-C235 Preferred Voltage Levels for AC Systems, 0-50,000V.

.3 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.4 National Electrical Manufacturers Association (NEMA).

.5 Institute of the Electrical and Electronic Engineers (IEEE).

.6 Insulated Cable Engineers Association (ICEA).

.7 Canadian Standards Association (CSA).

.8 Canadian Gas Association (CGA).

.9 Underwriters Laboratories Canada (ULC).

.10 American National Standards Institute (ANSI).

.11 National Fire Protection Agency (NFPA).

.12 Ontario Electrical Safety Code(OESC).

.13 Comply with the latest editions of CSA C22.1 Canadian Electrical Code – Part 1, Provincial Electrical Authority Safety Codes and Bulletins, and local codes and requirements which govern the installation. Where these regulations conflict, comply with the most stringent condition.

.14 Comply with latest editions of the CSA Certification Standards and Bulletins.

.15 Instrument Society of America (ISA): RP12.6, Wiring Practices for Hazardous (Classified) Locations Instrumentation – Part I: Intrinsic Safety.

.16 Underwriters Laboratories Inc. (UL).

1.4 DEFINITIONS

.1 The following are definitions used in Division 16. Refer also to Division 1.

.2 Inspection Authority means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical Site Work.

.3 Electrical Code or Code means Ontario Electrical Safety Code.

1.5 PRODUCT DATA

.1 Submit product data in accordance with Section 01330 – Submittals.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 Shop Drawings:

.1 Device boxes for use in hazardous areas.

.2 Junction and pull boxes used at or below grade.

.3 Large junction and pull boxes.

.4 Terminal junction boxes.

.5 Panel boards and circuit breaker data.

.6 Wiring devices.

.7 Control devices.

.8 Control relays.

.9 Timers.

.10 Fuses.

.11 Magnetic contactors.

.3 Information Submittals: Test Report: Provide sound test certification for dry type power transformers (0 to 4160V volt, primary) if applicable.

1.7 QUALITY ASSURANCE

.1 CSA or ULC Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to ULC Standards and have an applied ULC listing mark.

.2 Hazardous Areas: Materials and devices shall be specifically approved for hazardous areas of the class, division, and group shown and of a construction that will ensure safe performance when properly used and maintained.

1.8 EXTRA MATERIALS (IF APPLICABLE)

.1 Furnish, tag, and box for shipment and storage the following spare parts and special tools:

.1 Fuses, 0 to 600 Volts: Six (6) of each type and each current rating installed.

.2 5kV Fuses: Six (6) of each type and each current rating installed.

PART 2 PRODUCTS

2.1 GENERAL

.1 Equipment Enclosures: Compatible with the room or area environment where the equipment is located and unless otherwise indicated in the Contract Documents, shall be in accordance with classification specified in Section 16010 – Electrical General Requirements

.2 Finishes: Unless otherwise indicated in the Contract Documents, factory finish all equipment inside and outside with ANSI/ASA #61 grey paint.

2.2 DISCONNECT SWITCHES

.1 Disconnect switches: Fusible & Non fusible as indicated, front operated, heavy duty, industrial grade, quick make, quick break, horsepower rated and with provision for padlocking in the OFF position.

.2 Fusible switches: Quick-make, quick-break, heavy duty, industrial type with provision for padlocking in the OFF position and fuse holders suitable for High Rupture Capacity fuses type HRC1-J.

.3 Mechanical interlock: Prevent opening of the enclosure door when handle is in the ON position.

.4 Auxiliary contacts: As indicated, late make, early break, rated 120V, 10A minimum.

.5 Fusible switches: Fuse holders for HRC1-J fuses without adaptors.

.6 Acceptable Manufacturers:

.1 Eaton Cutler Hammer.

.2 Schneider SQ-D.

.3 Siemens.

2.3 CONTROL RELAYS

.1 General purpose relays: Heavy duty, industrial, EEMAC rated, electrically held, 120V AC coil, minimum 10A, 120V AC convertible contacts, Type P by Rockwell Automation Canada Ltd (Allen-Bradley Canada Ltd.), Type X by Square D Canada, or Type AR by Cutler-Hammer or by Eaton Yale Company.

.2 Magnetic latching relays: Heavy duty, industrial, EEMAC rated, mechanically held, electrically released, 120V AC coil, minimum 10A, 120V AC convertible contacts, Type NM by Rockwell Automation Canada Ltd (Allen-Bradley), Type XL by Schneider Canada Inc. (Square D), Type ARML by Eaton Yale Company (Cutler-Hammer).

.3 Timing relays: ON delay, OFF delay or Interval type as indicated, 120V AC coil, minimum 10A, 120V AC convertible contacts, knob adjustable timing, timing range as indicated in the Contract Documents, Type PT, or NT by Rockwell Automation Canada Ltd (Allen-Bradley), Type X by Schneider Canada Inc. (Square D), Type ARPT by Eaton Yale Company (Cutler-Hammer).

.4 Double voltage relays: Convertible contacts, metal barrier between coil and contact terminations.

2.4 FUSES

.1 Type: Unless otherwise indicated in the Contract Documents, HRC (high rupturing capacity) with fault interrupting capability of 100,000A symmetrical.

.2 Rating: HRC1-J fast acting 600A maximum rating and HRC1-L, fast acting for circuits exceeding 600A.

2.5 LIMIT SWITCHES

.1 Switch: Specification grade, flush mount, back and side wired, white high strength toggle, rated 20A, 120V AC. 20 AC Series manufactured by Pass & Seymour Canada Inc., GE595 Series manufactured by Smith & Stone Inc., 490 Series manufactured by Bryant Wiring Devices, 199 Series manufactured by Arrow-Hart, 122 Series manufactured by Hubbell Canada Inc., or122 Series manufactured by Leviton Canada Ltd.

PART 3 EXECUTION

3.1 DISCONNECT SWITCH

.1 Provide disconnect switches of the type and rating indicated.

.2 Flush mount fractional horsepower disconnect switches in concealed conduit areas.

.3 Provide fusible disconnect switches complete with fuses.

.4 Provide mounting pedestal for units located adjacent to equipment in open areas.

.5 Install 1400mm above finished floor.

3.2 FUSES

.1 Install fuses in mounting assembly before energizing circuit.

.2 Verify that the fuses physically match mounting devices. Where fuses and holders do not match, replace the holder.

.3 Provide sizes and types of fuses in accordance with ESA requirements.

END OF SECTION

TORONTO

SECTION 16080

ELECTRICAL TESTING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 The work covered by this Section includes the furnishing of all labour, test equipment, and performance tests for installations shown on the Drawings and as specified in this Section during and at the conclusion of the Contract.

.2 Test the following items affected under this Contract for proper operation and adjustments:

.1 Cables and bus-bars.

.2 Medium and low voltage power circuit breakers and protective relays.

.3 Medium and Low voltage molded case breakers.

.4 Motor Control Centers.

.5 Medium and Low voltage feeders.

.6 Panelboard circuits.

1.2 GENERAL

.1 Testing and commissioning applies to all new and retrofitted equipment.

.2 Establish testing methods and plans meeting codes, standards and engineering practices i.e. IEEE, NETA etc.

.3 Include manufacturer requirements and specialty systems verification certificates and equipment calibration certificates in testing methods.

.4 Establish testing results acceptable measurement range based on standards and manufacturer testing parameters

.5 Submit testing plan and methods, forms, reports, acceptable measurement range and instruments to the Engineer for review ahead of task application. Implement and comply with Engineers comments.

.6 Revise forms, plan and requirement per the Engineer’s review.

.7 Test conduits and ducts installed but required left empty for clean bore, Install fish wire and cap.

.8 Testing methods and test results to also meet requirements of CSA, Toronto Hydro, Electrical Safety Authority (ESA), Ontario Electrical Safety Code (OESC), and authorities having jurisdiction and manufacturer's recommendations.

.9 Perform testing with up-to-date testing instruments provided with valid calibration certificate from a local recognized calibrating laboratory and bearing calibration company seal.

.10 Perform testing with systems completely connected, both loaded and unloaded.

1.3 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements.

.2 Section 16122 – Wires & Cables 0-1000V.

.3 Section 16441 – Panelboards.

.4 Section 16450 – Grounding.

.5 Section 16480 – 600V Motor Control Centres.

.6 Section 16500 – Natural Gas Engine Indoor Generator.

1.4 REFERENCES

.1 CSA, Canadian Standard Association.

.2 Ontario Electrical Safety Code (OESC).

.3 OBC, Ontario Building Code.

.4 ANSI/NETA MTS, Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems, latest edition.

.5 ESA, Electrical Safety Authority Bulletins.

.6 CSA C9, Dry Type Transformer.

.7 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 IEEE 400-2012, IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.

1.5 SUBMITTALS

.1 Information Submittals:

.1 Submit 30 Days prior to performing inspections or tests:

a. Schedule for performing inspection and tests.

b. List of references to be used for each test.

c. Sample copy of equipment and materials inspection form(s).

.2 Sample copy of individual device test form.

.3 Sample copy of individual system test form.

.4 Submit within 30 Days after completion of test:

.5 Test or inspection reports and certificates for each electrical item tested.

.6 Operation and Maintenance Data:

.1 In accordance with Section 01783 – Operating and Maintenance Data.

.2 After test or inspection reports and certificates have been reviewed by the Engineer and returned, insert a copy of each in operation and maintenance manual.

1.6 QUALITY ASSURANCE

.1 Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA.

.2 Test instrument calibration shall be in accordance with NETA or ATS.

1.7 SEQUENCING AND SCHEDULING

.1 Perform inspection and electrical tests after equipment has been installed.

.2 Perform tests with apparatus de-energized whenever feasible.

.3 Inspection and electrical tests on energized equipment are to be:

.1 Scheduled with the Engineer prior to de energization.

.2 Minimized to avoid extended period of interruption to the operating plant equipment.

.3 Notify the Engineer at least one (1) week prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

.1 General:

.1 Ensure that a suitable power supply is available for test equipment, both 120V AC and battery-powered devices. Record the make, model, and calibration date of test instrument(s).

.2 All test equipment shall have valid calibration stickers displayed on the equipment and must be calibrated within the last 12 months by a company who

regularly engages in this service and who is otherwise acceptable to the Engineer.

.2 Relay Test Equipment:

.1 Relay test equipment shall be designed for relay testing and secondary current injection.

.2 Current output shall be capable of 60A for testing of instantaneous features.

.3 Indicators shall detect open signals, pick-up signals and other required signals.

.4 Timers shall be accurate to 1 millisecond.

.5 Multi-Amp or equivalent relay test units. Specifically designed relay testers for specific relays should be used if available.

.6 For equipment required on three phase systems, use a three-phase voltage and current output test unit.

.7 For equipment required on three-phase differential test, use a six-channel current output test unit(s) or approved equivalent.

.3 DC High Pot Units:

.1 Test instruments shall have a minimum output of 60kV DC, 2000 uA capacity.

.2 Shall be 120V AC powered.

.3 Test shall be conducted with full safety measures in force, including “barrier” of conductor ends, proper bonding and a “flag-person”, as necessary.

.4 Insulation Resistance Meter (Megger):

.1 DC megger to have an insulation scale to 100,000 megohms (1000V scale).

.2 Output voltages on DC megger units shall be 500V, 1000V, 2500V and 5000V.

.3 DC megger units shall be suitable for 10-minute megger tests and polarization index tests.

.5 Low Resistance Test Units (Ductor):

.1 Low resistance test units shall have 100A output.

.2 Digital display and accuracy to 1 microhm.

.6 Ground Resistivity Tester:

.1 Ground resistivity tester shall measure earth impedance in variable distances from the source to 250 meters.

.2 Unit shall be capable of plotting ground resistivity from 0.1 ohms and higher.

.7 Load Survey:

.1 Test equipment shall be a Fluke Corporation (Fluke) 3 phase Power/Power Quality monitor or a Engineer approved equivalent with the capability of Harmonic measurements, amplitude and phase angle for each harmonic, Watts, VA, VAR, true power factor, and displacement power factor, power quality standard measurements with high speed sampling of impulses at 2 MHz to measure impulses to 6400 volts peak, 500 nanoseconds duration and displays peak voltage.

.8 Thermo Graphic Scan Equipment:

.1 Test equipment shall be, at a minimum, equal to FLIR Systems, Inc. Agema Thermo Vision 570 portable Infrared camera system. System must be capable of taking a colour infrared image of all irregularities.

.9 Ultrasonic Scan Equipment:

.1 Test equipment shall be, at a minimum, equal to UE Systems Inc. – Portable Ultrasonic system. A digital camera must be used for photo recording ability at high resolution high definition formats.

.10 The Contractor shall submit all forms necessary to fully describe the inspection, testing and maintenance of all items.

2.2 REPORTS

.1 Reports of all tests shall be in written and electronic format.

.2 Include a copy of test results in the maintenance manuals and in an electronic format.

.3 General:

.1 All test results shall be input into an electronic test sheet program.

.2 All test sheets shall include equipment nameplate data, customer identification, time and date of tests, environmental conditions during tests, and test results.

.4 Test Results and Reporting – Data for Inclusion:

.1 The following data shall be included in the test reports:

a. Equipment data with selected position, if applicable, e.g., transformer tap.

b. Protective device(s) make, model number, rating, “as found” settings. These shall include CT, PT relays, overloads, fuses, breakers.

c. Adjustments, modifications and repairs made on the equipment on Site with an explanation of such work (necessity and method of execution).

d. A summary of conclusions of the inspection and testing:

(a) The acceptable criteria and limiting values of measured figures by the equipment manufacturer. These shall include the insulation resistance, (mega-ohm) contact resistance (micro-ohm), and leakage current (micro-ampere).

.2 Recommendations for long-term and short-term remedial work.

.5 Report Format:

.1 The final report shall be submitted in electronic and paper format in three copies neatly bound in 3-ring binders with separate sections for each item as listed therein.

.2 All test reports shall be submitted in written and electronic format.

.3 Photographs shall be mounted on background sheet complete with labels. Curves and graphs shall be neatly plotted on appropriate graph paper. Result tables shall be made electronically and logically arranged.

PART 3 EXECUTION

3.1 GENERAL

.1 Coordinate all tests and shut downs with the City of Toronto. The Contractor shall provide notice to the Engineer and City a minimum of 60 days prior to the proposed dates of the tests and shutdowns. Seasonal demands must also be taken into consideration by the Contractor during the scheduling of tests.

.2 Pre-service inspection and testing and post-service inspection and testing of equipment shall be as described in this Section and shall include the following:

.1 Insulation resistance tests.

.2 DC medium and low voltage tests.

.3 Switchgear tests.

.4 Low voltage distribution switchgear.

.5 Low voltage power circuit breaker and protective relays.

.6 Motor Control Centres.

.7 Low voltage moulded case breakers greater than or equal to 100A.

.8 Medium and Low voltage feeders.

.9 Generator and Feeder Protective relays.

.10 Power monitoring equipment.

.11 Coordination study related to calibration and testing.

.12 Thermo graphic scan.

.13 Load study.

3.2 REQUIRED TEST

.1 Insulation Resistance Tests:

.1 Use a megger with 100,000 mega-ohm at 1000V resolution for megger tests.

.2 Record ambient temperature and adjust the measured mega-ohm reading to 20ºC ambient.

.3 Use a 2.5kV megger for 2.4kV equipment and a 1000V megger range for power equipment of 600V and below.

.4 For 10-minute megger test, record mega-ohm values in mega-ohms at 30 seconds, 60 seconds, 5 minutes and 10 minutes. Plot mega-ohms against time for each connection. Calculate and record the ratio of measured mega-ohms as follows:

a. 60-second megohm/30-second mega-ohm = dielectric absorption.

b. 10-minute megohm/1-minute mega-ohm = polarization index.

c. Report the 1-minute mega-ohm as the insulation resistance value.

d. Submit tabulated measured mega-ohm figures for 10-minute insulation tests, in a graphical format.

.2 Operational Checks:

.1 Operate the closing and tripping mechanism and the shutters for correct and smooth movement.

.2 Operate each protective and monitoring device for correct operation and indication.

.3 Sample check the torque of bus bar bolts and cabling termination for correct tightness. Include Ductor tests.

.4 Check contact alignment and bouncing, contact pressure and contact resistance.

.5 Check mechanical and electrical interlocks.

.6 Check the draw out feature of breaker and PT drawer.

.7 Check the auxiliary switches operation and contacts.

.8 Verify all interlocks are functioning as designed, including key interlocks, hard wired interlocks between cells, emergency stop pushbuttons and 86 lockout relay interlocks.

a. Conduct Insulation Resistance Test on all interlocks.

.9 Conduct DC hi pot test on each switchgear (circuit breaker, transition unit, fuse switch and load break switch).

.10 Perform Doble® test on each switchgear (circuit breaker, transition unit, fuse switch and load break switch).

.11 Duct tests on relays (relay testing), voltage/control transformers, current transformers, indicating meters, switchgear cell inspection and lightning arresters all in accordance with test schedules. For relays, check operation indication.

.12 Lightning Arrester Testing.

a. Conduct tests after the lightning arresters have been isolated from system.

b. Check the arresters for cracks, corrosion and tracking marks.

c. Conduct megger and Doble® tests on 5kV lightning arresters per manufacturer's recommendations for one minute and record the results/ Check grounding on arrestors and check the pressure and state of operation indicator. Use a megger with 100,000 megohm at 1000V resolution for megger tests.

.3 Low Voltage Power Circuit Breakers and Protective Relays:

.1 Perform contact resistance testing on all breakers at or above 400A frame level, including limiters.

.2 Perform secondary injection testing of zero sequence current transformers and ensure that pick-up value is in accordance with its respective ground fault relay. Function test each breaker via its zero sequence CT in order to ensure reliable operation.

.3 Inspection and testing shall include visual inspection of the breaker and auxiliary device(s). Note any deficiencies.

.4 Verify protective relay settings with the coordination study.

.5 Check draw out devices, electrical and mechanical functions, and interlock sequences. Test contact resistance.

.6 Perform current injection tests to confirm the proper operation of trip devices.

.7 Record:

a. Long time pick-up current.

b. Long time trip times at 200% and 300% of pick-up.

c. Short time pick-up current.

d. Short time trip time at 150% of pick-up.

e. Instantaneous pick-up.

f. Ground pick-up.

g. Insulation resistance test from pole to pole and from pole to ground for one minute at kV DC.

.8 Overcurrent and Ground Fault Tripping Relays:

a. Test by secondary current injection, tripping of device or alarms to be confirmed.

b. Test draw-out function, etc.

c. All relays shall be adjusted and tested to show conformance with the settings recommended in the coordination study.

.4 600V MCC/PDP:

.1 Insulation resistance.

.2 Continuity Check and Ductor tests.

.3 Proper phase sequence, ABC. Conduct inspections and tests and compile test reports.

.5 Low Voltage Cable Feeders:

.1 In and out of main board shall be meggered at 1,000V DC and terminals checked for torque. Any reading less than 50 Mega-ohms to be investigated.

.2 Insulation Resistance.

.3 Continuity Check.

.4 Proper Phasing, ABC.

.6 Protective Relaying:

.1 General:

a. Conduct inspection and tests, and compile test results on relay test sheets approved by the Engineer.

b. Conduct tests on all protective relays, auxiliary voltage and current relays, overloads, specialty protection relays including generator, transformer and switchgear relays, trip supervisory relays and trip relays.

c. Calibrate all relays if tests indicate that the actual set points are outside the tolerance indicated in the coordination study, or recommended by the manufacturer. Record “as found”, and “as revised”, values.

.2 Relay Testing:

a. Use special test equipment and methods as available from the relay manufacturer. Comply with all of the manufacturer’s recommended precautions.

b. Include a copy of the relay manufacturer’s test and commissioning schedule as part of the test report.

c. Submit calculations to substantiate current/voltage figures used in tests where these are not obvious.

.3 Protective Relay Testing, Power Monitor Testing:

a. For motor protection relays and similar relays, use 3-phase current for unbalanced protection testing, unless recommended otherwise by the manufacturer.

b. Use 6-channel current relay (3-phase line, 3-phase load) test units, or approved equivalent for differential protection relays.

.7 Power Monitoring:

.1 General:

a. Conduct inspections and tests, and compile test results on setup and test sheets approved by the Engineer.

b. Conduct tests on all power monitors and power monitoring features on protective relays.

c. Verify current transformer and potential transformer windings.

d. Verify and correct, if necessary, current transformer and potential transformer orientation and polarities. Verify correct power flow direction.

.2 Power Monitor Testing – General:

a. Use special test equipment and methods as available from monitor manufacturer. Take all recommended precautions from the manufacturer.

b. Include a copy of power monitor manufacturer's test and commissioning schedule as part of the test report.

c. Submit calculations to substantiate current/voltage figures used in tests where these are not obvious.

d. Verify current transformer and potential transformer windings.

.3 Protective Relay Testing, Power Monitor Testing:

a. Use 3-phase current and voltage relay test units for verification of power monitoring devices, including verification of power flow quadrant.

.8 Coordination Study Related Calibration & Testing:

.1 Test and calibrate, using relay test equipment, all settings as indicated by the coordination study, and approved by the Engineer. Show "as found" and "as left" settings and test results.

.2 Test and calibrate new breakers that have been installed after the coordination study. Incorporate test results as part of the study.

.3 Relays (including, but not limited to feeder protection, differential protection, synchronization, generator protection and transformer protection), motor starters relays and power meters shall be calibrated and tested prior to final energization.

.4 Listing relays (including, but not limited to feeder protection, differential protection, synchronization, generator protection and transformer protection), motors starters relays and power meters shall be calibrated and tested during switchovers or scheduled power outages.

.9 Thermographic Scan:

.1 Visual and Mechanical Inspection:

a. Remove all necessary covers prior to scanning.

b. Inspect for physical, electrical, and mechanical condition.

c. Conduct a survey on 5kV and 347/600V, electrical distribution equipment indicated on the Contract Drawings.

(a) All 600V MCC's and 600V 3-phase panel boards.

(b) All 208V Panelboards.

.2 Test Parameters:

a. Scanning/detection system shall have the ability to detect 1ºC difference between subject area and reference point at 30ºC.

b. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

c. Infrared surveys should be performed during periods of the maximum loading possible but not less than 20% of rated load of the electrical equipment being inspected.

.3 Test Results:

a. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:

(a) Temperature gradients of 3ºC to 7ºC indicate possible deficiency and warrant investigation.

(b) Temperature gradients of 7ºC to 15ºC indicate deficiency; repair as time permits.

(c) Temperature gradients of 16ºC and above indicate major deficiency; repair immediately.

(d) Provide infrared and digital photo recording (thermograms) of each irregularity. Submit an electronic photograph of the general area around the hot spot. Label and identify data/photo clearly.

.4 Report Sheets:

a. Report shall be provided in accordance with subsection 2.2, and shall include the following:

(a) List of equipment that was scanned by name.

b. Deficient items shall be identified on a separate page and shall include the following:

(a) Equipment identification and location.

(b) Photograph of item.

(c) Thermograph of item.

(d) Temperature measurement in ºC of the following:

(e) Defective component.

(f) Reference component.

(g) Over temperature of component.

(h) Difference to ambient temperature.

c. Electrical load on device during inspection:

(a) Phase unbalance, if present.

(b) Probable cause of deficient item.

(c) Recommendation for corrective action.

.10 Load Survey:

.1 Measure and record phase-to-phase voltage, phase to neutral voltage, phase current, neutral current and ground current of the following:

a. All 600V MCC's.

b. All 600V & 208V panelboards.

c. All primaries and secondary's of all dry type transformers; record tap settings.

.2 Measure and record magnitudes of harmonic phase and neutral currents at all of the equipment mentioned in subsection 3.1. Identify the current magnitudes for the 3rd, 5th, 7th, 9th, 11th, 13th, 15th, 17th, 19th and 21st harmonic (based on 60 Hz).

.3 Utilize test instruments with a maximum error of ±2% and submit two signed, dated and bounds copies of typed result sheets to the Engineer.

.4 Measure power quality standard measurements: sags, swells, and wave shape fault events, rms volts, rms amps, and frequency summaries. Measure transients to 1000 volts peak, 130 microseconds duration.

.5 Measure at the main switchboard, power consumption: W, VA, VAR, PF (true and displacement), demand, kWh. Visual and Mechanical.

3.3 CONTROL AND COMMUNICATIONS WIRES AND CABLES

.1 Check each cable and wire for continuity, short circuits and grounds. Ensure resistance to ground of circuits 50 megohms minimum; apply 1000V AC for 600 volt insulated wires.

.2 Tests:

.1 After installing cable and terminating, perform insulation resistance test with megger on each conductor.

.2 Check insulation resistance after each termination.

.3 Test continuity of wires, conductor resistance and capacitance.

.4 Verify wiring interconnections by ring out.

.5 During testing ensure terminations and accessory equipment disconnected.

.6 During testing ground shields, ground wires and conductors not under test.

.7 Restore termination connections, grounds, shields, ground wires and conductors after testing.

.3 Provide the Engineer with written list of test results showing location each test made, circuit tested and result of each test. Provide assurance that conditions were restored.

.4 Remove and replace entire length of cable if cable fails to meet test criteria.

3.4 CONTROL PANELS AND CABINETS

.1 Verify system installations, connections and controls complete and Product in operable condition.

.2 Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

3.5 DUCTS/CONDUITS

.1 Verify each underground duct or conduit to contain no blockages by pulling through appropriately sized mandrel in presence of the Engineer.

3.6 COMPLETION OF TEST SHEETS

.1 Incorporate any modifications to test sheets arising from the Engineer's approval of test program.

.2 Sign test sheets indicating contents accurate. The Engineer to sign sheets to confirm test sheet as accurate record:

.3 Carry out procedure promptly.

.4 Signature of the Engineer does not mean transfer of responsibility. Responsibility for Work remains with Contractor until Contract Completion.

END OF SECTION

TORONTO

SECTION 16110

CONDUIT SYSTEMS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL CONDITIONS

.1 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

.2 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for Electrical General requirement related to this work.

1.2 SCOPE

.1 All 600V power cabling to be in tray unless noted otherwise.

.2 120/208V power cabling to be in conduits according to the site conditions.

.3 Supply and install all conduits, fittings, supports, hangers and miscellaneous support materials and hardware required for the complete systems in accordance with the applicable codes and regulations and as specified herein and on the drawings.

1.3 LOCATION OF CONDUITS

.1 Drawings do not indicate all of the conduits and supporting runs. Those indicated are in diagrammatic form only.

PART 2 PRODUCTS

2.1 CONDUITS

.1 All conduits shall be rigid PVC.

.2 Rigid PVC conduit, manufactured to schedule 40 wall thickness. Solvent weld compound for all PVC joints. Complies with CSA C22.2 No. 211.2-M1984. For use underground and embedded in concrete.

.3 Liquid-tight flexible metal conduit, spirally wound interlocked armour construction with overall PVC jacket. Complies with CSA C22.2 No.56-M1977.

.4 Flexible PVC conduit, as indicated. Complies with CSA C22.2 No. 227.2-M1987.

.5 Minimum conduit size: 21mm.

.6 EMT conduits are NOT acceptable for use in the project.

2.2 CONDUIT FASTENINGS AND SUPPORTS

.1 One-hole and two-hole hot dip galvanized steel straps for metal conduit.

.2 Two hole PVC straps for PVC conduit.

.3 Hot dip galvanized steel beam clamps.

.4 Hot dip galvanized steel channel type supports, U-shape, size 41 x 41mm, 2.5mm thick.

.5 6mm diameter threaded galvanized steel rods to support suspended channels. Provide all necessary galvanized steel spring loaded bolts, nuts, washers and lock washers.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit. Fittings to incorporate nylon insulated throat or bushing.

.2 Factory “ells” where 90° bends are required for 25mm and larger conduits.

.3 Pressure type terminals for all rigid metallic conduit grounding wire connections.

.4 Rigid conduit hub type connectors in wet or outdoor areas: nylon insulated with recessed neoprene ‘O’ ring.

.5 Liquid tight flexible conduit fittings to incorporate a threaded grounding core, nylon compression ring and gland. Insulated throat, male thread and locknut or bushing with an integral ‘O’ ring seal.

.6 Locknuts bonding type with sharp edges for digging into metal wall of enclosure.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions.

.2 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 6mm stranded nylon cord, tensile strength 5kN.

2.6 MANUFACTURERS

.1 Acceptable rigid PVC conduit manufacturers:

.1 Scepter.

.2 Cobra.

.3 Canron.

.2 Acceptable liquid tight and flexible conduit manufacturers:

.1 Anaconda Metal Hose.

.2 Thomas and Betts (T&B).

.3 Acceptable conduit fittings manufacturers:

.1 T&B.

.2 Efcor.

.3 Swift.

.4 Canlet.

.5 Robroy Industries.

.4 Acceptable support channel manufacturers:

.1 W.C. Pursley.

.2 Pilgrim.

.3 Canstrut.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits in finished areas.

.3 Use liquid tight flexible metal conduit for connection to all motors or vibrating equipment.

.4 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.5 Mechanically bend metallic conduit over 19mm diameter.

.6 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.7 Install fish cord in empty conduits.

.8 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.9 Dry conduits out before installing wire.

.10 Support equipment using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.11 Install expansion sleeves wherever conduits cross a structural expansion joint.

.12 Extend spare conduits 100mm into building and/or switchgear enclosure and seal with threaded cap for future use.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface mounted channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

.7 Do not use ‘C’ type clamps or perforated metal straps.

.8 The maximum length of straight conduit run shall be 60 m between pull boxes or other terminations. Reduce this length by 15 m for each 90º bend or 7 m for each 45º bend or offset. Conduit runs to include not more than the equivalent of two 90º bends between pull boxes except where indicated otherwise on the drawings.

.9 Make no holes in building structural members for supporting conduits without the permission of the Contract Administrator.

.10 Touch up and repair coated conduits and fittings on which the epoxy or PVC finish has been damaged; paint with a compound material supplied by the original conduit manufacturer.

.11 Fasten exposed conduit to building construction or support system using straps.

.1 One-hole galvanized steel straps to secure surface conduits 50mm and smaller.

.2 Two-hole galvanized steel straps for conduits larger than 50mm.

.3 Beam clamps to secure conduit to exposed steel work.

.12 Suspended support systems.

.1 Support individual conduit runs with 6 mm dia. threaded rods and spring clips.

.2 Support two or more conduits on channels supported by 6mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.13 For surface mounting of two or more conduits use channels at 1m o.c. spacing.

.14 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit runs.

3.3 CONCEALED CONDUITS

.1 Do not install horizontal runs in masonry walls.

.2 Do not install conduits in terrazzo or concrete toppings.

.3 Run concealed conduits in ceiling spaces in straight lines with large radius bends where applicable.

.4 Do not cut into the wall after the walls are in place, unless otherwise authorized by Contract Administrator.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete. Terminate stub-ups 100mm above finished floor and seal with threaded cap.

.3 Install sleeves where conduits pass through slab or wall.

.4 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 25mm and larger below slab and encased in 75mm concrete envelope. Provide 50mm of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage. Drill 9mm drainage hole at lowest point.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.7 NEW OPENINGS IN EXISTING CONCRETE

.1 Make new holes in existing concrete for piping, conduit, cables, or equipment, using either method described below:

.1 Chip with a hammer and chisel. Adjust the location of holes as necessary to avoid electrical conduits if encountered. Cut reinforcing steel after permission is received.

.2 Core-drill holes after radiograph procedures are followed.

.2 Radiograph the existing concrete in the area of each proposed hole for 3 diameters around the centreline of the proposed penetration. If no structural steel, piping or electrical conduits are found, core the hole. If structural steel, piping or electrical conduits are found, select an alternative location and radiograph it, until a suitable coring location is identified. Include up to three (3) sets of Radiographs in base price.

.3 Prior to commencing work, submit to the Contract Administrator a photocopy of the license issued under the Atomic Energy Control Board Regulations for radiography. Perform work in accordance with current Atomic Energy Control Board Regulations for radiography. Be responsible for boundary controls, signs, etc. that protect the facility personnel and others from hazards in the radiograph work area. Inform the Contract Administrator in writing 48 hours prior to commencing any radiography.

END OF SECTION

TORONTO

SECTION 16111

CABLE TRAYS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements and Section 16010 – Electrical General Requirements.

.2 Provide all new cable trays to suit the requirements of the power distribution and controls applications identified on the drawings.

.3 Not all cable tray applications are identified on the drawings. The Contractor is required to provide additional cable trays in accordance with the requirements of the distribution power feeders identified on single line diagrams and control wiring drawings.

.4 Unless indicated otherwise Comply with Division 1 – General Requirements and Section 16010 – Electrical General Requirements.

.5 Unless indicated otherwise, provide cable tray to suit all TECK90 power conductors.

1.2 RELATED SECTIONS

.1 Section 01330 – Submittals.

.2 Section 16010 – Electrical General Requirements.

.3 Section 16122 – Wire and Cable 0-1000V.

.4 Section 16450 – Grounding.

1.3 REFERENCES

.1 CSA C22.2 No. 126 Cable Tray Systems.

1.4 DESIGN REQUIREMENTS

.1 CSA Class C1 load carrying capability, ladder, aluminum, 75mm minimum side rail height, width to suit the design drawings.

.2 All installation and mounting hardware shall be galvanized steel.

.3 All cable tray dimensions shown on the drawings are minimum requirements. The Contractor is required to increase the cable tray dimensions as required to ensure that all single conductor installations maintain a free air ampacity ratings in accordance with the Ontario Electrical Safety Code.

.4 Provide support and cable tray loading calculations at the request of the Engineer.

1.5 SITE CONDITIONS

.1 Provide cable tray applications in accordance with the single line diagram and building power distribution layout drawings. The Contractor is required to verify the building conditions and locations of existing building services that may be in the path of the proposed cable tray installations.

.2 The Contractor is responsible for obtaining all measurements and clearances to suit the design and installation of the new cable tray.

.3 The Contractor is required to coordinate with existing cable trays that are intended for future use and to be extended to suit the distribution requirements of this project.

.4 The Contractor is required to confirm the locations of other building services that may conflict with the installation of the cable tray and adjust the routing to suit.

1.6 PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 Drawings to include individual product sheets for each type of cable tray section, quantity, and dimensions.

1.7 SUBMITTALS

.1 A detailed submittal package identifying the equipment to be supplied shall be furnished.

.2 The submittal package shall identify all cable tray components to be installed to suit the specific cable tray applications.

.3 Provide a drawing for each application that identifies the cable tray routing for each, including horizontal and vertical bends and transitions.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Acceptable cable tray manufacturers:

.1 Eaton.

.2 Pilgrim Technical Products Ltd.

.3 Electro Tray.

.4 Canstrut Inc.

.5 B-Line Systems, Canada.

.6 Pursley Inc.

.7 T&B Cable Tray Systems

.2 Ladder type aluminum cable tray: 300mm rung spacing.

.3 Material – Aluminum.

.4 Solid type cable tray: For unarmoured and instrumentation cables in plant area, complete with solid cover.

.5 Barriers: Solid aluminum, of same material as cable tray.

.6 Fitting bending radius: 600mm minimum, except that minimum bending radius for trays supporting high voltage cables (above 3000V) is as required by Inspection Authority, unless otherwise indicated.

.7 Anchors: Type HKD by Hilti (Canada) Ltd., type Redhead Multi-set II Anchors by Phillips.

.8 Hanger rods and hardware to be stainless steel 12mm minimum diameter.

.9 All mounting hardware to be stainless steel. Supply and install the necessary temporary bracing, supporting structures, guards, warning signs, etc. necessary to complete the project safely and in accordance with all regulations and/or codes.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Provide aluminum cable tray raceway systems as indicated with all fittings, accessories and hangers required to complete installation.

.2 Do not suspend or support the Cable tray from existing building services or service equipment. All cable trays are to be supported from the building structure.

.3 Install cable tray and duct runs to avoid interferences with process or service equipment, piping and ducting. Install trays and ducts parallel to building lines and conserve head room.

.4 Coordinate location of supports and runs with other trades.

.5 Space tray supports 1200mm maximum and duct supports 1500mm maximum. Mechanically bolt tray connections. Install supports within 300mm of either side of bends and T fittings.

.6 Contractor to make use of existing tray system unless the existing tray cannot support the additional cable run. Provide support system adequate to accommodate stresses imposed by cable pulling.

.7 Allow for unobstructed clamping of cables or conduits in cable trays.

.8 Close off dead ends of cable tray and duct with fittings recommended by manufacturer.

.9 Install tray and duct systems continuous through walls and floors.

.10 Provide vertical tray sections with removable solid covers to 3000mm minimum from finished floor level.

.11 After installation of trays, and cables seal openings in walls and floors to original fire rating with fire resistant material. Refer to Penetration Seals in Section 16010.

.12 Anchor support system to concrete, concrete block and other masonry surfaces. Do not drill into concrete beams without written authorization from Engineer. Do not crack masonry surface when drilling.

.13 Fasten support systems to structural steel with beam clamps. Do not weld, drill or cut structural steel without written authorization from Engineer.

.14 Fasten vertical cable trays terminating at equipment enclosure to top of enclosure.

.15 Provide expansion joint type coupling connectors and bonding jumpers at building expansion joints and on straight runs exceeding 30m.

.16 Install a bare copper conductor in each tray for equipment grounding. Comply with Inspection Authority requirements. Attach ground conductor to each tray section and fitting with an accepted ground clamp. Alternatively, connect tray sections and fittings together utilizing a mechanical bonding method acceptable to Inspection Authority.

.17 Bond trays and ducts to building grounding system at 5m maximum intervals and at ends.

.18 Touch-up field cut steel trays and ducts with zinc rich galvanizing primer. Remove burrs and uneven edges. Organize the work and provided sufficient labour and equipment to ensure safety at all times.

END OF SECTION

TORONTO

SECTION 16122

WIRES AND CABLES 0-1000V

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements.

.2 Section 16080 – Electrical Testing.

1.2 REFERENCES

.1 CSA C22.2 No.0.3-92, latest edition, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No.131-14 (latest edition), Type TECK 90 Cable.

.3 All power cables must be CSA approved for the application.

.4 Ontario Electrical Safety Code(OESC), latest edition.

1.3 APPLICATION REQUIREMENTS

.1 Wire or cable sizes smaller than indicated are not acceptable.

.2 Unless otherwise indicated every cable run from a source to a load is to include an appropriately sized separate ground wire properly bonded and grounded.

1.4 PRODUCT DATA

.1 Submit product data in accordance with Section 01330 − Submittals.

1.5 DELIVERY AND STORAGE

.1 Deliver, store and handle materials in accordance with Division 1 requirements and as per manufacturers written instructions.

.2 Delivery and acceptance requirements: deliver materials to site in original factory packaging, labelled with manufacturers name and address.

.3 Storage:

.1 Cap or seal ends to prevent water penetration into cable. Reseal after cutting length of cable.

PART 2 PRODUCTS

2.1 LOW VOLTAGE CABLES (1000V AND BELOW)

.1 Conductors: stranded annealed copper for all conductors.

.2 Copper conductors: size as indicated, with 1000V XLPE insulation of chemically cross-linked thermosetting polyethylene material rated RW90, suitable for -40°C ambient, 90°C maximum conductor temperature, flame test rated at FT4.

.3 Conductors below grade in conduit shall be type RWU90 cross-link polyethylene.

.4 Motor or branch circuit feeder sizes shall be as noted on drawings and in no case shall be smaller than #12 AWG. Control wiring shall be of minimum size #14.

.5 All feeders shall be run in continuous length between power supply point and the load. No splices will be allowed in feeder cable.

.6 Ground wire to be green jacket with RW90 insulation when run in ducts or conduits.

.7 Ground wire to be bare stranded soft drawn copper conductor when installed in cable trays.

.8 Install 20% spare control wiring capacity in each controls conduit.

.9 All wiring for remote DC emergency fixtures shall be #10 AWG.

.10 Identify all wiring with wire markers at both ends.

.11 All branch circuit wiring and all systems wiring shall be identified at all panels and terminal boxes with City of Toronto PCS approved heat shrink markers.

.12 All necessary power and control wiring to all equipment shall be supplied and installed to suit the power and control requirements noted on the drawings. It shall be noted that the drawings do not necessarily indicate the locations of each individual feeder, but these shall be located to best suit the site conditions.

.13 All wiring connections shall be made with T & B Sta Kon pressure connector, or approved equal, applied with a pressure tool.

.14 Wiring connections, where required, shall be made with CSA approved compression tool with a nylon cap equal to Buchanan “Pres Sure”.

.15 All wiring shall be identified with City of Toronto PCS approved heat shrink markers at junction boxes and termination points.

.16 All wiring shall be sized so that voltage drop between the panel board and the furthest outlet shall not exceed 2% when the circuit has a full load.

.17 Only circuits of the same voltage shall be installed in a common conduit or duct or share the same ground return line. Do not mix voltage in the same duct or conduit.

.18 Colour Coding:

.1 Phase A – Red.

.2 Phase B – Black.

.3 Phase C – Blue .

.19 Acceptable Manufacturers:

.1 Nexans.

.2 Pirelli Cables & Sysytems Inc.

.3 United Wire & Cable Inc.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No.131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Inner jacket: XLPE-Cross Linked Polyethylene.

.4 Armour: aluminum.

.5 Overall covering: polyvinyl chloride material.

.6 Fastenings:

.1 One (1) hole malleable iron straps to secure surface cables 50mm and smaller. Two (2) hole steel straps for cables larger than 50mm.

.2 Channel type supports for two (2) or more cables at 600mm centers.

.3 Threaded rods: 6mm dia. to support suspended channels.

.7 Connectors:

.1 Watertight approved for TECK cable.

.8 Acceptable Manufacturers:

.1 Nexans.

.2 Pirelli Cables & Systems Inc.

.3 United Wire & Cable Inc.

2.3 COMMUNICATION CABLE

.1 Supply and install all communications cables to suit the SCADA system architecture connection requirements.

.2 Coordinate cable types and installation requirements with Division 13.

.3 Acceptable Manufacturers:

.1 Belden.

.2 Approved Equal.

2.4 INSTRUMENTATION, CONTROL, COMMUNICATION & SPECIAL FIELD WIRING CABLE

.1 Refer and conform to the requirements of Division 13.

PART 3 EXECUTION

3.1 GENERAL CABLE INSTALLATION

.1 Conductor lengths for parallel feeders to be identical.

.2 Install wiring as follows:

.1 In conduit systems in accordance with Section 16110. Provide aluminum cable tray raceway systems as indicated with all fittings, accessories and hangers required to complete installation.

.3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.4 Provide numbered wire collars for all control wiring.

3.2 INSTALLATION OF TECK CABLES

.1 Install cables as indicated on drawings.

.1 Install cables.

.2 Group cables wherever possible on channels and on cable trays.

3.3 INSTALLATION OF ARMORED CABLES

.1 Group cables wherever possible.

3.4 TESTING

.1 Perform 1000V DC megger test on all power cables specified in this section prior to energization. This test to be witnessed by Engineer.

.2 Provide a written (typed) report to suit the test results for each cable within one (1) week of testing.

.3 All tests results shall be included in the operation and maintenance manuals.

.4 The Contractor shall repeat the test in the presence of the Engineer for any cable listed in the test report, at the request of the Engineer.

END OF SECTION

TORONTO

SECTION 16130

ELECTRICAL BOXES

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INTENT OF SECTION

.1 This section describes the requirements for the various electrical boxes required for splicing, connecting and pulling cables.

.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

1.2 SCOPE

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install all electrical boxes specified herein and on the drawings.

PART 2 PRODUCTS

2.1 ENCLOSURE RATINGS

.1 The following enclosure ratings apply to all equipment listed herein:

.1 Indoor and dry locations: NEMA 12, unless otherwise noted on drawings.

.2 Below grade, damp or outdoor locations: NEMA 4X, unless otherwise noted on drawings.

2.2 SPLITTERS

.1 Reference: CAN CSA C22.2 No. 76-M92.

.2 Galvanize steel enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.3 Main, branch and ground lugs to match required size and number of incoming and outgoing conductors as indicated.

.4 At least three spare terminals on each set of lugs in splitters less than 400 A.

.5 Lugs: insulator-copper construction.

.6 Ampacity size as specified on drawings.

2.3 JUNCTION, TERMINAL, AND PULL BOXES

.1 Reference: CAN CSA C22.2 No. 40-M1989.

.2 Non-metallic construction, maintenance free and corrosion resistant enclosure.

.3 Gasketed cover with two (2) piece tongue and groove construction.

.4 Cover shall be secured with included stainless steel machine screws.

.5 Cover holes in corners shall be outside of the gasketed area.

.6 Cover screws are self-captivating.

.7 One piece continuous gaskets to be made of polyurethane foam.

.8 All hardware is stainless steel to avoid corrosion.

2.4 OUTLET AND CONDUIT BOXES GENERAL

.1 Reference: CAN CSA C22.2 No. 18-M1987.

.2 Size boxes in accordance with CSA C22.1.

.3 102mm square or larger outlet boxes as required for special devices.

.4 Gang boxes where wiring devices are grouped.

.5 Blank cover plates for boxes without wiring devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.5 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm or as indicated. 102mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102mm square or octagonal outlet boxes for lighting fixture outlets.

.3 102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.6 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.7 CONCRETE BOXES

.1 Electro-galvanized steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.8 CONDUIT BOXES

.1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.9 FITTINGS – GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.10 MANUFACTURERS

.1 Crouse-Hinds.

.2 Appleton – Emerson.

.3 BEL.

.4 Pyle National.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

.3 Install pull boxes in inconspicuous but accessible locations.

.4 Mount cabinets with top not higher than 2m above finished floor.

.5 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.6 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

.7 Provide access panels in ceilings where junction and pull boxes are located in spaces not otherwise accessible.

.8 Make cut-outs for outlet boxes recessed in walls neatly and of the minimum practical size.

.9 Install boxes to clear all building and mechanical services equipment. Where two or more devices are shown at one location, utilize multi-gang boxes. Supply all outlet boxes with covers or plaster rings as required.

.10 Size all boxes to accommodate the number of conduits, conductors and terminal blocks. Provide junction boxes with 20% spare terminal blocks.

.11 Securely fasten surface-mounted boxes to the building or mounting structure and support independently of the conduits entering the box.

.12 Install junction and pull boxes mounted on brick, concrete or block walls with 3 mm thick lead or nylon washers between box and wall face.

.13 Provide all boxes sized to the Electrical Code requirements, in all conduit raceway systems to limit length of straight conduit runs to 60m. Reduce this length by 15m for each 90° bend or 8m for each 45° bend or offset.

.14 Mark location and size of all pull boxes on the record drawings.

.15 Install boxes in hazardous locations as required and shown on the drawings. Provide conduit seals for all conduits entering enclosure.

.16 Support boxes independently of connecting conduits.

.17 Fill outlet and conduit boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.18 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.

.19 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers are not allowed.

.20 Flush mount all outlet, switch and junction boxes, unless noted otherwise.

END OF SECTION

TORONTO

SECTION 16132

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements.

.2 Section 16050 – Basic Materials and Methods.

1.2 REFERENCES

.1 Ontario Electrical Safety Code – Latest Edition and ESA latest bulletins.

1.3 GENERAL REQUIREMENTS

.1 All mounting hardware shall be of non-corrosive type material including:

.1 Stainless steel.

.2 Outlet and Conduit Boxes must be of the same material as the conduit application. Refer to Section 16110 – Conduit Systems for the acceptable material type for conduits.

.3 All junction and outlet boxes installed outdoors shall be of the same manufactures as the conduit application.

PART 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with code requirements.

.2 102mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one (1) system are grouped.

.6 All boxes used with exposed conduits to be galvanized rigid metal. Boxes to be as manufactured by Appleton or equal.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm or as indicated. 102mm square outlet boxes when more than one (1) conduit enters one (1) side with extension and plaster rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface mounted EMT conduit, minimum size 102 x 54 x 48mm.

.3 102mm square or octagonal outlet boxes for lighting fixture outlets.

.4 102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63mm with two (2) double clamps to take non-metallic sheathed cables.

2.7 FITTINGS GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32m and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SERVICE FITTINGS

.1 ‘High tension’ receptacle fitting made of two (2) piece stainless steel housing finish for one (1) single receptacle(s). Bottom plate with two (2) knockouts for centered or offset installation. 12 x 102mm extension piece as indicated.

.2 Pedestal type ‘low tension’ fitting made of two (2) piece stainless steel housing finish to accommodate two (2) amphenol jack connectors.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

TORONTO

SECTION 16275

DRY TYPE TRANSFORMERS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 INTENT

.1 This Section 16275 describes the requirements for the design, fabrication, inspection, testing, delivery, and installation of dry type transformers.

1.2 RELATED REQUIREMENTS

.1 Contract Drawings

.2 Section 16050: Basic electrical materials and methods.

.3 Single Line Diagrams (SLD) of the project

.4 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents.

1.3 REFERENCES

Refer to the latest edition of the following standards

.1 CSA International

.1 CSA C9-02 (R2011), Dry-Type Transformers.

.2 CSA-C22.2 No. 47 Air-Cooled Transformers (Dry Type).

.3 CAN/CSA-C802.2-06, Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

.3 IEEE/American National Standards Institute (ANSI)

.1 C57.12.91, IEEE Standard Test Code for Dry-Type Distribution and Power Transformers

.4 Ontario Electrical Safety Code (OESC), including Electrical Safety Authority (ESA) amendments and published bulletins.

.5 ASHRAE 90.1 & SB-10, Table 8.4.4 Minimum Nominal Efficiency Levels for 10 CFR 431 Low-Voltage Dry-Type Distribution Transformers

1.4 SUBMITTALS

.1 Submit in accordance with Division 1- Submittal Requirements.

.2 The equipment supplier/manufacturer shall provide a "specification compliance report" for the equipment. The report shall provide details which demonstrate that all the clauses of the specification, and contract drawing requirements are met. In case there is any deviation(s) then it shall be mentioned in the "specification compliance report", and it shall be reviewed and approved by the Engineer.

.3 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria including efficiency, physical size, finish and limitations.

.4 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate on drawings:

a. Dimensions showing enclosure, mounting details, terminals, taps, internal and external component layout.

b. Technical data:

(a) kVA rating.

(b) Primary and secondary voltages.

(c) Frequency.

(d) Number of phases.

(e) Polarity or angular displacement.

(f) Full load efficiency.

(g) Regulation at unity pf.

(h) BIL.primary and secondary

(i) Insulation type, temperature class and temperature rise.

(j) Sound rating.

(k) Conductor material.

(l) Impedance.

(m) Efficiency.

(n) Weight.

(o) Colour.

c. Schematic and wiring diagram.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Division 1 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for Dry Type Transformers for incorporation into manual.

.3 Operation and maintenance instructions to include:

.1 Installation, operation, and maintenance instructions.

.2 Parts list with details of local service and supply organizations.

.3 Certified final test results.

.4 Final shop drawings.

.5 Final data sheets

.6 Tap changing details.

.7 Recommended environmental conditions.

.8 Recommended periodic inspection and maintenance.

.9 Bushing replacement details, if applicable.

1.6 CSA COMPLIANCE

.1 Product manufactured shall conform to CSA Standards and have applied CSA or equivalent approved listing mark recognized by the Electrical Safety Authority (ESA).

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 1 – Electrical General Requirements and manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors, in a dry location, and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.

.2 Store and protect transformers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.8 EXTRA MATERIALS

.1 Supply maintenance materials in accordance with Division 1 - Closeout Submittals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Hammond Manufacturing Co. Ltd.

.2 General Electric

.3 ABB Canada Inc.

.4 Marcus Transformers

.5 Siemens

.6 Pioneer

.7 REX

.8 Approved Equivalent

2.2 MATERIALS

.1 Dry-type transformers: to CSA C9.

.2 Bushings: to CSA C9.

2.3 TRANSFORMER CHARACTERISTICS

.1 Comply with standards listed under Section 1.3 References.

.2 No load and full load losses not to exceed those indicated in CAN/CSA-C802.2.

.3 Project specific transformer characteristics as listed in Table 1.

Table 1 –Transformer Characteristics [Revise data in "REQ'D" column to suit specific project]

EQUIPMENT NUMBER(S):		SERVICE DESCRIPTION:	
DESCRIPTION	**REQ'D**	**DESCRIPTION**	**REQ'D**
SITE CONDITIONS		COOLING	
Location: [**I**ndoor/**O**utdoor]	I	Cooling Type Designation [ANN, ANF]	ANN
Ambient Design Temperature:	40°C	Cooling Fan Controls	No
		WINDINGS	
		Winding Type: [**O**pen, **V**PI Epoxy, **E**ncapsulated, **C**ast]	C
		Winding Temperature Class: [**130/150/180/200/220**]	200°C
DESIGN CONDITIONS			
Primary Voltage	600 V	PRIMARY / SECONDARY CONNECTIONS	
Secondary Voltage	120/208 V	Entry: [**T**op/**B**ottom]	T
Base Rating	As per drawing	Primary Conductors: Number, Type and Size/Phase	As per drawing
Rating with Fan cooling	N/A	Conductors: Number, Type and Size/Phase	As per drawing
No. of Phases	3	LIGHTNING ARRESTERS (Primary)	
Frequency:	60 Hz	Voltage Class	KV
Primary Configuration [**D**elta, **W**ye]	D	Class Type: [**S**tation/**I**ntermediate/**D**istribution]	D
Secondary Configuration [**D**elta, **W**ye]	W	TESTS	
Primary BIL	kV	Standard Production Tests	
Secondary BIL	kV	Temperature Rise Test	
Neutral Grounding Method [**S**olid, **L**ow Res., **H**igh Res.]	S	Sound Level Test	
Impendance, % of Base kVA	Min 3% Max. 6%	Insulation	H
		ACCESSORIES	
TAPS		CSA C9 Standard Accessories	
Type: [**On** / **Off** Load, **F**lexible Bolted Links)]	F	Winding Temperature Monitoring and Control	none
Number, 2 _2 1/2_ % FCAN		Winding Temperature Detector: [**T**hermistors/**R**TD]	
Number, 2 _2 1/2_ % FCBN		ENCLOSURE	
		Enclosure Type:	Nema 12
		Colour:	ASA 61

REMARKS:

2.4 ENCLOSURE

.1 Fabricated from sheet steel NEMA 12 construction, minimum 12 gauge (2.7mm) thick ness, rigid, vibration free housing.

.2 Bolted hinged removable panels for access to tap connections, enclosed terminals.

.3 Include fan brackets.

.4 Conductor entry:

.1 Knockouts.

.2 Potheads.

.3 Junction boxes.

.4 Bushings.

.5 Clamping rings.

.6 Entry for cable.

.5 Designed for [floor] [wall mounting].

.6 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.

.7 Outdoor, ventilated, self cooled type, CSA 3 enclosure.

.8 Pad mounted type:

.1 Include conductor entry through bottom for underground distribution, with separate high and low voltage compartments divided by full length metal barrier.

.2 Ensure each compartment includes access door with concealed hinges.

.3 Secondary door to have 3-point latch, external operating handle, provision for padlocking and arranged so that secondary door must be open before access gained to primary compartment.

.9 Open type: no enclosure, for installation in switchgear enclosure.

.10 Paint finish of Enclosure shall be ANSI 61 Grey.

2.5 VOLTAGE TAPS

.1 Standard 4 taps, two at 2.5% FCAN and two at 2.5% FCBN.

2.6 TAP CHANGER

.1 Flexible bolted-link type, with visible tap positions.

2.7 WINDINGS

.1 Primary and secondary coils:

.1 Copper, uniformly insulated.

.2 Vacuum cast epoxy.

.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

.3 Sound level: not to exceed [as per project requirements] dB.

2.8 ACCESSORIES

.1 Winding temperature detector relay and sensing elements with 1 set of SPDT contacts.

.2 Wiring and terminal box for protective devices.

.3 Digital type winding temperature indicator with alarm contacts, to be provided on the enclosure.

.4 If required for the project, provide fans for forced air cooling, 120 V, 1 phase, 60 Hz, with thermostat control and Auto/Manual switch for testing purposes.

.5 Grounding terminal: inside of enclosure.

.6 Touch up paint for enclosure.

2.9 EQUIPMENT (IDENTIFICATION)

.1 Provide equipment identification in accordance with Section 13040 – Toronto Water Tagging Standards requirements.

.2 Equipment labels: label as indicated on contract drawings and specifications.

.3 The equipment shall meet the Seismic requirements for Water and Wastewater facilities. The equipment and major components shall be suitable for and certified by Seismic testing to meet all applicable Seismic requirements of the latest Ontario Building Code. The manufacturer shall provide anchor bolts of sufficient size and number adequate for the seismic conditions.

2.10 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 The Engineer and the client to witness standard Factory Acceptance Tests (FAT) of complete dry type transformer including operation of switches and circuit breakers.

.3 The manufacturer shall confirm the date of FAT minimum six (6) weeks in advance, and provide the test procedures for Factory Acceptance Tests (FAT) of the low voltage switchgear.

.4 The manufacturer shall provide three (3) copies of test records immediately after the tests.

.5 All the Type and Factory Acceptance Tests (FAT) results shall be included in Operation and Maintenance Manual.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transformers installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Engineer.

.2 Inform Engineer, in writing, of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.2 INSTALLATION

.1 Locate, install and ground transformer in accordance with manufacturer's instructions. Secure equipment to the floor or base channels with anchor bolts of sufficient size and number adequate for the seismic conditions.

.2 Set and secure transformers in place, rigid plumb and square.

.3 Connect primary terminals to high voltage circuit.

.4 Connect secondary terminals to secondary circuit.

.5 Energize transformers and check secondary no-load voltage.

.6 Adjust primary taps as necessary to produce required secondary voltage at no-load.

.7 Wire one set of contacts on winding temperature detector relay to sound alarm, wire second set of contacts to trip transformer circuit interrupter.

.8 Wire alarm contacts on winding temperature indicator to sound alarm when excessive temperature reached.

.9 If required for the project, locate and install cooling fans.

.1 Connect thermostat control.

.2 Connect sequence contacts of temperature indicator:

a. First contact closure: start fan.

b. Second contact closure: sound alarm.

c. Third contact closure: trip secondary breaker.

.10 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.11 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

.2 Energize transformers and apply incremental loads:

.1 0% for 4 hours.

.2 10% for next 1 hour.

.3 25% for next 2 hours.

.4 50% for next 3 hours.

.5 Full load.

.6 At each load change, check temperatures ambient, enclosure, ventilating air, and winding.

.7 Adjust cooling fan controls if required.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by transformers installation.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Division 1 - Cleaning requirements.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 1 - Cleaning requirements.

.3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

TORONTO

SECTION 16412

MOLDED CASE CIRCUIT BREAKERS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements.

.2 Section 16441 – Panelboards.

.3 Section 16480 – Low Voltage Switchboards.

1.2 REFERENCES

.1 CSA C22.2 No.5-02 Molded Case Circuit Breakers.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01330 – Submittals.

.2 Include time current characteristic curves for breakers with interrupting capacity to match connected bus kA rating.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Plug-in moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 NEMA equipment only.

.7 All breakers shall be CSA listed for applications at 100% of their continuous ampere rating in their intended enclosure.

.8 Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

.9 Circuit breakers shall be operated by a toggle type handle and shall have a quick make, quick break over center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be

non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes.

.10 A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

.11 Circuit breakers shall have a minimum symmetrical interrupting capacity of 42,000A or as indicated on the drawings whichever is greater.

.12 Circuit breakers 600 ampere frame and below shall be equipped with thermal magnetic trip units and inverse time current characteristics.

.13 Circuit breakers 800 ampere through 1200 ampere frame shall be equipped with solid state based RMS sensing trip units including ground fault protection.

2.2 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKER

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide tripping for short circuit protection. Provide instantaneous trip, adjustable long and short time trip settings and ground fault protection.

.2 Provide a solid state electronic tripping module for timed and instantaneous over-current protection as indicated on the drawings.

.3 Include a solid state electronic tripping module for timed and instantaneous over-current and ground over-current protection for all breakers rated 1000A or greater.

2.4 SOLID STATE TRIP BREAKERS(MAIN CIRCUIT BREAKERS)

.1 Moulded case circuit breaker to operate by means of a solid state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, ground fault short circuit protection.

2.5 ENCLOSURE

.1 Individual wall mounted breakers to be installed in a NEMA 4 enclosures complete with a hinged door and a lockable external breaker handle.

2.6 ACCEPTABLE MANUFACTURERS

.1 Cutler Hammer – Eaton.

.2 Allen Bradley.

.3 Schneider Electric.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated by manufacturer.

END OF SECTION

TORONTO

SECTION 16440

DISCONNECT SWITCHES FUSED AND NON FUSED UP TO 600V

TABLE OF CONTENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 Provide disconnect switches for 347/600 volt and 120/208 volt distribution as indicated on the drawings.

1.2 SHOP DRAWINGS

.1 Refer to and comply with Section 01330 – Submittals.

.2 Section 16010 – Electrical General Requirements.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Ratings: 600 Volts for 347/600 volt distribution, 240 volts for 120/208 volt distribution. Unless otherwise shown, 3 pole for 3 phase, 3 wire distribution, 3 pole and solid neutral for 3 phase 4 wire distribution, ampere ratings as shown on the drawings. For motors, use disconnect switches with HP ratings at least equal to motor HP. Provide viewing window to display the switch blades.

.2 Enclosures: CSA code gauge galvanized steel, hinged doors, external operating handles. Disconnect switches shall be NEMA 12 in indoor dry locations, NEMA 4X in outdoor or indoor wet locations. Provide ON-OFF switch position indication on switch enclosure cover.

.3 Material of Construction: Stainless Steel.

.4 Switch mechanisms: Quick make and quick break action with self-wiping contacts, solderless pressure lug connectors. For switches 100 amperes and over, provide non-tracking arc shrouds. All switch poles to operate together from a common operating bar.

.5 Pad lock mechanism: Provide facilities to allow minimum 3 pad locks for padlocking disconnect switches in "Off" position. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle is in ON position.

.6 Neutral Bars: Where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.

.7 Fuse Holders: Provide fuse holders (relocatable and suitable without adapters) on load side of switches, ampere rating equal to switch ratings, suitable for fuses specified.

2.2 FUSES

.1 All fuses to be 100,000 ampere (minimum) interrupting capacity of the current limited type. In addition, fuses feeding motors where applicable to be of the time delay type.

Provide one full set of spare fuses, three for each different ampere rating used, stored in suitable enclosure.

2.3 ACCEPTABLE MANUFACTURERS

.1 Eaton Cutler Hammer.

.2 Schneider SQ-D.

.3 Siemens.

PART 3 EXECUTION

3.1 DISCONNECT SWITCHES

.1 Mounting: Provide supports independent of conduits. Wall mount where possible, otherwise provide unistrut frame support. Where switches are grouped mount in uniform arrangement.

.2 Wiring: Connect line and load cable to all switches.

.3 Fuse Rating: Install so that rating is visible.

END OF SECTION

TORONTO

SECTION 16441

PANELBOARDS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 The Contractor shall provide and install the panelboard(s) as specified and as shown on the contract drawings.

.2 Panelboard(s) to be provided with two (2) main breakers and a tie breaker to suit primary over current protection and isolation.

.3 This section applies only to panels tagged as “FHA-ELS-DP-XXXXX” with two (2) main breakers and a tie breaker.

1.2 RELATED SECTIONS

.1 Section 01430 – Manufacturers Service

.2 Section 01783 – Operation and Maintenance Manual

.3 Section 01830 – Factory Acceptance Testing

.4 Section 16010 – Electrical General Requirements

.5 Section 16412 – Molded Case Circuit Breakers

1.3 CODES AND STANDARDS

.1 Materials and workmanship shall comply with codes and standards of Ontario and the local codes, regulation and standards.

.2 In addition the work to confirm to the latest editions and amendments of the applicable Codes and Standards of the following agencies:

.1 CSA C22.2 No.29 Panelboards and Enclosed Panelboards.

1.4 PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 Drawings to include electrical detail of panel, main/tie/branch breaker type, quantity, ampacity and enclosure dimension.

1.5 SUBMITTALS

.1 The following information shall be submitted to the Engineer:

.1 Breaker layout drawing with dimensions indicated and nameplate designation.

.2 Panel Schedule in accordance with the design drawings.

.3 Circuit designations for all branch breaker applications including spare breakers.

.4 Component list.

.5 Conduit entry/exit locations.

.6 Assembly ratings including:

a. Short circuit rating.

b. Voltage.

c. Continuous current.

.7 Cable terminal sizes.

.8 Product data sheets.

.9 Single Line Diagram.

.2 Where applicable the following additional information shall be submitted to the Engineer:

.1 Key interlock scheme drawing and sequence of operations.

1.6 SUBMITTALS-CONSTRUCTION RECORD

.1 The following information shall be submitted for record purposes:

.1 Final as-built drawings and information for items listed in Clause 1.4.

.2 Installation information.

.2 The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.7 SOURCE QUALITY CONTROL

.1 The manufacturer of the panelboard(s) shall be the manufacturer of the major components within the assembly including circuit breakers and fusible switches.

.2 For the equipment specified herein, the manufacturer of the major components shall be ISO 9001 or 9002 certified.

.3 The manufacturer of this equipment shall have produced similar Electrical equipment for a minimum period of five (5) years. When requested by the engineer, an acceptance list of installation with similar equipment shall be provided demonstrating compliance with this requirement.

.4 Provide seismic qualified equipment, when required as follows:

.1 The equipment and major components shall be suitable for and certified to meet all applicable seismic requirement of the latest national building code of Canada.

.2 The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.

.3 The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

.4 The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the provided seismic qualified equipment, when required as follows:

.5 Conduct equipment inspection at manufacturer's plant.

.6 Provide manufacturer's type test certificates in accordance with the latest CSA, ANSI, IEEE, NEMA and EEMAC standards.

.7 Manufacturer to provide standard factory testing to complete panelboard(s) including circuit breakers.

.8 Submit certified written test results to Engineer prior to shipment.

.9 The panelboard(s) shall be CSA labelled.

1.8 DELIVERY STORAGE AND HANDLING

.1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.9 OPERATIONS AND MAINTENANCE MANUALS

.1 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewals parts lists where applicable, for the complete assembly and each major component.

PART 2 PRODUCTS

2.1 PANELBOARDS

.1 Panelboard(s): product of one (1) manufacturer.

.1 All new panelboard(s) shall have two (2) main breakers and a tie breaker.

.2 Install circuit breakers in panelboard(s) before shipment.

.3 In addition to CSA requirements the manufacturer's nameplate must show the fault current that the panel including breakers has been built to withstand.

.2 Sequence phase bussing with odd numbered breakers on left and even numbered breakers on right, with each breaker identified by permanent number identification as to circuit number and phase.

.3 Panelboard(s): mains, number of circuits, and number and size of branch circuit breakers as indicated.

.4 Two (2) keys for each panelboard.

.5 Copper bus with neutral of same ampere rating as mains.

.6 Mains: suitable for bolt-on breakers.

.7 Panelboard trims shall cover all live parts.

.8 Trim with concealed front bolts and hinges.

.9 Trim finish: baked grey enamel.

.10 Main incoming cables to enter at the top.

.11 Provision for outgoing cables to exit via top.

2.2 PANELBOARD CIRCUIT BREAKERS

.1 Breakers: to Section 16412 – Molded Case Circuit Breakers.

.2 Panelboard(s) shall have molded case circuit breakers which have fully rated interrupting ratings.

.3 Molded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics.

.4 Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-centre switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinction shall be accomplished by means of de-ion arc chutes. A Push-To-Trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

.5 Circuit breakers shall have a minimum 35,000A symmetrical interrupting capacity.

.6 Main breaker: separately mounted on the top and bottom of panel. When mounted vertically, down position should open breaker.

.7 All breaker applications shall include the provision for lockout capability. The lockout feature shall accommodate a safety tag that can be lockout out via a safety pad lock.

.8 A clear cover is provided over cable lugs when the breaker is removed to prevent contact with the lugs.

2.3 RATINGS

.1 Panelboard(s) rated 600V AC shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 35,000 amperes RMS symmetrical or as shown on the drawings whichever rating is greater.

.2 Panelboard(s) shall be labelled with a CSA short circuit rating.

2.4 CONSTRUCTION

.1 Interiors shall be completely factory assembled devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

.2 Panelboard trims shall cover all live parts. Switching device handles shall be accessible.

.3 Surface trims shall be the same height and width as the box.

.4 A directory with a clear plastic cover shall be supplied and mounted on the panelboard(s).

.5 All locks shall be keyed alike.

2.5 BUS

.1 Main bus bars shall be tin-plated copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65°C above an ambient of 40°C base.

.2 Bolted and insulated ground bus shall be included in all panelboard(s).

.3 Full size (100% rated) insulated neutral bars shall be included for panelboard(s) shown with neutral. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200% rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.6 ENCLOSURE

.1 Enclosure shall be made from galvanized steel. Provide minimum gutter space in accordance with the Ontario Electrical Safety Code.

.2 Indoor NEMA 12 Enclosure (Gasketed)

.3 Provide an engraved nameplate for each panel section.

.4 Surfaces of the trim assembly shall be properly cleaned and primed with a finished coat of Grey ANSI 61 plant applied.

2.7 APPROVED MANUFACTURERS

.1 Eaton (Cutler Hammer), Pow-R-Line 4 or approved equal.

.2 Schneider Electric.

.3 Siemens.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Locate panelboard(s) as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Mount panelboard(s) to height specified in the contract drawings.

.3 Connect loads to circuits.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

3.2 MANUFACTURER'S SERVICES

.1 Provide manufacturer's service representative in accordance with Section 01430 – Manufacturers Services.

3.3 TRAINING

.1 Train plant operational staff in aspects of Panelboard operation, maintenance and start-up procedures, as per Specification 01820 - Demonstration and Training.

.2 Training to be project specific.

.3 The training session shall be a minimum of two (2) hours and be conducted by a manufacturer's qualified representative.

.4 Submit training program details for review and approval within a minimum of ten (10) business days.

.5 Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.

.6 Provide three-ring binders to participants complete with copies of drawings and other course material covered.

3.4 TESTS

.1 Perform tests in accordance with Section 16080 – Electrical Testing.

.2 Ensure moving and working parts are lubricated where required.

3.5 WARRANTY

.1 Each Panelboard and associated equipment shall be warranted for a period of no less than two (2) years from the date of substantial completion against defects in materials, labour and workmanship.

.2 The warranty period shall commence when the Panelboard is first placed into service. Multiple warranties for individual components will be acceptable. Satisfactory warranty documents must be provided.

.3 The Manufacturer shall maintain records of each switch, by serial number, for a minimum of twenty (20) years.

.4 For ease of maintenance, each Panelboard nameplate shall include manufacturer drawing numbers and serviceable part numbers.

END OF SECTION

TORONTO

SECTION 16450

GROUNDING

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 Provide a complete grounding and bonding system for the new 600V & 120/208V distribution, including motor control centres (MCC), low voltage switchboards, generators, automatic transfer switches, panelboards, transformers, and all equipment supplied by the distribution system.

.2 Provide a capable grounding system to suit all low voltage 120/208V distribution including all equipment and lighting supplied by the distribution system.

.3 Bond all non-current carrying metallic equipment to the ground bus.

.4 Provide bonding conductors for all MCCs, low voltage switchboards, panelboards, and electrical equipment. Unless indicated otherwise provide a dedicated ground/bond conductor for each distribution applications, sized in accordance with Table 16 of the Ontario Electrical Safety Code.

.5 Utilize existing building ground and steel structure for grounding of equipment. Grounding to be in compliance with Ontario Electrical Safety Code.

.6 Provide separate bonding conductors between all electrical distribution components and equipment supplied by the distribution system.

.7 Provide a dedicated ground/bond conductor for each power distribution, raceway application sized in accordance with Table 16 of the Ontario Electrical Safety Code.

1.2 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements.

.2 Section 16080 – Electrical Testing.

1.3 REFERENCES

.1 Ontario Electrical Safety Code (OESC) latest edition, including Electrical Safety Authority(ESA) amendments and published bulletins.

.2 CSA C22.2 N0. 41(latest edition) Grounding and Bonding Equipment.

.3 ANSI/IEEE 837-14, or latest edition, Qualifying Permanent Connections used in Substation Grounding.

.4 IEEE Std 142™-1991or latest edition, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

.5 IEEE Std No 80, IEEE Guide for Safety in AC substation Grounding.

.6 IEEE 81.2-1991or latest edition IEEE Guide for Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

1.5 PRODUCT DATA

.1 Provide manufacturers printed product literature, specifications and data sheets including product characteristics, performance criteria, physical size, finish and limitations.

1.6 QUALITY CONTROL

.1 Provide in accordance with Division 1 Section 01450 – Quality Control.

.2 Manufacturer's instructions: Provide manufacturers written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 1 requirements and as per manufacturers written instructions.

PART 2 PRODUCTS

2.1 GROUND CONDUCTORS

.1 Grounding conductors: bare, stranded, copper, tinned, soft annealed, size No 4/0 for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

.2 Conductors: PVC insulated coloured green, stranded soft annealed copper wire size No 4 AWG for grounding cable sheaths, raceways, pipe work, screen guard, switchboards, potential transformers.

.3 Ground conductors in corrosive environments: Insulated or having tinned copper where in contact with aluminum or corrosive material, soil or atmosphere.

.4 Grounding bus in electrical rooms where indicated in the Contract Documents: Copper, minimum 50mm by 8mm or as indicated in the Contract Documents.

2.2 CONNECTORS

.1 Exothermic Weld Type:

.1 Outdoor Weld: Suitable for exposure to elements or direct burial.

.2 Indoor Weld: Utilize low-smoke, low-emission process.

.3 Manufacturers:

a. nVent Erico; Cadweld and Cadweld Exolon.

b. Continental Industries Inc. – Thermoweld.

c. Approved equal.

.2 Compression Type

.1 Compress deforming type; wrought copper extrusion material.

.2 Single indentation for conductors 6 AWG and smaller.

.3 Double indentation with extended barrel for conductors 4 AWG and larger.

.4 Barrels pre-filled with oxide-inhibiting and anti-seizing compound and sealed.

.5 Manufacturers:

a. Burndy Corp.

b. Thomas and Betts Co.

c. Ilso Corp.

.3 Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

.1 Manufacturers:

a. Burndy Corp.

b. Thomas and Betts Co.

2.3 ROD ELECTRODES

.1 Copper clad steel 19mm diameter by 6m long.

PART 3 EXECUTION

3.1 GENERAL

.1 Install continuous grounding and bonding system including, electrodes, conductors, connectors and accessories.

.2 Install connectors and cadweld in accordance with manufactures instructions.

.3 Protect exposed grounding conductors during and after construction.

.4 Make buried connections, and connections to electrodes, structural steel work, using coper welding by thermit process or permanent mechanical connectors to ANSA/IEEE 837.

.5 Interconnect conduits terminating in MCCs with bare copper conductor. Connect to MCC ground bus.

.6 Ground all transformer neutrals using # 6 ground wire and bond transformer neutral to casing of transformer using conductors as required by Table 16. See ESA rule 10-814.

.7 Provide bonding wire on all cable trays.

.8 Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

.9 Shielded Instrumentation Cables: Ground shields at each splice or termination in accordance with recommendations of the splice or termination manufacturer.

.10 Shielded Control Cables:

.1 Ground shield to ground bus at power supply for analog signal.

.2 Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.

.3 Do not ground instrumentation cable shield at more than one point.

3.2 WIRE CONNECTIONS

.1 Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

.2 Non-metallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent carrying grounding bus.

.3 Connect ground conductors to raceway grounding bushings.

.4 Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

.5 Connect enclosure of equipment containing ground bus to that bus.

.6 Bolt connections to equipment ground bus.

.7 Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

.8 Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 9.5mm machine screws.

3.3 CONNECTIONS

.1 General:

.1 Above grade Connections: Install compression-type connectors.

.2 Below grade Connections: Install exothermic weld or if connections are accessible compression type connectors are permitted.

.3 Remove paint, dirt, or other surface coverings at connection points to allow good metal to-metal contact.

.4 Notify the Engineer prior to backfilling ground connections.

.2 Exothermic Weld Type:

.1 Wire brush or file contact point to bare metal surface.

.2 Use welding cartridges and molds in accordance with the manufacturer's recommendations.

.3 Avoid using badly worn molds.

.4 Mold to be completely filled with metal when making welds.

.5 After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

.3 Compression Type:

.1 Install in accordance with the connector manufacturer's recommendations.

.2 Install connectors of proper size for grounding conductors and ground rods specified in the Contract Documents.

.3 Install using the connector manufacturer's compression tool having proper sized dies.

.4 Mechanical Type:

.1 Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.

.2 Install in accordance with the connector manufacturer's recommendations.

.3 Do not conceal mechanical connections.

3.4 METAL STRUCTURE GROUNDING

.1 Ground metal sheathing and exposed metal vertical structural elements to grounding system.

.2 Bond electrical equipment supported by metal platforms to the platforms.

.3 Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.5 CABLE SHEATH GROUNDING

.1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.

.2 Use N0 6 AWG flexible copper wire soldered, not clamped to cable sheath.

.3 Connect bonded cables to ground with No 2/0 AWG copper conductor.

3.6 SURGE PROTECTION EQUIPMENT GROUNDING

.1 Connect surge arrestor ground terminals to equipment ground bus.

3.7 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to the following. Service equipment, transformers, switchgear, duct systems, frames of motors, MCCs, low voltage switchboards, panelboards, combustion exhaust stacks, starters, control panels, building steel work, generators, fuel tanks, distribution panels, outdoor lighting.

3.8 FIELD QUALITY CONTROL

.1 As specified in Section 16080 – Electrical Testing.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Engineer and the local authority having jurisdiction over installation.

.3 The new grounding system shall be tested to determine the resistance to earth. Testing shall be performed by an independent electrical or grounding system testing organization.

.4 Conduct soil resistivity testing by implementing the Wenner method.

.5 Testing shall be completed after not less than three full days without precipitation and without any other moistening or chemical treatment of the soil. The grounding system shall be tested for resistance to earth utilizing the three-point fall of potential test as defined by IEEE 81.

.6 The current source probe for the test shall be placed in soil at a distance of 5 to 10 times the distance of the widest measurement across the grounding system ring or grid to ensure adequate measurements outside of the grounding system's sphere of influence. Test probe measurements shall be taken at a distance of one foot from the grounding system reference connection and at each 10 percent increment from the grounding system reference connection to the current source probe location. Test results shall be documented on a graphical plot with resistance in ohms on the vertical axis and distance in feet on the horizontal axis. The results shall clearly indicate a system resistance plateau which confirms a valid test procedure.

.7 Perform tests before energizing electrical system. Testing shall be completed prior to installation of the electrical distribution equipment to ensure the grounding system is isolated from the utility grounding system and the systems of other structures.

.8 Disconnect ground fault indicator during tests.

END OF SECTION

TORONTO

SECTION 16480

LOW VOLTAGE SWITCHBOARDS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

.2 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 – Electrical General Requirement for information related to this work.

1.2 SCOPE

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install the Low Voltage Switchboards specified herein and on the contract drawings.

.2 Provide new Low Voltage Switchboards for critical loads as shown on the contract drawings.

.3 Refer to contract drawings for equipment tag of each new Low Voltage Switchboard.

1.3 RELATED SECTIONS

.1 Section 01430 – Manufacturers Services.

.2 Section 01783 – Operation and Maintenance Manual.

.3 Section 01830 – Factory Acceptance Testing.

.4 Section 16010 – Electrical General Requirements.

.5 Section 16412 – Molded Case Circuit Breakers.

.6 Section 16600 – Automatic Transfer Switch.

1.4 CONFLICTING REQUIREMENTS

.1 Any ambiguities in, or contradictions between sections of this Specification, or between this Specification and the local codes, must be resolved by the equipment manufacturer to the satisfaction of the Engineer.

1.5 COORDINATION AND CONSTRAINTS

.1 The Contractor must coordinate with the authorized suppliers/manufacturers to ensure the overall Switchboard footprints and overall heights are not to exceed the dimensions shown on the contract drawings.

1.6 CODES AND STANDARDS

.1 Materials and workmanship shall comply with codes and standards of Ontario and the local codes, regulations and standards.

.2 In addition the work to confirm to the latest editions and amendments of the applicable Codes and Standards of the following agencies:

.1 NEMA ICS 2-322.

.2 CSA C22.2 No.31 Switchgear Assemblies

.3 CSA Standard C22.2 – 14, “Industrial Control Equipment”.

.4 CSA Standard C22.1, Canadian Electrical Code, Part I plus Provincial supplements.

.5 Ontario Electrical Safety, latest Edition.

.6 Applicable sections of ANSI (American National Standards Institute) Standards.

1.7 SOURCE QUALITY CONTROL

.1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

.2 For the equipment specified herein, the manufacturer of the major components shall be ISO 9001 or 9002 certified.

.3 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

.4 Provide Seismic qualified equipment, when required, as follows:

.1 The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the latest National Building Code of Canada.

.2 The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licenced engineer in Ontario. Mounting recommendations shall be provided by the manufacturer based upon the criteria to verify seismic design of the equipment.

.3 The equipment manufacturer shall certify that the equipment can withstand, following a seismic event, including both vertical and lateral required response as specified in contract documentation.

.4 The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment meets or exceeds the specified response spectra.

.5 Conduct equipment inspection at manufacturer’s plant.

.6 Provide manufacturer's type test certificates, in accordance with the latest CSA, ANSI, IEEE, NEMA and EEMAC standards.

.7 Manufacturer to provide standard factory testing of complete Low Voltage Switchboards including operation of switches, circuit breakers, starters and controls.

.8 Submit certified written test results to Engineer prior to shipment.

.9 The Low Voltage Switchboard shall be CSA labelled.

1.8 SHOP ASSEMBLY

.1 Maximize shop assembly to minimize the on-site erection work.

.2 Ship the equipment in as few sub-assemblies as is practical and in accordance with overall erection schedule.

1.9 PACKAGING AND SHIPPING

.1 Equipment shall be handled and stored in accordance with manufacturer's instructions. Include with the shipment one (1) copy of erection drawings, instructions and maintenance manuals in English.

.2 Pack, crate or otherwise protect each item so that it is not damaged in transit and arrives in serviceable condition at the site. In particular, ensure accumulation of water in equipment is prevented.

.3 Clearly mark all crates, boxes and cartons to indicate the purchase order number and the name of the equipment.

.4 Shipping invoice to show the crate, box or carton number.

1.10 SHOP DRAWINGS

.1 Indicate on the shop drawing submission:

.1 Outline dimensions.

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 Cable entry and exit locations.

.5 Dimensions of all openings and doors.

.6 Door hinge locations, maximum opening angles.

.7 Dimensioned position and size of busbars and details of provision for future extension.

.8 Elementary control diagrams, as indicated.

.9 Major component ratings including Voltage, Continuous Current and Interrupting Ratings,

.10 Cable terminal sizes.

.11 Product data sheets.

1.11 SUBMITTALS

.1 Within a maximum of one (1) week, after receipt of an order, prepare the following drawings marked " Shop Drawings for Review" for submission to the Engineer.

.2 Protective Devices: Copies of time-current characteristics.

.3 Seismic certification and equipment anchorage details and instructions.

.4 Typed Tabulation:

.1 Motor name; tag (equipment) numbers as shown on the Drawings.

.2 Motor horsepower.

.3 Nameplate full load current.

.4 Measured load current and voltage.

.5 Heater catalog number.

.6 Protective device trip settings.

.5 Control Diagrams:

.1 NEMA ICS 2, Section 322.08 Type II.

.2 Wiring Type B.

.6 One-line diagrams.

.7 Schematic (elementary) diagrams. Must also show and identify all remote devices and in addition to hard copies, provide electronic copies in AutoCAD format.

.8 Plan Layout Drawing: The Contractor shall provide a plan layout drawing. The plan drawing shall include the final location of the equipment with dimensions, including clearances to adjacent equipment and structures, door swings, foundation, etc. Failure to include this drawing with the first submission will result in the Contractor having to 'Revise and Resubmit'.

.9 Interconnection diagrams.

.10 Submit final record wiring diagrams at completion of the Contract. Include changes made during field installation and start-up. Enclose one (1) copy of the wiring diagram in a plastic envelope and leave in each starter compartment door pocket.

1.12 OPERATION AND MAINTENANCE DATA

.1 Refer to Section 01783 – Operation and Maintenance manual.

.2 Provide 3-ring binder(s) and indexed copies and an electronic copy of operating and maintenance manuals with the following:

.1 Complete parts list.

.2 Spare parts list.

.3 Installation instructions.

.4 Operating instructions.

.5 Maintenance instructions.

.6 Detailed trouble shooting procedures and fault correction schedules.

.7 Data for each type and style of starter, relays and circuit breakers.

.8 Final record drawings.

.9 Disc with electronic copies of the drawings.

.10 Certified test results.

PART 2 PRODUCTS

2.1 ACCEPTABLE LOW VOLTAGE SWITCHBOARD MANUFACTURERS

.1 Eaton (Cutler Hammer), Pow-R-Line 3A or approved equal.

.2 Schneider Electric.

.3 Siemens.

2.2 LOW VOLTAGE SWITCHBOARD SUPPLY CHARACTERISTICS

.1 600V, 60 Hz, three (3) phase, 3-wire, with grounding.

2.3 GENERAL DESCRIPTION

.1 The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available symmetrical fault current at rated voltage as indicated on the contract drawings .

.2 Shall be suitable for use as service entrance equipment and be labelled in accordance with CSA requirements.

.3 Compartmentalized sections with common power busbars.

.4 Concrete pad mounting, free standing, enclosed dead front, front access only.

.5 Indoor NEMA 12 enclosure (gasketed).

.6 Equipment dimensions not to exceed dimensions shown on drawings.

.7 Accommodating branch circuit breakers as indicated.

.8 Suitable for front mounting.

.9 Top entry for all cables.

.10 General arrangement of each Low Voltage Switchboard as indicated on the contract drawings.

.11 Provide all necessary warning signs as required by local Inspection Authorities.

.12 Vertical Section Construction.

.13 Independent vertical sections fabricated from rolled flat steel sheets, bolted together to form rigid, completely enclosed assembly.

.14 Openings, with removable cover plates, inside of vertical sections for horizontal wiring between sections.

.15 Main incoming cables to enter at top as indicated.

.16 Provision for outgoing cables to exit via top.

.17 Adequate lifting means.

.18 The sides and rear shall be covered with removable bolt-on-covers. All edges of front covers shall be formed.

.19 All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

.20 Provide a full capacity neutral bus where a neutral bus is indicated on contract drawings.

.21 Provision of adequate ventilation within the enclosure.

.22 All protective devices shall be group mounted. They shall be front removable and connection for loads front accessible.

.23 Each Low Voltage Switchboard shall be of one-piece, bolted together construction.

2.4 BUSBARS

.1 Provide busbars (three phase) of high conductivity tin-plated copper in separate compartment bare self-cooled, extending within the Low Voltage Switchboard, supported on insulators and rated:

.1 Busbars: as shown on drawings.

.2 Branch busbars for distribution of power to units.

.3 Refer to contract drawings for short-circuit rating of busbars and bus bracing.

.4 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

.5 Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient. (Outside the enclosure)

2.5 GROUND BUS

.1 A Copper ground bus shall be furnished firmly, secured to each section structure and shall extend the entire length of the switchboard.

.2 Provide lugs suitable for up to #4/0 AWG grounding copper (stranded) conductor.

2.6 LOW VOLTAGE SWITCHBOARD BRANCH BREAKERS

.1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

.2 Breaker frame: 600 V, 60 Hz, 3-pole, minimum symmetrical interrupting capacity as indicated on the contract drawings.

.3 All breaker applications shall include the provision for lockout capability. The lockout feature shall accommodate a safety tag that can be locked out via a safety pad lock.

.4 Breaker trip unit: fix mounted.

2.7 WIRING AND TERMINAL BLOCKS

.1 Mechanical type terminals shall be provided for all line and load terminations suitable for copper or aluminium cable rated for 75 degrees C of the size as indicated on the drawings.

.2 Control wiring: 600V rated, XLPE insulated, minimum #14 AWG size stranded copper. Install wiring to panel doors utilizing extra flexible 49-strand conductors.

.3 Identify all wiring by means of oil-resistant markers fixed to each conductor at both ends.

.4 Wires Colour Code:

.1 Control circuits – Red.

.2 Power circuits – Black.

.5 Terminal blocks: compression type, modular pull-apart construction, enabling unit wiring to be easily separated from field wiring. Identify all terminal blocks with numbers identical to the wire numbers.

.6 No more than two (2) wires per terminal screw (i.e. on terminal block).

.7 Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided.

2.8 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust-resistant primer inside and outside, and at least two coats of finish enamel.

.2 Paint Low Voltage Switchboard exterior ASA #61 light grey and interiors white.

.3 Provide a 100 mL container of finish enamel for touch-up of scratches during installation.

2.9 NAMEPLATES

.1 Engraved nameplates mounted on the face of the assembly shall be furnished for all feeder circuits as indicated on the contract drawings.

.2 Nameplates shall be laminated plastic with black characters on white background.

.3 Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating.

.4 Furnish master nameplate giving Low Voltage Switchboard designation, voltage ampere rating, short-circuit rating, manufacturers name, general order number and item number.

.5 Refer to Section 16010 – Electrical General Requirements.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install equipment in accordance with NEMA ICS 2.3, Submittal Drawings, and Manufacturer's Instructions and Recommendations.

.2 Set and secure Low Voltage Switchboard in place on channel bases, rigid, plumb and square to building floor and wall.

.3 Secure equipment to concrete mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.

.4 Coordinate terminal connections with installation of secondary feeders.

.5 Grout mounting channels into concrete mounting pads.

.6 Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

.7 Remove foreign material, including dust before energizing equipment.

.8 Connect power, control and grounding wiring.

.9 Make grounding connections between equipment ground busses and building grounding system.

.10 Check all factory made connections for mechanical security, electrical continuity and current phasing.

3.2 MANUFACTURER'S SERVICES

.1 Provide manufacturer's service representative in accordance with Section 01430 – Manufacturers Services.

3.3 TRAINING

.1 Train plant operational staff in aspects of Low Voltage Switchboard operation, maintenance and start-up procedures, as per Specification 01820 - Demonstration and Training.

.2 Training to be project specific.

.3 The training session shall be a minimum of two (2) hours and be conducted by a manufacturer's qualified representative.

.4 Submit training program details for review and approval within a minimum of ten (10) business days.

.5 Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.

.6 Provide three-ring binders and 1 electronic copy to participants complete with copies of drawings and other course material covered.

3.4 TESTS

.1 Perform tests in accordance with Section 16080 – Electrical Testing.

.2 Ensure moving and working parts are lubricated where required.

3.5 WARRANTY

.1 Each Low Voltage Switchboard and associated equipment shall be warranted for a period of no less than two (2) years from the date of commissioning against defects in materials, labour and workmanship.

.2 The warranty period shall commence when the Low Voltage Switchboard is first placed into service. Multiple warranties for individual components will be acceptable. Satisfactory warranty documents must be provided.

.3 The Manufacturer shall maintain records of each switch, by serial number, for a minimum of twenty (20) years.

.4 For ease of maintenance, each Low Voltage Switchboard nameplate shall include manufacturer drawing numbers and serviceable part numbers.

END OF SECTION

TORONTO

SECTION 16500

NATURAL GAS ENGINE INDOOR GENERATOR

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 This section specifies the requirements for all labour, materials, and equipment to provide, install, test, commission and place in operation one (1) complete new factory assembled natural gas power generator systems at the R. C. Harris Water Treatment Plant, complete with electronic control system, water-cooling system, and one (1) portable load bank connection box in accordance with the contract documents and manufacturer's drawings and installation instructions.

.2 Refer to PART 3 – EXECUTION, Section 3.2 for important allowable maximum dimensions and weights of the new Generator as well as allowable dimensions and weight during the Generator delivery process.

.3 The generator as follows:

.1 One (1) 300 kW Standby Rating, 347/600V AC, 3 Phase, 4 Wire 60 Hz, indoor, natural gas fueled generator set in Residue Management Facility (RMF).

.4 Generator shall be standby power rated.

.5 This section is to be read in conjunction with following Sections:

.1 Section 01110 – Summary of Work (Overall Project).

.2 Section 01430 – Manufacturer's Services.

.3 Section 01820 – Factory Acceptance Testing.

.4 Section 15101 – Installation of Pipework.

.5 Section 15111 – Valves.

.6 Section 15142 – Water Piping – Copper.

.7 Section 15190 – Natural Gas Piping System.

.8 Section 15550 – Generator Engine Exhaust System.

.9 Section 16010 – Electrical General Requirements.

.10 Section 16441 – Panelboards.

.11 Section 16480 – Low Voltage Switchboards.

.12 Section 16600 – Automatic Transfer Switch.

1.2 QUALIFICATIONS

.1 It is the intent of this specification to secure the generator set system that has been tested during design verification, in production, and at the final job site. The generator set shall be complete with all the necessary accessories for a complete working system.

.2 The Manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

.3 All equipment shall be new and of current production by a North American power system manufacturer of generators and transfer switches for a period of at least 15 years who also maintains a service organization available twenty four-hours a day throughout the year. The Manufacturer shall be a supplier of a complete, coordinated and tested power system. There will be single-source responsibility for warranty, parts and service through a factory-authorized representatives within Ontario and with local factory-trained certified technicians to service the generator sets.

.4 Generator shall be factory assembled and supplied by the same generator manufacturer.

.5 The generator system design is based on the information of the first named supplier. Should the Contractor choose to provide other suppliers, it is the Contractor's responsibility to ensure that the purchased equipment meets all design requirements and is compatible with all design documents, and pay for all costs associated with the upgrading the relevant structure/electrical/control/building service/architecture system and engineering review.

1.3 SUBMITTALS

.1 Within a maximum of six (6) weeks, after receipt of an order, prepare following drawings marked "Shop Drawings for Review" for submission to the Engineer.

.2 Action Submittals: Shop Drawings:

.1 Shop drawing table of contents

1. Project Documentation

1. Generator Set Assembly Drawings
2. Sub-Assembly Shipping Drawings
3. Piping & Instrumentation Diagram
4. Electrical Schematics
5. Draft Factory Acceptance Test Report
6. Draft Site Acceptance Test Report

2. Component Specifications

1. Engine
2. Alternator
3. Automatic Voltage Regulator 2.4 Block Heater
4. Battery Charger
5. Generator Controller
6. Controller Expansion Module 2.8 Remote Display Module
7. Primary Breaker
8. Load Bank Breaker
9. Exhaust Silencer
10. Exhaust Flexible Connector
11. Gas Solenoid Valve
12. Low Gas Pressure Switch
13. Hi Gas Pressure Switch
14. Natural Gas Flex Hose 2.17 External Spring Vibration Isolators

.2 Shop drawings to include following information

1. Dimensioned outline drawing showing plan and elevations of the proposed engine generator set including anchoring requirements.
2. Engine and generator weights.
3. Breakdown of generator component weights and dimensions after disassembly for shipping and hoisting into place.
4. Catalog information and technical description of the proposed engine generator set. Include proposed materials for the block, heads, valves, rings, cylinders, pistons, crankshaft, and major bearings and wear surfaces.
5. Arrangement of engine generator set motor starting capability and percent voltage dip curve.
6. Complete list of accessories provided.
7. Complete list of spare parts
8. Details of vibration isolators.

9. Performance curves showing engine efficiency (natural gas fuel consumed per kWh output), gross natural gas fuel consumption rate, and kW output at design rated output, one-half load, and one-quarter load. Account for design altitude and temperature corrections and for engine parasitic loads. No performance reduction or deration of the engine up to 40ºC.

10. Engine heat rejection from alternator, water cooling system and engine crankcase.

11. Combustion air consumption.

12. Generator transient and sub transient reactance in per unit.

13. Generator output waveform and Telephone Interference Factor (TIF).

14. Electrical schematic and wiring diagrams for:

    1. Generator control panel complete with layout of all inside and front panel equipment and instrumentation.

    2. Main generator and governing system.

    3. Voltage regulator.

    4. Battery charging system.

    5. Interconnection wiring diagram for generator and breaker controls.

    6. Power Monitor integration wiring diagram.

15. Control panel instrument identification inscriptions.

16. Cooling system information, including:

    1. Schematic of water cooling system for the engine.

    2. Heat exchanger cut sheet indicating sizes, pressure and temperature ratings, manufacturer, materials and pressure drops.

    3. Heat rejection through each heat exchanger.

    4. Confirmation of the number of connections to the plant water supply.

17. Block heater size and voltage.

18. Noise and emissions data.

19. Engine exhaust and silencer details

20. Disassembly and Reassembly details

21. Bills of Material giving make, model and rating of components

.3 The Manufacturer shall submit six (6) copies of the installation and start-up procedure manual and electronic copies to the Engineer prior to delivery of the standby power generator system.

.4 Information Submittals:

.1 Operation and maintenance data.

.2 Description of parts and service availability.

.3 Certified Factory Test Report**.**

.4 Manufacturer's Certificate of Performance.

.5 Manufacturer's Certificate of Proper Installation.

.6 Site Quality Control Instructions.

.7 FAT and SAT test templates

.8 Warranty and Guarantee.

1.4 DISTRIBUTION OF SHOP DRAWINGS

.1 Unless otherwise directed by the Engineer, forward shop drawings in electronic format to the Contractor for review by the Contractor and the Engineer, with the request that one "REVIEWED" copy shall be returned for equipment manufacture and assembly. Review period by Contractor and Engineer to be 3 weeks, if rejected, and the revised shop drawing to be re-submitted by manufacturer in following 2 weeks.

.2 On receipt of the reviewed copy, construction of assembly of equipment may commence. Do not ship any equipment that does not comply with the "APPROVED" drawings, until any issues are resolved between the Contractor and the Manufacturer, to the satisfaction of the Engineer.

.3 On completion of equipment manufacture and at the time of shipment, forward six (6) sets of "AS CONSTRUCTED" Final Shop Drawings and Manuals to the Contractor for distribution to the Engineer. One (1) set bound copy marked "CONSTRUCTION COPY – DO NOT REMOVE FROM SITE" is to be shipped with the equipment.

1.5 DISTRIBUTION OF OPERATION AND MAINTENANCE DATA MANUALS (Q&M)

.1 Submit six (6) hardcopies (and PDF on CD) of O&M Manuals, and include the following information in each:

.1 Description of all parts and service availability and contacts.

.2 Certified Factory Test Reports.

.3 Manufacturer's Certificate of Performance.

.4 Start-up and Commissioning Form for Gensets

.5 Manufacturer's Certificate of Proper Installation.

.6 Site Quality Control Instructions.

.7 Warranty/Special Guarantee Certificates.

1.6 QUALITY ASSURANCE

.1 Components shall be CSA listed where CSA listing categories are available.

.2 The Manufacturer shall test equipment, components and auxiliaries to ensure their correct operation and function prior to shipment. The Manufacturer shall test actual safety devices and circuits and record actuating levels. Jumper tests are not acceptable. Transient testing shall be performed and recorded at 25, 50, 75 and 100% loads during FAT and SAT.

.3 The Manufacturer shall operate the engine and generator sets for a minimum of four (4) hours under full load during FAT and SAT.

.4 Check the operation of each alarm device and demonstrate its operation. Engine should stop under simulated alarm/shutdown condition.

.5 Conduct harmonic test at full load conditions.

.6 Provide factory tests, start-up and on-site testing of the system.

.7 The City and the Engineer reserve the right of inspection of the generator set at the Manufacturer's plant by its authorized representative and to witness factory tests. Provide the City and the Engineer at least two (2) full weeks prior notice that the equipment is ready for inspection and test at the factory. Reconfirm the date 5 business days prior to testing. This permits the Engineer to make arrangements for the visit when it is considered necessary.

.8 Prepare certified test reports with results of the above tests, and the usual factory tests. Distribute the reports in electronic format with witness signatures: One (1) set to the City, one (1) set to the Engineer and one (1) set in each Maintenance Manual.

.9 For any defects during factory witness test, provide updated certified test reports for the City and Engineer review prior to shipment.

1.7 GENERAL REQUIREMENTS

.1 One (1) Generator, 300 kW/375 kVA Standby Rating, 347/600V AC, 3 Phase,4 Wire, 60 Hz, indoor, natural gas fuelled generator sets complete with accessories and spare parts.

.2 The generator system shall include the following new parts/equipment:

.1 Engine-driven Generator set.

.2 Skid mounted Control Panel c/w microprocessor based controller/annunciator.

.3 Water and heat exchanger based cooling system.

.4 Connections to Natural Gas system.

.5 Connections to external load bank of the same generator rating.

.6 Air intake and Exhaust system.

.7 Generator set accessories and Spare parts.

.8 Mounting Vibration Isolation.

.9 Integral Exhaust System highlight in yellow.

.10 Warranty.

.3 Provide factory test, start-up by a Supplier authorized by the Manufacturer, and on-site testing of the system.

.4 The Manufacturer shall warrant all equipment provided under this section so that there is one source for warranty and product service. Technicians specifically trained and certified by the Manufacturer to support the product and employed by the generator set supplier shall service the generator set.

.5 It is made clear that the Contractor shall provide all generator products and perform installations, start-up, testing, commissioning procedures and requirements as per all applicable CSA Standards and codes. The Contractor shall include all required costs to do so into the tender price.

1.8 CODES AND STANDARDS

.1 The generator set and their installation and on-site testing shall conform, as a minimum, to the requirements of the following codes and standards:

.1 CSA C22.2 Canadian Electrical Safety Code – Latest Edition.

.2 CSA C22.2, No. 14-M91 Industrial Control Equipment.

.3 CSA-B149-1-15 Natural Gas and Propane Installation Code

.4 EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.

.5 EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

.6 IEC8528 part 4, Control Systems for Generator Sets.

.7 IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.

.8 IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

.2 The generator system (which includes the generator, sound attenuation, emissions controls devices, and all other accessories required to run as designed) shall be certified to meet the noise and emissions requirements of the following Ontario Ministry of Environment regulations:

.1 NPC-300 - Environmental Noise Guideline.

.2 O.Reg. 346/12 - Registrations Under Part 11.2 of the Act - Heating Systems and Standby Power Systems (comply with the 2014 amendment of the O.Reg. 346/12).

1.9 ACCEPTABLE MANUFACTURERS

.1 Suppliers must be manufacturers of generators or their local authorized distributor.

.2 Refer to Clause 1.2.5 in this specification.

.1 T&T Power Group.

PART 2 PRODUCTS

2.1 GENERATOR SET

.1 Ratings:

.1 The generator set shall operate at 1800 RPM and at a voltage of 600V AC, 3 Phase, 4 Wire, 60 Hz.

.2 Each generator set shall be rated as follows:

1. 300 kW/375kVA at 0.8 PF lagging, standby rating, based on site conditions of ambient temperatures up to 40°C.

2. The generator set shall be capable of a 130°C standby rating while operating in an ambient condition of less than or equal to 40°C.

3. Engine-generator set shall operate in the following conditions without any damage to the unit or its loads:

Ambient Temperature: 40°C.

Altitude: 150m above sea level.

Relative Humidity: 95%.

4. Standby rating shall be available for the duration of the Hydro outage.

.2 Performance:

.1 Voltage regulation shall be ±0.5% for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed ±0.25%.

.2 Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed ±0.25%.

.3 Natural gas engine generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with engine generator set at operating temperature.

.4 The alternator shall produce a clean AC sine voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic.

.3 Construction:

.1 Engine generator set shall be mounted on a heavy-duty steel base with corrosion resistant paint to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

.2 All switches, lamps, and meters in the control system shall be oil tight, dust tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

.3 Connections:

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.

2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a generator-mounted common distribution panel.

3. Generator set control interfaces to other system components shall be made on a common, permanently labelled terminal block assembly.

2.2 ENGINE AND ENGINE EQUIPMENT

.1 Engine:

.1 The minimum 11.8 liter displacement engine shall deliver a minimum of 440.9 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:

1. Electronic isochronous governor capable of 0.5% steady-state frequency regulation.

2. 24-volt positive-engagement solenoid shift-starting motor.

3. 70-ampere automatic battery charging alternator with a solid-state voltage regulation.

4. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.

5. Dry-type replaceable air cleaner elements for normal applications.

6. The engine shall be turbocharged and fueled by Natural Gas.

7. The engine shall have a minimum of 6 cylinders and be liquid-cooled.

.2 The engine shall be EPA certified from the factory.

.3 The generator must accept rated load in one-step.

.2 Cooling System:

.1 The engine shall be liquid-cooled by closed loop, unit mounted heat exchangers rated to operate the generator set at full load at an ambient temperature of 40°C (104°F). A 10% safety margin shall be incorporated in the heat exchanger design.

.2 The cooling system shall include a thermostatic valve, isolating valves, expansion tank, flexible connectors, and any other accessories necessary for a complete engine cooling system.

.3 The heat exchangers, jacket water and charge-air, shall be sized for adequate cooling at full load operation with a raw water supply through 3” supply and return connections providing a raw water supply of 55 gpm at maximum 100 psi with an inlet temperature of 20°C and a maximum return temperature of 58.3°C.

.4 The rotating engine parts shall be guarded against accidental contact.

.3 Standard Air Cleaner:

.1 The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

1. The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.

.4 Battery:

.1 The genset requires a BCI group 31 Heavy-Duty lead acid 24VDC batteries which must meet the engine manufactures' specifications for the ambient conditions as specified and shall comply with the NFPA requirements for engine cranking cycles. Each battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 950 amps and a minimum reserve capacity of 185 Minutes at 27˚C (80˚F). The battery plates shall be constructed of a Calcium-Lead alloy to provide long waterless operation and extended battery life. The battery elements must be anchor-locked with full-frame grids and tight-packed commercial plates to resist the effects of vibration. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Removable cell covers shall be provided to allow for checking of electrolyte specific gravity. Provide all inter-cell and connecting battery cables as required for a complete operating system.

.2 Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

.5 Battery Charger:

.1 A UL listed, CSA certified, 10 A voltage regulated battery charger shall be provided for the engine generator set. The charger is to be mounted on the unit inside NEMA 1 Enclosure. AC voltage and DC output voltage shall be as required. The charger shall be equipped with float, taper and equalized charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 A, 120V AC, 30V DC for remote indication of:

1. Loss of AC power – red light.

2. Low battery voltage – red light.

3. High battery voltage – red light.

4. Power ON – green light (no relay contact).

.2 Charger shall include an analog DC voltmeter and ammeter, 12-hour equalize charge timer, and AC and DC fuses.

2.3 AC ALTERNATOR

.1 The alternator shall be a 4 pole, revolving field type, 6 or 12 lead, wired for 347/600V AC, 3 phase, 4W, 60 Hz, rated at 300kW with a permanent magnet driven exciter. Photosensitive components will not be permitted in the rotating exciter. The stator shall be direct connected to the engine to ensure permanent alignment. The generator shall meet temperature rise standards for Class "H" insulation, operate within Class "F" standards for extended life. All leads must be extended into a separate AC connection box. The alternator shall be protected by internal thermal overload protection and an automatic reset field circuit breaker. The generator shall be capable of delivering rated

output (kVA) at rated frequency and power factor, at any voltage not more than 5% above or below rated voltage.

.2 One step load acceptance shall be 100% of engine-generator set nameplate rating. The generator set and regulator must sustain 300% short circuit current for 10 seconds during 3 phase faults.

.3 A NEMA 1 enclosure for the main line circuit breaker that is an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. A fully rated, isolated neutral must be included by the generator set manufacturer to insure proper sizing.

.4 The electric plant (engine and alternator) shall be mounted with internal vibration isolation onto a welded steel base.

.5 The generator shall be supplied with a thermostatically controlled strip alternator heater to prevent the accumulation of moisture and dampness and to maintain the stator windings above the dew point. The heater shall be wired to be “on” at all times that the generator set is not operating.

2.4 GENERATOR SET CONTROL PANEL

.1 The generator set shall be provided with a fully integrated microprocessor based control system for emergency engine generators. The control system shall also be designed to allow local monitoring and control of the generator sets, and control as described in this specification. The control system should control the cool down time of the generator once the start signal drops out from the transfer scheme. The cool down time is to be set as per manufacturer’s recommendations.

.2 The control panel shall meet the City of Toronto Control Panel standards and requirements for size and type of panel, size and type of operator controls, terminal blocks, wiring type, colour coding standards and wiring. Refer to Division 13 Section 13320 – Panel Wiring.

.3 The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

.4 The control panel shall detect the following shutdown conditions and display on control panel:

.1 Emergency stop – one (1) switch mounted on the control panel.

.2 High coolant temperature.

.3 High oil temperature.

.4 Controller internal fault.

.5 Locked rotor – fail to rotate.

.6 Low coolant level.

.7 Low oil pressure.

.8 Overcrank.

.9 Overspeed.

.10 Overvoltage.

.11 Over frequency.

.12 Underfrequency.

.13 Undervoltage.

.14 Coolant temperature signal loss.

.15 Oil pressure gauge signal loss.

.5 Conditions resulting in generator warning (generator will continue to operate):

.1 High battery voltage.

.2 Low battery voltage.

.3 High coolant temperature.

.4 Low coolant temperature.

.5 Loss of AC sensing.

.6 Underfrequency.

.7 Gas valve closed (from any position indicating contact).

.8 Low oil pressure.

.9 Overcurrent.

.10 Speed sensor fault.

.11 Weak battery.

.12 Not in AUTO mode.

.13 Intake damper fail.

.14 Generator breaker not closed.

.15 ATS not in AUTO mode or in bypass mode.

.16 Engine and alternator operating conditions.

.17 Oil pressure and oil temperature.

.18 Engine speed.

.19 DC battery voltage.

.20 Run time hours.

.21 Generator voltages, amps, frequency, kilowatts, and power factor.

.22 Alarm Status.

.23 Current alarm(s) condition per applicable CSA standards and codes.

.24 Alarm log of last twenty (20) alarm events (date and time stamped) low oil pressure (alarm).

.25 Audible natural gas valve closure (from any position indicating contact) (alarm).

.26 High AC voltage (shutdown).

.27 Low AC voltage (shutdown).

.28 Under frequency (shutdown).

.29 Over current (warning).

.30 Over current (shutdown).

.31 Short circuit (shutdown).

.32 Over load (alarm).

.6 Provide a separate junction box complete with identified terminal blocks for all control wiring (signals) that will be installed external to the generator enclosure. Make provision for a minimum of 20% spare terminations. Refer to Division 13 drawings and specifications for the required I/O list.

.7 Control Panel shall have all auxiliary dry contacts indicated on the electrical and/or I&C drawings.

.8 Control Switches:

.1 Mode Select Switch: It shall initiate the following control modes. When in the “Run” or “Manual” position, the generator set shall start and accelerate to rated speed and voltage as directed by the operator. In the “Off” position, the generator set shall immediately stop, bypassing all time delays. In the “Auto” position, the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

.2 Emergency Stop Switch: Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting. It will be mounted on the control panel.

.3 Reset Switch: It shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

.4 Panel Lamp Switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

.5 Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:

1. Analog voltmeter, ammeter, frequency meter, and kilowatt (kW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and kW meter scales shall be color coded in the following fashion: readings from 0% to 90% of generator set standby rating – green; readings from 90% to 100% of standby rating – amber; readings in excess of 100% - red.

2. Digital metering set, with 1.0% accuracy, to indicate generator RMS voltage and current, frequency, output current, output kW, kWh, and power factor. Generator output voltage shall be available in line to line and line to neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.

3. Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.

.9 Engine Status Monitoring:

.1 All monitored functions must be viewable on the control panel display.

.2 The following generator set functions shall be monitored:

1. All output voltages – single phase or three phase line to neutral, 1.0% accuracy.

2. All single phase and three phase currents, 1.0% accuracy.

3. Output frequency, 1.0% accuracy.

4. Power factor by phase with leading/lagging indication.

5. Total instantaneous kilowatt loading and kilowatts per phase, 1.0 accuracy.

6. kVAr, 1.0 accuracy.

7. kVA, 1.0% accuracy.

8. k, 1.0 accuracy.

.3 Engine parameters listed below shall be monitored:

1. Coolant temperature both in English and metric units.

2. Oil pressure in English and metric units.

3. Battery voltage.

4. Engine RPM.

.4 Operational records shall be stored in the control beginning at system start-up.

1. Run time hours.

2. Last run data including date, duration.

.5 The controller shall store the last fifty (50) generator set system events and the last thirty (30) alarms with date and time of the event as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

.6 Inputs:

1. There shall be 21 minimum dry contact inputs (rated 7 A each, minimum) that can be user-configured to shut down the generator set or provide a warning.

2. There shall be eight (8) minimum user-programmable analog inputs for monitoring and control.

3. Provide a digital input to accept a dry contract from automatic transfer switch for starting the engine (remote start/stop control).

4. Each analog input can accept 0-5 V analog signals.

5. Resolution shall be 1:10,000, minimum.

6. Each input shall include range settings for two (2) warnings and two (2) shutdowns.

7. All values shall be on the control panel display and shall be user-assigned.

8. Additional standard inputs required:

Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.

Reset of system faults.

Remote two-wire start.

Remote emergency stop.

9. Idle mode enable.

.7 Outputs:

1. All NFPA 110 Level 1 outputs shall be available.

2. Thirty outputs shall be available for interfacing to other equipment.

3. All outputs shall be user-configurable from a list of 25 functions and faults.

4. These outputs shall drive optional dry contacts.

5. A programmable user-defined common fault output with over 40 selections shall be available.

.8 Communications (Modbus protocol):

1. The controller shall communicate with the generator control panel for control, monitoring and diagnosis.

2. Industry standard Modbus communication.

3. A Modbus master shall be able to monitor and alter parameters, and start or stop a generator.

4. The controller shall have the capability to communicate to a personal computer running Windows XP, or later.

5. Communications shall be via serial, CAN, and Ethernet bus networks.

6. A single control connection to a PC.

7. Network shall be self-powered.

.9 The following status and alarms are to be available from a set of relay contacts to be used as inputs to the site RPU:

1. Gen-set in “Auto Mode”.

2. Gen-set “Running” status.

3. Gen-set “General Alarm” status (collective).

4. Refer to Division 13 drawings and specifications.

2.5 ENGINE CONTROL FUNCTIONS

.1 The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for four (4) cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

.2 The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

.3 The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

.4 The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

2.6 ALTERNATOR CONTROL FUNCTIONS

.1 The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. The voltage regulator shall include adjustments for gain, damping, and frequency roll off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

.2 Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

.3 Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

.4 An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than ten (10) seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

.5 A battery monitoring system shall be provided which initiates low voltage alarm. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC

voltage drops to less than 14.4V for more than two seconds a “weak battery” alarm shall be initiated.

.6 The generator set shall be provided with a mounted ? 100% rated 350 A, 3-pole main line circuit breaker, sized to carry the rated output current of the generator set on a continuous basis. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided. Provide auxiliary contact to annunciate breaker open condition 24V DC.

.7 Provide a second circuit breaker for “load bank” connections: as shown on the drawings, 100% rated circuit breaker. Provide shunt trip control for this breaker so that if during load bank testing, normal power supply is loss then this breaker will trip. Load bank will be tested only when normal power supply is available. The line side connections are to be made in the factory. The breaker shall be equipped with 24V DC shunt trip wired for activation of trip unit when there is a power outage and call to run in emergency mode from any transfer switch during load bank test. The breaker shall be clearly labelled “Resistive Load Bank Breaker”. Load side lugs shall be provided for a portable loadbank.

2.7 OPERATION

.1 Sequence of Operation:

.1 Contractor to review full sequence of operation detailed on the electrical drawings.

.2 Generator set shall start on receipt of start signals from remote equipment. The start signals shall be hardwired via connection to the generator set control.

.3 The generator set shall complete a time delay start period as programmed into the control.

.4 The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions.

.2 The control system shall verify that the engine is rotating when the starter is signalled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate “fail to crank” shutdown.

.3 The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate “fail to start”.

.4 The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to

prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

.5 On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.

.6 When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

.7 On completion of the time delay stop period (cool down time set as per the manufacturers recommendations), the generator set control shall switch off the excitation system and shall shut down.

.1 Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

2.8 UNIT ACCESSORIES

.1 The following equipment is to be installed at the engine-generator set manufacturer's facility:

.1 The exhaust silencer(s) shall be provided of the size as recommended by the Manufacturer and shall be of hospital plus grade.

.2 The generator set shall be pad-mounted on a concrete pad inside a containment.

.3 Battery and battery charger shall be provided as per Clauses 2.2.4 and 2.2.5 in this specification.

.4 Battery rack and battery cables capable of holding the Manufacturer's recommended batteries shall be supplied.

.5 The generator shall be supplied with a thermotatically controlled strip alternator heater to prevent the accumulation of moisture and dampness and to maintain the stator windings above the dew point. The heater shall be wired to be "on" at all times that the generator set is not operating.

.6 Block Heater – The block heater shall be sized sufficiently to ensure quick starting in ambient temperatures down to 10 degrees centigrade.

.7 The generator system shall be equipped with a minimum 60A, 120/208V AC lighting panel with sufficient circuits to power all of the accessories. It shall be powered with normal power from the existing lighting/distribution panel (refer to design drawings). All AC accessories supplied are to be factory wired to the unit mounted lighting panel.

2.9 SPARE PARTS

.1 Provide the following spare parts:

.1 Provide engine oil drip tray, 1.5mm minimum, and galvanized steel with 50mm lip suitable for location on the concrete pad. The tray shall extend completely under the generator set, between the vibration isolators and easily removable without disturbing any components.

.2 Provide one (1) wall mounted steel cabinet. Cabinet shall be provided with front hinged doors(s), padlock and hasp. Cabinet to accommodate tools, spare and one set of manuals.

.3 Special tools, spare parts shall be provided by the supplier, which are non-standard off the shelf items.

.4 Provide three (3) lubricating oil filter elements and gaskets.

.5 Provide one (1) air cleaner filter element.

.6 Provide two (2) sets V-belts for fan and pump drives.

.7 Provide spare heater element for coolant heater.

.8 Provide pre-lube pump repair kit (impellers, gaskets, seals).

.2 Spare parts list to be submitted as part of the shop drawings

PART 3 EXECUTION

3.1 FACTORY QUALITY CONTROL

.1 Refer to specification Section 01830 for general FAT requirements.

.2 Factory testing (FAT) procedures shall be carried out using load banks that consist of resistive and reactive loads. All equipment including load banks used in the factory tests shall be calibrated and evidence of this calibration shall be provided to the Engineer prior to the commencement of the tests. FAT shall be four (4) hours at 100% loads.

.3 Factory testing may be witnessed by the City of Toronto representative and Engineer. If the factory test is to occur a distance further than 200km from the site, costs for travel expenses will be the responsibility of the Contractor. Factory testing must be undertaken at a site within Canada. Supplier is responsible to provide two (2) weeks' notice for testing.

.4 The Engineer and/or the City will witness the factory tests. The supplier shall provide the Engineer and the City a minimum of notice of the date when the equipment will be ready for such testing and reconfirm the testing date 5 business days prior to testing. Equipment is not to be delivered to the site until such testing has been completed to the satisfaction of the Engineer and the City as specified.

.5 Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: running at full load, maximum power, voltage regulation, transient and steady state governing, single step load pickup, and function of safety shutdowns.

.6 Factory testing plan shall be sent to Engineer and the City for prior approval.

.7 All the alarms shall be simulated during factory testing.

3.2 GENERATOR DELIVERY RESTRICTIONS

.1 GENERATOR 1 (RMF BUILDING)

.1 From building entry level to the hoist lifting position (all at road level), generator will have to pass through three (3) existing building doors.

1. Lowest height of the three doors above finish floor: 2100mm

2. Shortest width of the three doors: 1840mm

.2 Lifting from floor level to Pipe Gallery level approximately 17 meters high.

.3 Passing through existing opening between shaft and Pipe Gallery. Opening size width 1490mm, height 2080mm to underside existing monorail

.4 Generator delivery package shall be able to pass through all above, proposed size to meet the following:

1. Height shall be less than or equal to 2000 mm.

2. Width shall be less than or equal to 1450 mm.

3. Length shall be less than or equal to 3200mm

.5 Dimensions to be field verified by Contractor prior to delivery; in particular existing monorail and cable trays to be encountered during the lifting process (refer to photo of lifting area indicated on the electrical drawings).

.6 It is recommended that the generator engine shall be a separate delivery to meet the above weight restriction, but it is up to the manufacturer to provide details of its proposed delivery parts and its integration back into the generator unit by the Generator manufacturer authorized personnel when delivery is completed. The Contractor shall include for all costs required to do so including re-assembly and testing (labor and parts) of the generator on site for a completely functional system. There will no additional compensation for this issue after the close of Tender.

.7 Generator manufacturer to submit detailed generator delivery packages: complete with dimensions and weights as part of the shop drawing submission. This should include for any wheel carrying platform that will be part of the

generator package entering through the existing building doors. The max weight limit of each disassemble part delivery package is to be less than 1360 kg (3000 lb).

3.3 INSTALLATION

.1 Provide the services of a manufacturer's technical representatives to carry out site acceptance tests, field adjustments for all parameter settings, commission and start-up of the standby generator system equipment and for as long as required during the installation phase of the work. The Supplier is responsible to coordinate and perform all the aspects of the above work with the Contractor, the Engineer, and the City representatives at no extra cost. Refer to Section 01430 – Manufacturers Services.

.2 The generator set shall be levelled and securely mounted in accordance with the manufacturer's recommendations.

.3 Assembly and testing in place.

.4 The generator set shall be mounted on vibration isolators in accordance with isolator and generator manufacturers' recommendations.

3.4 WIRING AND PIPING METHODS

.1 All final conduit connections to the engine and generator to be in "Sealtite" flexible conduit.

.2 CSA B149.1 compliant rigid and flexible piping shall be used to connect generator to gas supply.

.3 All field erected pipe work, steel work etc. are to be cleaned, primed and painted with two (2) coats of paint. Refer to Division 5 (Structural) and Division 15 (Mechanical) where applicable.

.4 Provide approved flexible connectors for connection to all piping at the engine, including jacket water, fuel oil, compressed air, and similar services.

3.5 SITE ACCEPTANCE TESTING (SAT) AND COMMISSIONING

.1 Provide the services of the manufacturer's technical representative to carry out the manufacturer's recommended field tests and to start up unit. Testing conducted at FAT is to be repeated at Site Acceptance Test (SAT) (load banking, transients, etc.).

.2 Submit a field test and start-up plan and report.

.3 The contractor shall carry out the following work in addition to the SAT testing as a minimum requirement:

.1 Check the installation as to its workmanship.

.2 Check the operation of the set.

.3 Check that the operation of engine cooling equipment is satisfactory.

.4 Check the interconnecting wiring of the engine safety devices.

.5 Supply and connect a temporary portable load bank to provide load for generator load test.

.6 Instruct plant personnel in the operation and service of the equipment.

.4 The city authorized representatives and the Engineer will be present for SAT. Notify the City and the Engineer two (2) weeks prior to SAT testing being scheduled and reconfirm the test date 48 hours prior to testing.

.5 Performance Tests:

.1 Perform upon completion of installation.

.2 SAT: Operate four (4) hours at 100% generator nameplate rating with plant load and resistive load bank.

.3 Practical performance test (2 days): It will take place after SAT. Plant operators shall operate the Plant loads in different modes, such as different backwashing sequencing and etc.

.4 Contractor to coordinate the test around the plant operation.

.5 Manufacturer's representative shall make necessary adjustments.

.6 Demonstrate ability of engine generator set to carry specified loads.

.7 Demonstrate engine generator set safety shutdowns.

.6 Test Report: Record and report the following:

.1 Electric load on generator.

.2 Natural gas fuel consumption.

.3 Exhaust temperature.

.4 Ambient air temperature.

.5 Safety shutdown performance results.

.6 Transients.

.7 Post Test Requirements:

.1 Make final adjustments.

.2 Replace oil and oil filters.

.3 Check belt drive tensions.

.4 Demonstrate proper operation of equipment, including automatic operation with control from automatic transfer switch to the Engineer and the City representatives.

.5 The Contractor is responsible to meet the Manufacturer's vibration requirements under full load on site, evaluated by City specified third party. spring vibration isolators to be included and sized by Manufacturer. All frequency shall be recorded during the test.

3.6 MANUFACTURER'S TRAINING FIELD SERVICES

.1 Refer to Section 01820 – Demonstration and Training.

.2 Manufacturer's Representative: Present at site or classroom designated by the City for minimum person-days listed below, travel time excluded:

.1 One (1) person-day for installation assistance inspection.

.2 One (1) person – two (2) days for facility start-up.

.3 Two (2) persons- one (1) day for SAT.

.4 One (1) person- two (2) days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

.5 Post start-up training of the City's personnel: Training shall be provided after start-ups are successfully completed by the Contractor.

.6 Contractor to submit Pre-SAT check out sheets for the Engineer and the City review prior to the City's representative involvement for SAT and Training.

3.7 SERVICE AND SUPPORT

.1 The manufacturer shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

.2 The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

3.8 WARRANTY

.1 The Generator set and associated internal equipment and controls shall be warranted by the Manufacturer for a period of not less than two (2) years from the date of commissioning against defects in materials, labour and workmanship.

.2 The warranty period shall commence when the generator is first placed into service. Multiple warranties for individual components will not be acceptable. Satisfactory warranty documents must be provided.

.3 The manufacturer shall maintain records of each generator set item, by serial number, for a minimum of 20 years.

END OF SECTION

ELECTRICAL INSTALLATION AND START-UP FORM

PROJECT: **R.C. Harris WTP – Standby Generator – Residue Management Facility (RMF) Building**

CONTRACT No.:

CONTRACTOR:

EQUIPMENT: 275 kW Natural Gas Generator		**DATE INSTALLATION COMPLETE:**	
SERIAL NO:		**MAKE & MODEL NO:**	
PRE-START-UP TESTING	**Check By (Initial)**	**DATE**	**REMARKS**
All power/control cables terminated/tested.			
Test installation and continuity of grounding.			
Phase rotation check.			
Natural Gas pressure available and adequate.			
All other conditions met as per Manufacturer Start-up requirements.			
Specific Setup/Checks/Testing:			
Calibration / Testing of Generator Main Breaker, as per settings from Co-ord. Study.			
Check safeties and interlocks before and after 4 hour heat run on load bank.			
4 hour load bank test			
1 hour building load test			
Other Requirements:			
Confirm activation of warning lights on ATS during Genset testing.			
All Nameplates and Warning Labels Adhered			
Sign-Off - Cert of Proper Installation Form			
DEFICIENCIES NOTED:			

COMMENTS: (Manufacturer's Rep may append additional testing sheets to this commissioning form).

SIGNATURES FOR EQUIPMENT CHECKOUT COMPLETE & READY FOR SERVICE

Manufacturer's Site Representative	**Contractor**	**Site Inspector**	**Consultant/ Tech Services**
Date:	Date:	Date:	Date:

ELECTRICAL INSTALLATION AND START-UP FORM

PROJECT: **R.C. Harris WTP – Standby Generator – Screen Building**

CONTRACT No.:

CONTRACTOR:

EQUIPMENT: 275 kW Natural Gas Generator		**DATE INSTALLATION COMPLETE:**	
SERIAL NO:		**MAKE & MODEL NO:**	
PRE-START-UP TESTING	**Check By (Initial)**	**DATE**	**REMARKS**
All power/control cables terminated/tested.			
Test installation and continuity of grounding.			
Phase rotation check.			
Natural Gas pressure available and adequate.			
All other conditions met as per Manufacturer Start-up requirements.			
Specific Setup/Checks/Testing:			
Calibration / Testing of Generator Main Breaker, as per settings from Co-ord. Study.			
Check safeties and interlocks before and after 4 hour heat run on load bank.			
4 hour load bank test			
1 hour building load test			
Other Requirements:			
Confirm activation of warning lights on ATS during Genset testing.			
All Nameplates and Warning Labels Adhered			
Sign-Off - Cert of Proper Installation Form			
DEFICIENCIES NOTED:			

COMMENTS: (Manufacturer's Rep may append additional testing sheets to this commissioning form).

SIGNATURES FOR EQUIPMENT CHECKOUT COMPLETE & READY FOR SERVICE

Manufacturer's Site Representative	**Contractor**	**Site Inspector**	**Consultant/ Tech Services**
Date:	Date:	Date:	Date:

TORONTO

SECTION 16600

AUTOMATIC TRANSFER SWITCH

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

.1 This section specifies the requirements for the supplying, testing, delivering, installing, commissioning and placing into operation of two (2) fully functioning Double Sided Bypass Isolation Automatic Transfer Switches (ATS) at the R.C. Harris Water Treatment Plant. These are:

.1 Two (2) 400 Amps, 600 Volts, 3 pole ATS's, Open Transition, with a minimum interruptible capacity of 50kA, c/w double sided bypass isolation.

.2 Each ATS shall be a separate unit from the associated switchboard.

.3 The Contractor shall refer to the contract drawings, conduct detailed field measurements, and confirm the installation space available for each ATS. If there are space issues, the Contractor shall advise the Engineer with the issue(s) before submission of shop drawings.

.4 It is made clear that the Contractor shall provide products and perform installations, start-up, testing and commissioning procedures and requirements as per all applicable standards listed herein. The Contractor shall include all required costs to do so into the tender price. There will be no extra costs provided during construction for providing, meeting or performing any installation, test, start-up, or commissioning procedure required by or mentioned in the Standards.

.5 All automatic transfer switches shall be factory assembled and supplied by the ATS manufacturer/authorized supplier.

1.2 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements (Summary of Work–Electrical).

.2 Section 16480 – Low Voltage Switchboards.

.3 Section 16500 – Natural Gas Engine Generator.

1.3 REFERENCES

.1 CSA C22.2 No. 178 Automatic Transfer Switches.

.2 NFPA 70 - National Electrical Code.

.3 NFPA 110 - Emergency and Standby Power Systems.

.4 CAN3-C13, Instrument Transformers.

.5 CSA 22.2 No. 5.1, Moulded Case Switches.

.6 UL 1008, Automatic Transfer Switches for Use in Emergency Systems.

.7 CAN3-C17, Alternating-Current Electricity Metering.

.8 ANSI/NEMA ICS 2, Industrial Control Devices, Controllers, and Assemblies.

.9 NEMA No. ICS 10, Industrial Control and Systems, AC Transfer Switch Equipment.

.10 ESA, Electrical Safety Authority Bulletins.

1.4 SYSTEM DESCRIPTION

.1 Each Automatic Transfer equipment to:

.1 Monitor voltage on all phases of normal power supply.

.2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below pre-set adjustable limits for an adjustable period of time.

.3 Transfer load from normal supply to standby unit when normal power is unavailable and the standby unit has reached rated frequency and voltage.

.4 Transfer load from standby unit to normal power supply when normal power is restored, confirmed by sensing frequency and voltage on all phases within adjustable pre-set limits for adjustable time period.

.5 Shut down standby unit after running unloaded, for engine cool down, using programmed adjustable time delay.

.2 The ATS shall be equipped with a double sided bypass isolation feature.

.3 Transfer Inhibit Terminals shall be provided for all new ATS units.

.4 The Contractor shall review the electrical drawings, in particular the Generator/ATS Block diagrams for Control Wiring, the Standby Generator/ATS Wiring Schematic and the ATS Sequence of Operation, and include all required interface contacts specified on the drawings and herein.

1.5 DOUBLE SIDED BYPASS ISOLATION TRANSFER SWITCH

.1 A double sided Normal bypass switch shall provide manual bypass of the load to Normal source to facilitate maintenance of the switch without having to shut off power to the critical loads.

.2 A double sided Emergency bypass switch shall provide manual bypass of the load to Emergency source to facilitate maintenance of the switch without having to shut off power to the critical loads, if maintenance on the switch is necessary when loads are powered by the emergency source.

.3 Bus-bars shall be made of silver-plated copper.

1.6 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 Include mounting details, dimensions, and wiring for all equipment.

.3 Include ratings for all equipment.

.4 Provide single line diagram and wiring diagrams.

1.7 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for automatic load transfer equipment, for incorporation into manual specified in Section 01783 – Operation and Maintenance Manual.

.2 Detailed instructions to permit effective operation, maintenance and repair.

.3 Technical Data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

.4 Test Records:

.1 Provide test records detailing tests achieved, remedial action taken during testing and final record of all settings. Test record to be dated and signed by the Manufacturers authorized representative.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Eaton Cutler-Hammer.

.2 ASCO.

.3 Thomson Technology Inc.

.4 Approved equal.

2.2 CONFORMANCE

.1 Automatic Transfer Switch conforms to CSA C22.2 No.178.

.2 Meters: to CAN3-C17.

.3 Instrument transformers: to CAN3-C13.

2.3 MECHANICALLY HELD TRANSFER SWITCH

.1 The switching device for 30A through 1000A transfer switches shall be moulded case switch type. All transfer switches shall be CSA listed for application in their intended enclosure for 100% of their continuous ampere rating.

.2 The automatic transfer switch shall be of double throw construction operated by a reliable electrical mechanism, momentarily energized.

.3 Main operators which include overcurrent disconnect devices will not be accepted.

.4 The switch shall be mechanically interlocked to ensure only one of three possible positions; Normal position, Normal bypass and Emergency bypass.

.5 Minimum interrupting capacity as indicated.

.6 All main contacts shall be silver composition and mechanically held in both normal emergency position.

.7 Transfer switches shall be capable of being operated manually under full rated load conditions. Manual operation shall be accomplished by a permanently attached manual operator, or by integrally mounted pushbuttons. Removable manual operating handles, and handles that may move in the event of an electrical operation during the manual operation, are not acceptable. Manual operators requiring source or load disconnection prior to manual operation are not acceptable.

.8 A neutral terminal plate with fully-rated CU pressure connectors shall be provided.

2.4 CONTROLS

.1 The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent serial communications capability. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.

.2 The controller shall be enclosed with a protective cover and be mounted for safety and ease of maintenance. Sensing and control logic shall be provided. Interfacing relays shall be industrial grade plug-in type with dust covers.

.3 Controller shall be flush-mounted display with LED indicators for switch position and source acceptability. It shall also include test and time delay bypass switches.

.4 The voltage of each phase of the Normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting.

.5 Single-phase voltage and frequency sensing of the emergency source shall be provided.

.6 An adjustable time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.

.7 An adjustable time delay shall be provided to transfer from Normal to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.

.8 A generator stabilization time delay shall be provided after transfer to emergency.

.9 An adjustable time delay shall be provided to retransfer from Emergency to normal, adjustable to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.

.10 A minimum of 10-minute cooldown time delay shall be provided on shutdown of engine generator.

.11 All adjustable time delays shall be field adjustable without the use of special tools.

2.5 ENCLOSURE

.1 Each transfer switch shall be provided in a NEMA 12 enclosure suitable for use in environments indicated in the drawings.

2.6 ACCESSORIES

.1 Auxiliary relay to provide 4 N.O. and 4 N.C. contacts for remote alarms.

.2 Auxiliary relay contacts for load bank shunt trip.

.3 Control Transformers:

.1 Control transformers shall be sized and rated for total transfer equipment control load including transfer motor.

.2 Separate control transformers for utility and emergency power.

.4 A set of contacts rated 5A, 32V DC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

.5 A push-button type test switch shall be provided to simulate a normal source failure.

.6 A push-button type switch to bypass the time delay on transfer to emergency, the engine exerciser period on the retransfer to normal time delay whichever delay is active at the time the push-button is activated.

.7 Auxiliary contacts, rated 10A, 250V AC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact, closed, when the ATS is connected to the emergency source.

.8 Indicating lights shall be provided, one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red). Also provide indicating lights for both normal and emergency source availability.

.9 Terminals shall be provided to indicate actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.

.10 An engine generator exercising timer shall be provided, including a selector switch to select exercise with or without load transfer.

.11 The Contractor shall review the electrical drawings, in particular the Generator/ATS Block diagrams for Control Wiring, the Standby Generator/ATS Wiring Schematics and the ATS Sequence of Operation, and include all required interface contacts specified on the drawings and herein.

2.7 CONNECTIONS

.1 Provide lugs for all cable connections. Refer to the electrical single line diagrams for rating and type of cables used.

.2 Top entry for power supply. Contractor is responsible to review and verify field requirements.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 13040 – Toronto Water Tagging Standard.

.2 Control Panel:

.1 For selector switch and manual switch: size 5 nameplates.

.2 For meters, indicating lights, minor controls: size 3 nameplates.

2.9 SIGNALS TO AUTOMATIC LOAD TRANSFER SWITCH

.1 Provide the following form C dry contacts from the Generator Control Panel:

.1 Engine running.

.2 Refer to Division 13 for additional required signals.

.2 The Contractor shall review the electrical drawings, in particular the Generator/ATS Block diagrams for Control Wiring, the Standby Generator/ATS Wiring Schematic and the ATS Sequence of Operation, and include all required interface contacts specified on the drawings and herein.

2.10 SIGNALS FROM AUTOMATIC LOAD TRANSFER SWITCH

.1 Provide the following form C dry contacts:

.1 Engine start command.

.2 Auxiliary contact for load bank shunt trip.

.3 "Transfer Inhibit" dry contact as shown on the contract drawings.

.4 Refer to Division 13 for additional required signals.

.2 All the form C dry contacts in above shall be:

.1 Rated at minimum 5A @ 250V AC, 5A @ 30V DC

.3 The Contractor shall review the electrical drawings, in particular the Generator/ATS Block diagrams for Control Wiring, the Standby Generator/ATS Wiring Schematic and the ATS Sequence of Operation, and include all required interface contacts specified on the drawings and herein.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Locate, install and connect transfer equipment in space indicated on the contract drawings. Contractor is responsible to review and verify available space and dimensions.

.2 Connect cables to lugs. Ground cable armour as applicable.

.3 Connect control cables, loop check each and record results for each conductor.

.4 Check relays or solid state monitors and adjust as required.

3.2 FACTORY ACCEPTANCE TESTING (FAT)

.1 Provide the City and the Engineer with at least two (2) full week's prior notice that the equipment is ready for FAT.

.2 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

.1 Insulation check to ensure the integrity of insulation and continuity of the entire system.

.2 Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards.

.3 Mechanical tests to verify that the switch's power sections are free of mechanical hindrances.

.4 Electrical tests to verify the complete electrical operation of the switch.

.5 Electrical tests to set up time delays and voltage sensing settings of the logic.

.3 The manufacturer shall provide a certified copy of factory test reports.

.4 Transfer switch shall include a label indicating order number, catalogue number and date.

.5 Refer to Section 01830 – Factory Acceptance Testing for additional requirements.

3.3 FIELD QUALITY CONTROL

.1 It is made clear that the Contractor shall provide products and perform installations, start up, testing and commissioning procedures and requirements as per all applicable standards listed herein. The Contractor shall include all required costs to do so into the tender price. There will be no extra costs provided during construction for providing, meeting or performing any installation, test, start-up, or commissioning procedure required by or mentioned in the Standards.

.2 The complete ATS's shall be factory and site tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

.3 Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

.4 The ATS manufacturer shall be certified to ISO 9001: 2000 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001: 2000.

.5 The Manufacturer should provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in the installation and start-up of the equipment specified under this section for a period as required by the Contractor. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, staff and City training and testing of the assembly and components contained therein.

.6 Perform tests in accordance with Section 16010 – Electrical General Requirements and Section 16080 – Electrical Testing.

.7 Refer to Section 01430 – Manufacturers Services for additional requirements.

.8 Energize transfer equipment from normal power supply.

.9 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.10 Set selector switch in "Manual" position and check to ensure proper performance.

.11 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.12 Set selector switch in "Auto" position and open normal power supply disconnect. Verify the generator starts, comes up to rated voltage and frequency, and then transfer the load

to standby power. Allow to operate for 10 min, then close main power supply disconnect. Load transfers back to normal power supply and generator follows proper shutdown sequence.

.13 Perform test with 100% rated load for a minimum of two hours. Supply all necessary cables and connections.

.14 Record test results, compile into a binder, and indicate changes done to the equipment as a result of the testing, in addition to electronic copy. Confirm all parameters for the programmable controls, including time settings. Field test results to be dated and signed by the Manufacturers authorized representative.

3.4 SITE ACCEPTANCE TESTING (SAT)

.1 Provide The City and the Engineer with at least two (2) full week's prior notice that the equipment is ready for SAT.

.2 The following tests shall be performed on site, on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

.1 Check selector switch, in all modes of operation Test, Auto, Manual, Engine Start and record results.

.2 Check voltage sensing and time delay relay settings.

.3 Check:

a. Automatic starting and transfer of load on failure of normal power.

b. Retransfer of load when normal power supply resumed.

c. Automatic shutdown.

d. In-phase monitor operation.

.3 Transfer switch shall include a label indicating order number, catalogue number and date.

.4 Documentation:

.1 Assemble, final, proven parameters for programmable transfer controller listed in the manufacturers standard format, bound for submission to the City.

.2 List all changes made to equipment, wiring and parameters for programmable transfer controller. Clearly indicate reasons for changes.

.3 Final test results to be dated and signed by the Manufacturers authorized representative.

3.5 SITE TRAINING

.1 The Manufacturer's qualified representative shall conduct a classroom type training session for up to five (5) of the City's representatives for a minimum of one (1) hour during the normal workdays at a jobsite. The training program shall consist of the instruction on the operation of the transfer switch and the major components within the assembly.

.2 Refer to Section 01820 Demonstration and Training for additional requirements.

3.6 WARRANTY

.1 Each ATS and associated equipment shall be warranted for a period of not less than two (2) years from the date of commissioning against defects in materials, labour and workmanship.

.2 The warranty period shall commence when the ATS is first placed into service. Multiple warranties for individual components will not be acceptable. Satisfactory warranty documents must be provided.

.3 The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

.4 For ease of maintenance, the transfer switch nameplate shall include drawing numbers and serviceable part numbers.

.5 Refer to Section 01760 – Warranty Work.

END OF SECTION

Appendix A
Section 1640a – Appendix G – WMS Entity Information – Excel Sheet

WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

General Information of New and Modified Assets

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant	Provided by: Consultant
Entity Number	**Original Entity Number** Applicable if an existing equipment is being reused. NOTE: the Original E# may be the same or different.	**Entity Name**	**Entity Site Name**	**Parent Number**	**Parent Site Name**	**Entity Type**	**Entity Classification**	**Entity Category**	**Entity Location Description**	**Description**	**Drawing Number** Enter the Toronto Water's Master P&ID drawing number where possible. Otherwise, use contract drawing number
FHA-ELS-GEN-0100		Generator, 300kW,Natural Gas, water cooling	FHA			Electrical Equipment	Generator	Generator,Electricity	Residue Management Facility		
FHA-ELS-TS-0400		Transfer Switch, Automatic,double-bypass	FHA	FHA-ELS-MCC-0400B	FHA	Electrical Equipment	Switchgear	Switchgear,Indoor	Residue Management Facility		E103
FHA-ELS-PDP-0400E		Power Distribition Panel, Emergency	FHA	FHA-ELS-TS-0400	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Residue Management Facility		E103
FHA-ELS-TR-0400E		Transformer, Distribution, dry type	FHA	FHA-ELS-PDP-0400E	FHA	Electrical Equipment	Transformer	Transformer,Power,Dry	Residue Management Facility		E103
FHA-ELS-LP-0400E		Power Load Panel, Emergency	FHA	FHA-ELS-TR-0400E	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Residue Management Facility		E103
FHA-ELS-TS-0300		Transfer Switch, Automatic,double-bypass	FHA	FHA-ELS-PDP-0300A	FHA	Electrical Equipment	Switchgear	Switchgear,Indoor	Pumping Station		E133
FHA-ELS-PDP-0300E		Power Distribition Panel, Emergency	FHA	FHA-ELS-TS-0300	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Pumping Station		E133
FHA-ELS-PDP-0200E		Power Distribition Panel, Emergency	FHA	FHA-ELS-PDP-0300E	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Residue Management Facility		E143
FHA-ELS-TR-0300E		Transformer, Distribution, Dry type	FHA	FHA-ELS-PDP-0400E	FHA	Electrical Equipment	Transformer	Transformer,Power,Dry	Pumping Station		E133
FHA-ELS-LP-0300E		Power Load Panel, Emergency	FHA	FHA-ELS-TR-0300E	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Pumping Station		E133
FHA-ELS-LP-0301E	FHA-ELS-LP-0301B	Power Load Panel, Emergency	FHA	FHA-ELS-LP-0300E	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Pumping Station		E-133
FHA-ELS-DP-0301E	FHA-ELS-DP-0301A-2	Power Distribition Panel, Emergency	FHA	FHA-ELS-PDP-0400E	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Pumping Station		E-133
FHA-ELS-DP-0302E	FHA-ELS-DP-0301B-5	Power Distribition Panel, Emergency	FHA	FHA-ELS-PDP-0400E	FHA	Electrical Equipment	Power Distribution Panel	Switchgear,Indoor	Pumping Station		E-133
FHA-ELS-FN-0101		Fan Coil Cooler	FHA	FHA-ELS-FN-0101	FHA	Mechanical Equipment	Condensing Unit	Fan	RMF Building	Fan Coil Cooler	2F-P&ID-I004
FHA-ELS-TSH-0101		Fan Coil Cooler, Thermostat	FHA	FHA-ELS-TSH-0101	FHA	Mechanical Equipment	Condensing Unit	Switch,Temperature-High	RMF Building	Fan Coil Cooler, Thermostat	2F-P&ID-I004
FHA-ELS-DM-6822		Louver, Actuated, Generator GEN-0200	FHA	FHA-ELS-DM-6822	FHA	Mechanical Equipment	Damper/Louver	Damper/Louver	RMF Building	Louver, Actuated, Generator GEN-0200	2F-P&ID-I004
FHA-NGS-V-0101		Valve, Isolation, Gas	FHA	FHA-NGS-V-0100	FHA	Mechanical Equipment	Valve	Valve,Solenoid	RM Building - Pipe gallery	Valve, Isolation, Gas	2F-P&ID-I004
FHA-NGS-V-0102		Valve, Solenoid, Gas	FHA	FHA-NGS-V-0100	FHA	Mechanical Equipment	Valve	Valve,Solenoid	RM Building - Pipe gallery	Valve, Solenoid, Gas	2F-P&ID-I004
FHA-NGS-V-0103		Valve, Solenoid, Gas	FHA	FHA-NGS-V-0100	FHA	Mechanical Equipment	Valve	Valve,Solenoid	RM Building - Pipe gallery	Valve, Solenoid, Gas	2F-P&ID-I004
FHA-ELS-V-0101		Valve, Solenoid, Water	FHA	FHA-ELS-V-0100	FHA	Mechanical Equipment	Valve	Valve,Solenoid	RM Building - Pipe gallery	Valve, Solenoid, Water	2F-P&ID-I004
FHA-ELS-V-0102		Valve, Solenoid, Water	FHA	FHA-ELS-V-0100	FHA	Mechanical Equipment	Valve	Valve,Solenoid	RM Building - Pipe gallery	Valve, Solenoid, Water	2F-P&ID-I004
FHA-ACC-FN-6822		Fan, Exhaust	FHA	FHA-ACC-FN-6822	FHA	Mechanical Equipment	Fan	Fan	RMF Building - Generator Room	Fan, Exhaust	2F-P&ID-I004
FHA-ACC-FN-6823		Fan, Combustion air supply	FHA	FHA-ACC-FN-6823	FHA	Mechanical Equipment	Fan	Fan	RMF Building - Generator Room	Fan, Combustion air supply	2F-P&ID-I004
FHA-ACC-FN-0102		Fan, Cooling	FHA	FHA-ACC-FN-0100	FHA	Mechanical Equipment	Fan	Fan	RMF Building - Generator Room	Fan, Cooling	2F-P&ID-I004
FHA-ELS-CP-0111		Control Panel, Mechanical	FHA	FHA-ELS-CT-0P00	FHA	Instrumentation Equipment	Gas Monitoring	Control Panel,Instrumentation	RMF Building - Generator Room	Control Panel, Mechanical	2F-P&ID-I004
FHA-ELS-FIT-0101		Cooling Water Flow	FHA	FHA-ELS-FIT-0100	FHA	Instrumentation Equipment	Analyzer	Meter,Flow	RMF Building - Generator Room	Cooling Water Flow	2F-P&ID-I004
FHA-ELS-FIT-0102		Natural Gas Flow	FHA	FHA-ELS-FIT-0102	FHA	Instrumentation Equipment	Analyzer	Meter,Flow	RMF Building - Generator Room	Natural Gas Flow	2F-P&ID-I004
FHA-ELS-CT-0101		Gas Detection Controller, Gas Interlock	FHA	FHA-ELS-CT-0100	FHA	Instrumentation Equipment	Gas Monitoring	Building Service	RMF Building - Generator Room	Control Panel, Gas Interlock	2F-P&ID-I004
FHA-ELS-AIT-0101		Analyzer, Natural Gas Detector	FHA	FHA-ELS-AIT-0100	FHA	Instrumentation Equipment	Gas Monitoring	Analyzer,Methane/LEL	RMF Building - Generator Room	Analyzer, Natural Gas Detector	2F-P&ID-I004
FHA-ELS-AIT-0102		Analyzer, CO Gas Detector	FHA	FHA-ELS-AIT-0100	FHA	Instrumentation Equipment	Gas Monitoring	Analyzer,Carbon Monoxide (CO)	RMF Building - Generator Room	Analyzer, CO Gas	2F-P&ID-I004
FHA-ELS-LTG-0101		Alarm Horn	FHA	FHA-ELS-LTG-0100	FHA	Instrumentation Equipment	Building	Building Service,Fire Alarm	RM Building - Pipe gallery	Alarm Horn	2F-P&ID-I004
FHA-ELS-LSH-0101		Float Switch High, Generator Containment	FHA	FHA-ELS-LSH-0100	FHA	Instrumentation Equipment	Switch	Switch,Flow-High	RMF Building - Generator Room	Float Switch High, Generator Containment	2F-P&ID-I004
FHA-ELS-TIT-0101		Ambient Temperature, Generator Room	FHA	FHA-ELS-LSH-0100	FHA	Instrumentation Equipment	Switch	Switch,Temperature-High	RMF Building - Generator Room	Ambient Temperature, Generator Room	2F-P&ID-I004
FHA-ELS-FDT-0101		Flame Detector	FHA	FHA-ELS-FDT-0100	FHA	Instrumentation Equipment	Fire Equipment	Fire Prevention,Alarm	RMF Building - Generator Room	Flame Detector	2F-P&ID-I004
FHA-ACC-FSH-6822		Flow Switch High, Combustion Air Supply	FHA	FHA-ACC-FSH-6822	FHA	Instrumentation Equipment	Switch	Switch,Flow-High	RMF Building - Generator Room	Flow Switch High, Combustion Air Supply	2F-P&ID-I004
FHA-ACC-ZSH-6822		Open Switch, Damper	FHA	FHA-ACC-ZSH-6822	FHA	Instrumentation Equipment	Switch	Sensor,Position	RMF Building - Generator Room	Open Switch, Damper	2F-P&ID-I004
FHA-FLT-CP-0007		Filter CV Shutoff Control Panel	FHA	FHA-FLT-CP-0000	FHA	Instrumentation Equipment	Valve	Control Panel,Instrumentation	Residue Management Facility	Control Panel, Instrumentation	2F-P&ID-I105
FHA-FLT-CP-0006		Filter CV Panel, west gallery	FHA	FHA-FLT-CP-0000	FHA	Instrumentation Equipment	Valve	Control Panel,Instrumentation	Residue Management Facility	Control Panel, Instrumentation	2F-P&ID-I107
FHA-FLT-CP-0005		Filter CV Panel, east gallery	FHA	FHA-FLT-CP-0000	FHA	Instrumentation Equipment	Valve	Control Panel,Instrumentation	Residue Management Facility	Control Panel, Instrumentation	2F-P&ID-I106

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WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

Procurement information of New Assets

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor
Entity Number	**OEM (Complete Business Name)**	**Supplier (Complete Business Name)**	**Supplier Phone Number**	**Purchase Order/ Contract #**	**Original Cost**	**Model/Style/Catalog Number**	**Serial Number**
FHA-ELS-GEN-0100							
FHA-ELS-TS-0300							
FHA-ELS-TS-0400							
FHA-ELS-PDP-0300E							
FHA-ELS-PDP-0400E							
FHA-ELS-PDP-0200E							
FHA-ELS-TS-0300							
FHA-ELS-TS-0400							
FHA-ELS-LP-0300E							
FHA-ELS-LP-0400E							

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WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

Recommended Maintenance Based on O&M Manual Recommendations

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contra	Provided by: Contractor
Entity Number	**Entity Maintenance Activity #** enter a number, I.e. 1, 2, 3, ...	**Maintenance Activity Name**	**Detailed Maintenace Activity Procedure** Each step must be entered in a numbered line. Presss Alt+Enter to start a new line in the cell. See example rows above for more detail.	**Activity Trades Requirements** e.g. electrician, millwright, etc.	**Estimated Time (hr)**	**Activity Frequency** e.g. daily, every 6 month, etc.
FHA-ELS-GEN-0100						
FHA-ELS-TS-0300						
FHA-ELS-TS-0400						
FHA-ELS-PDP-0300E						
FHA-ELS-PDP-0400E						
FHA-ELS-PDP-0200E						
FHA-ELS-TS-0300						
FHA-ELS-TS-0400						

WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

New Pumps

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contract	Provided by: Contract	Provided by: Contract	Provided by: Contract	Provided by: Contract	Provided by: Contract	Provided by: Contract	Provided by: Contrac	Provided by: Contracto	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contrac	Provided by: Contrac	Provided by: Contractor
Entity Number	Flow Rate (L/sec,USgpm,IMgpm)	Head (M, FT)_1	RPM	Suction Diameter (in, mm)_1	Discharge Diameter (in, mm)_1	Seal Type (Mech, Packing)	Number of Stages	Lubrication (oil, grease)	Impeller Diameter (in, mm)_1	Impeller Sleeve Diameter_1	Number of Impeller Vanes	Impeller Material	Rotation (CW, CCW)	Inboard Bearing Part # / Type	Outboard Bearing Part # / Type	Thrust Bearing Part # / Type	Additional Nameplate Info	Drive (Direct, Belt or Gear Box)	Coupling Type and Size	Belt Type and Size

WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

New Motors

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: Co	Provided by: C	Provided by: C	Provided by: Contra	Provided by: Co	Provided by: Cont	Provided by: Contracto	Provided by: Contractor	Provided by: Contrac	Provided by: Con	Provided by: Contra	Provided by: Contractor	Provided by: Contract	Provided by: Contract	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor
Entity Number	**Motor Function**	**Watts**	**Horse Power**	**RPM**	**AC or DC**	**Number of Phases**	**Cycles (Hz)**	**Frame Size**	**Frame Type (TEFC, DE,ODP)**	**Amperage (A, mA)**	**Voltage**	**Abbreviation**	**Insulation Class Code**	**Inboard Bearing Part #**	**Outboard Bearing Part #**	**Type (Ind, Synchr, Series, Shunt)**	**Mount, (Horizontal, Vertical)**	**Shaft (Single or Double Output)**	**Additional Nameplate Info**

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DATA PILOT (INTEGRATED)

New Valves

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contra	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor
Entity Number	Process Application	Valve Type	Connection Type	Valve Size	Body Type	Pressure Rating	Seat Material	Packing Material/Size	Interior Coated	Number of Rotations	Operator Manufacture	Operator Type	Operator Model Number	Operator Size	Operating Torque	Clockwise to Open	Additional Operator Info.	Actuator Name Plate Info	Additional Valve Info.

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DATA PILOT (INTEGRATED)

New Instrumentations

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contracto	Provided by: Co	Provided by: Con	Provided by: Contr	Provided by: C	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor
Entity Number	**Supply**	**Display**	**Input**	**Output**	**Range**	**Calibration Range**	**Activation Parameter**	**Pressure Rating**

WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

New Breakers - include all medium voltage, but exclude MCC molded case type

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor
Entity Number	**Type**	**Insulation Medium**	**Load Voltage**	**Frame Size Amp.**	**Modular Trip Unit?**	**Trip Unit Type**	**Trip Unit Sensor Rating I_n**	**Trip Unit OEM Name**	**Trip Unit Model**	**Separate CT/PT?**	**Separate Protection Relay?**

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DATA PILOT (INTEGRATED)

New Motor Starters

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: C	Provided by: C	Provided by: C	Provided by: Contra	Provided by: Contrac	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contrac	Provided by: Con	Provided by: Contra	Provided by: Contract	Provided by: Contract	Provided by: Contract	Provided by: Contractor	Provided by: Contractor
Entity Number	**Load Voltage**	**Load F.L.A.**	**Number of Phases**	**Starter - Configuration**	**Starter - Starting method**	**All Overload Element(s) Type(s)**	**Respective Overload Element(s) Location(s)**	**Starter Contactor - OEM and Model #**	**Starter Contactor - Max Amps.**	**Starter Contactor - Coil Voltage**	**Contact Insulation Medium (for MV)**	**Starter Control Transformer VA**	**Starter Control Fuse - OEM and Catalog No.**	**Main Fuse - OEM and Catalog No.**	**µ-Processor Relay - OEM and Model No.**	**Soft starter - OEM and Model No.**	**VFD controller - OEM and Model No.**

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WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

New Transformers

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: Contractor	Provided by: Contracto	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contractor	Provided by: Contrac	Provided by: Contractor
Entity Number	**Primary Voltage (Centre Tap)**	**Secondary Voltage**	**kVA Rating (@ max cooling)**	**Cooling Type**	**Winding Configuration**	**Oil Filled / Dry Type**	**Oil Type**	**Sudden pressure relay installed?**	**Cable Teminal Type**	**NGR Resistance**	**Online Gas Monitor Installed**
FHA-ELS-TR-0300E											
FHA-ELS-TR-0400E											

WMS ENTITY INFORMATION SPREADSHEET
DATA PILOT (INTEGRATED)

New HVAC Equipment

Mandatory Data Entry Requirements (press "+" button on the left margin to show)

Examples of Expected Entries (press "+" button on the left margin to show)

Project Data Table

Provided by: Consultant	Provided by: Contractor	Provided by: Contr	Provided by: Contrac	Provided by: Contrac	Provided by: Contra	Provided by: Cont	Provided by: Co	Provided by: Contra	Provided by: Contra	Provided by: Contrac	Provided by: Cont	Provided by: Contrac	Provided by: Con	Provided by: Con	Provided by: Cont	Provided by: Contracto	Provided by: Contrac	Provided by: Contra	Provided by: Contractor
Entity Number	**Type (Draw-Thru or Blow-Thru)**	**CFM Rating**	**Static Pressure Rating**	**Drive (Direct, Belt or Gear Box)**	**Pulley Dimensions - Motor**	**Pulley Dimension - Fan**	**Belt Size and Quantity**	**Inboard Fan Bearing #**	**Outboard Fan Bearing #**	**Coupling Type and Size**	**Cooling Coil Description**	**Filter Type Description**	**Filter Dimensions and #**	**Evaporator Style**	**Evaporator Dimensions**	**Humidification Info.**	**Compressor Name Plate Info.**	**Damper Info.**	**Additional Information**

Appendix B
DSS Report Standby Generator Upgrades

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS ASSESSMENT

Standby Generator Upgrade Project
R.C. Harris Water Treatment Plant
2701 Queen Street East
Toronto, Ontario
M4E 1H4

Prepared for:
Ms. Jian Zheng
Process Engineering, Project Manager

Cole Engineering Group Ltd.
70 Valleywood Drive
Markham, Ontario
L3R 4T5

Prepared by:
Safetech Environmental Limited

James Macklin
OH & S Technician

SEL Project Number 169018

Date of Site Work: July 6, 2018
Date of Issue: August 23, 2018

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EXECUTIVE SUMMARY

Safetech Environmental Limited (SEL) was commissioned by Cole Engineering Group Ltd. to conduct a designated substances and hazardous materials assessment within the Filter Gallery and Screen Room at R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Toronto, Ontario.

The objective of our assessment was to determine the presence, location, condition and quantities of designated substances and other hazardous materials within that have the potential to be disturbed as part of planned renovation activities (i.e. Standby Generator Upgrade Project) so that appropriate control measures can be implemented to protect workers during the work.

A summary of our assessment results and general recommendations based on our findings are provided in the following Table. This Table should be considered a summary only. Please refer to the Results (Section 3) and Conclusions and Recommendations (Section 4) of our report for additional details.

Designated Substance	Findings	Recommendations
Asbestos	No asbestos-containing materials were identified that may be disturbed as part of the planned construction project.	No action required.
	Other materials observed within the investigated area(s) that are suspected or previously confirmed to be asbestos-containing but are not likely to be disturbed as part of the project includes interior and exterior caulking, pipe insulation, red floor coating, vinyl floor tile, light heat shields and hard textile breaker switch gear within electrical components. Since the above materials are not likely to be disturbed as part of the project bulk sampling was not conducted to verify asbestos content. However, based on the age of the materials they should be assumed to be asbestos-containing until proven otherwise.	No action required. Follow appropriate procedures in accordance with O.Reg. 278/05 should these materials require disturbance/removal.

Lead	Varying concentrations of lead were identified in paints associated with the walls. Historical data confirmed that lead is also present in other paints throughout the facility.	Any disturbance of lead-containing paints and surface coatings should be conducted in accordance with measures and procedures outlined in the Environmental Abatement Council of Ontario (EACO) *"Lead Guideline"* (October 2014) and/or the Ministry of Labour *"Lead on Construction Projects"* guideline. Lead-containing wastes should be recycled if practicable or handled and disposed of according to O.Reg. 347.
	Suspect lead-containing batteries in the form of emergency lighting were identified that may require removal.	If emergency lighting is removed the batteries are recommended to be sent to a recycling facility for proper treatment.
	Lead may be a component of solder in pipe fittings and electrical equipment but is not expected to be a hazard as a result of the planned construction project.	No action required.
Mercury	Mercury vapour is expected to be present within fluorescent lamps and High Intensity Discharge lamps.	Handle lamps with care and keep intact. All waste lamps are recommended to be sent to a lamp recycling facility.
	Sealed liquid mercury is suspected within various gauges and thermometers associated with the mechanical equipment.	Handle equipment with care and avoid breakage/spillage. Any mercury-containing equipment that is to be removed is recommended to be recycled rather than disposed of in landfill.
Silica	Building materials identified that are suspected to contain crystalline silica and may be disturbed as part of the planned construction project include concrete floor. Several other building materials were also identified that are suspected to contain silica.	Any work involving the disturbance of silica-containing materials should follow the procedures outlined in the Ministry of Labour *"Silica on Construction Projects"* guideline. Type 1 operations are expected to be necessary based on the type of work to be conducted.
Other Designated Substances	No other designated substances are expected to be present in any significant quantities or in a form that would represent an exposure concern.	No protective measures or procedures specific to acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride are considered necessary.

Other Hazardous Materials	Findings	Recommendations
Urea Formaldehyde Foam Insulation	No UFFI was identified or is suspected within the areas assessed.	No action required.
Mould Contamination	No mould contamination was identified or is suspected within the areas assessed.	No action required.
Pest Infestation	No pest infestation was identified or is suspected within the areas assessed.	No action required.
Polychlorinated Biphenyls	Some fluorescent light ballasts may contain PCB's. Existing HID lamp ballasts are also assumed to be PCB-containing. However, the light fixtures are not likely to be impacted by the project.	PCB-containing ballasts should be removed, separated from other waste and disposed of as PCB waste at an authorized destruction facility.
Ozone Depleting and Global Warming Substances	No equipment was identified that would contain ozone depleting and/or global warming substances.	No action required.

This assessment satisfies the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statutes of Ontario 1990, as amended.

Should you have any questions regarding the information contained in the report, please contact our office.

Safetech Environmental Limited

James Macklin
OH & S Technician

August 23, 2018

Cole Engineering Group Ltd.
70 Valleywood Drive
Markham, Ontario
L3R 4T5

Attention: Ms. Jian Zheng
Process Engineering, Project Manager

RE: Designated Substances and Hazardous Materials Assessment
Standby Generator Upgrade Project
R.C. Harris Water Treatment Plant
2701 Queen Street East, Toronto, Ontario

1.0 INTRODUCTION

1.1 Background and Objectives

Safetech Environmental Limited (SEL) was commissioned by Cole Engineering Group Ltd. to conduct a designated substances and hazardous materials assessment within the Filter Gallery and Screen Room at R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Toronto, Ontario. The objective of our assessment was to determine the presence, location, condition and quantities of designated substances and other hazardous materials within the facility that have the potential to be disturbed as part of planned renovation activities (i.e. Standby Generator Upgrade Project) so that appropriate control measures can be implemented to protect workers during the work.

This assessment satisfies the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statutes of Ontario 1990, as amended. Section 30(1) requires a building owner to determine if there are any designated substances present at a project site prior to construction or demolition activity. Sections 30(2), (3) and (4) require the Owner and constructors for a project to provide the findings in this report as part of the tendering information for any tendered project or to prospective contractors (and subcontractors) of a project before entering into a binding contract.

This report documents findings of our on-site inspection that was conducted on July 6, 2018 and provides conclusions and recommendations based on our findings and knowledge of the planned renovation project.

1.2 Scope of Work

In accordance with our fee proposal document, our scope of work included the following activities:

- A review of existing documents, including renovation documents and drawings, floor plans and existing environmental assessment reports, etc., where available.

- A visual assessment of the accessible area(s) specific to the Standby Generator Upgrade Project to identify the presence, location, condition and quantities of designated substances and other hazardous materials.

- Collection, analysis and interpretation of representative bulk samples of suspect asbestos-containing building materials for the determination of asbestos content and material classification.

- Collection, analysis and interpretation of representative paint chip samples for the determination of lead content.

- Preparation of a report to document findings and provide recommendations regarding control measures and/or special handling procedures for designated substances or specific hazardous materials that may be disturbed as part of planned renovation activities.

Documents reviewed to aid in our assessment included the following:

- Designated Substance Reassessment Survey

This assessment only identified designated substances and hazardous materials that were deemed to be part of the building or somehow otherwise incorporated into the building structure and its finishes. Assessing occupant items such as stored products, furnishings, items and materials used or produced as part of a manufacturing process, etc. were beyond the scope of this assessment. In addition, our assessment did not include an investigation for underground materials or equipment (vessels, drums, underground storage tanks, pipes, cables, etc.). Furthermore, this assessment was limited to the areas investigated, and more specifically, to those materials that may be disturbed as part of the planned renovation work, as described in Section 1.3.

1.3 Description of Area(s) Assessed

The area investigated included all accessible locations of the facility. Particular attention was paid to those locations within the facility where work related to the Standby Generator Upgrade Project had the potential to disturb materials that may be hazardous.

The facility itself is approximately 100,000 ft² in size and is constructed with a precast concrete slab floor, cinderblock walls, and a corrugated metal ceiling. The facility housed other mechanical equipment such as an air-conditioning units, water pumps, compressors and transformers.

2.0 METHODOLOGY

The presence of hazardous materials was assessed by visual inspection. For the purpose of this assessment and this document, hazardous materials include designated substances as well as other chemical, biological and environmental hazards as defined below:

- **Designated Substances (as prescribed by Ontario Regulation 490/09):**
  - Acrylonitrile, Arsenic, Asbestos, Benzene, Coke Oven Emissions, Ethylene Oxide, Isocyanates, Lead, Mercury, Silica and Vinyl Chloride.

- **Other Hazardous Materials:**
  - ***Chemical Hazards*** – Urea Formaldehyde Foam Insulation (UFFI)
  - ***Biological Hazards*** – Mould Contamination and Pest Infestation
  - ***Environmental Hazards*** – Polychlorinated Biphenyls (PCBs) and Ozone Depleting & Global Warming Substances

For background information regarding the above hazardous materials, please refer to Appendix E.

Destructive testing was not conducted as part of this assessment. Concealed locations such as above solid plaster or drywall ceilings, within plaster or drywall wall cavities, enclosed mechanical/pipe shafts and bulkheads, etc. were not investigated. Similarly, motors, blowers, electrical panels, etc., were not de-energized or disassembled to examine concealed conditions. Building materials that are not detailed within this assessment due to inaccessibility at the time of our site visit and/or uncovered during renovation/demolition activities should be assessed by a qualified person prior to their disturbance.

Bulk sampling followed by laboratory analysis was also conducted to confirm the presence/absence of selected hazardous materials. Bulk sampling was limited to asbestos in building materials and lead in paint on building finishes. All other hazardous materials were identified by visual inspection only. Where possible, observations regarding the location, quantity and condition of the hazardous materials identified were made in order to determine the potential for exposure and provide appropriate recommendations for remedial action, if necessary. Specific methodology for each individual hazardous material assessed is further detailed below.

2.1 Designated Substances

2.1.1 Asbestos

A visual inspection for the presence of both friable and non-friable asbestos-containing material (ACM) was performed within the assessment area(s). The condition of ACM was rated as Good, Fair or Poor based on our assessment criteria provided in Appendix A.

Although destructive testing was not conducted, details regarding the possible presence of ACM in enclosed locations were provided on a case-by-case basis where our visual inspection indicated this possibility. Other materials observed within the investigated area(s) that are suspected or previously confirmed to be asbestos-containing but are not likely to be disturbed as part of the project includes interior and exterior caulking, pipe insulation, red floor coating, vinyl floor tile, light heat shields and hard textile breaker switch gear within electrical components. Since the above materials are not likely to be disturbed as part of the project bulk sampling was not conducted to verify asbestos content. However, based on the age of the materials they should be assumed to be asbestos-containing until proven otherwise.

If an existing asbestos survey was available for review, SEL relied on the information present. Building materials that were visually similar to materials previously tested and that were confirmed to be either ACM or non-ACM were considered to have consistent content and were not re-sampled. Additional sampling was only conducted where the investigator believed a need existed.

Bulk samples of building materials suspected to contain asbestos were retrieved by SEL only for materials that were deemed to have a potential to be disturbed as part of the Standby Generator Upgrade Project. Other suspect materials were noted but were not sampled. Bulk samples were retrieved in accordance with Section 3 and Table 1 of Ontario Regulation 278/05, *"Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations"*. The number of samples collected for each material was based on the type and quantity of the material present within the area(s) investigated. Each individual sample was placed in a labeled zip-lock bag for transportation to an independent laboratory (EMSL). EMSL is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos fiber analysis.

Analysis for asbestos content was performed by the independent laboratory in accordance with the U.S. Environmental Protection Agency (EPA) Test Method EPA/600/R-93-116:Method for the Determination of Asbestos in Bulk Building Materials. June 1993. This method identifies the asbestos fibre content of building materials using polarized light microscopy (PLM) analytical techniques, with confirmation of presence and type of asbestos made by dispersion staining optical microscopy. This analytical method meets the requirements set forth in Section 3 of O.Reg. 278/05.

In accordance with O. Reg. 278/05, an asbestos-containing material is defined as material that contains 0.5 per cent or more asbestos by dry weight. The laboratory was instructed to conduct "stop-positive" analysis for all materials. If a sample was found to be asbestos-containing no further analysis was conducted for samples taken from the same homogeneous material. The Laboratory Certificate of Analysis is included in Appendix B.

Locations where ACM have been identified are detailed in this report. Recommendations pertaining to ACM were made based on the friability, accessibility and condition of the material in conjunction with the potential for the planned renovation work to disturb the ACM.

2.1.2 Lead

An assessment for lead in paint was conducted by retrieving a paint chip sample from representative surface within the area(s) assessed that was deemed to have a potential to be disturbed as part of the planned renovation activities. The condition of the painted surface from which the sample was taken was also visually assessed for signs of deterioration such as cracking, chipping, flaking, bubbling and deterioration due to friction. The condition of this surface was assessed as good, fair or poor based on the degree and extent of deterioration.

The paint chip sample was retrieved by scraping the paint down to the base material substrate to ensure collection of all layers of paint. Care was taken to avoid collection of the underlying substrate to reduce analytical substrate matrix interference.

Upon completion of our assessment, the paint chip sample was submitted to an independent laboratory (EMSL) for the determination of lead content. This laboratory participates in and is accredited by the EPA (U.S. Environmental Protection Agency) for analysis of lead in paint chips through the American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Accreditation Program (ELLAP). Analysis was conducted by the laboratory following the EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846), Method 7000B "Flame Atomic Absorption Spectrophotometry". Result of analysis was reported by the laboratory as the percentage of lead by weight of the total sample (% by wt.). The Laboratory Certificate of Analysis is included in Appendix C.

The presence of lead in other materials, such as lead sheeting, pigmented mortar, lead piping, lead solder, etc. were noted where observed but were not sampled to verify lead content. Lead can be present in these materials to varying degrees, depending on their age of application (refer to Appendix E for additional details) and should be considered lead-containing until proven otherwise.

2.1.3 Mercury

The type, quantity and location of mercury-containing equipment and devices within the area(s) assessed were determined by visual inspection based on appearance, age and knowledge of historical uses. Sampling for mercury-containing building materials and dismantling of suspect mercury-containing equipment was not performed. Where possible, attempts were made to verify the presence/absence of mercury by gathering additional information such as equipment model number, serial number, etc.

2.1.4 Silica

The presence of crystalline silica in building materials was determined through visual inspection of building materials only, based on knowledge of the historic use of silica-containing materials in certain building materials. Sampling to verify the presence/absence of silica in building materials was not performed.

2.1.5 Other Designated Substances

Other designated substances (i.e. acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride) are typically not expected to be encountered in building materials as significant constituents or in a form that would represent an exposure concern. These substances were not included in our assessment unless specific information regarding their use (e.g. in a manufacturing process) was provided to us. Please refer to Appendix E for information regarding where these designated substances are typically found or used. No sampling for these designated substances was performed.

2.2 Other Hazardous Materials

2.2.1 Chemical Hazards

Urea Formaldehyde Foam Insulation (UFFI)

A visual inspection to evaluate the possible presence of Urea Formaldehyde Foam Insulation (UFFI) was conducted within the area(s) assessed. Our visual inspection was limited to looking for evidence of possible UFFI installation (i.e. repaired nozzle holes in walls) and overspray at wall/ceiling joints, etc. No destructive testing or material sampling was conducted as part of our assessment.

2.2.2 Biological Hazards

Mould Contamination

A visual inspection to determine the possibility of mould growth was conducted within the area(s) assessed. Our assessment was limited to looking for evidence of mould growth and water damage (staining, material deterioration, efflorescence, etc.) on the surface of building materials, which may be an indicator of hidden mould growth. No moisture content readings of building materials were taken to determine their current condition. Additionally, destructive testing to confirm the presence/absence of hidden mould growth and material sampling to verify the presence/absence of mould on suspect surfaces was beyond the scope of this assessment.

Pest Infestation

The presence and extent of pest infestation within the area(s) assessed was based on visually inspecting for evidence of significant pest activity, including signs of nesting, droppings/fecal accumulation, dead insects/carcass accumulation, etc. Evidence of minor pest presence was not considered to be indicative of pest infestation.

2.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

The presence of PCB-containing electrical equipment within the area(s) assessed was identified through visual inspection and knowledge of the timeline of historical use.

For stand-alone transformers and capacitors, information from the manufacturer nameplate (such as the date of manufacture, dielectric fluid trade name or "Type Number", etc.) was gathered, where possible, to further evaluate if the equipment may contain PCBs. This information was then compared to the information provided in the Environment Canada document entitled "*Handbook on PCB's in Electrical Equipment*" (Third Edition, April 1988) to aid in identification. Transformers and capacitors confirmed to be manufactured after 1979 were assumed to not contain PCBs. If appropriate information could not be obtained it was assumed that the transformer or capacitor contained PCBs.

For fluorescent light ballasts, a representative number of fixtures were inspected, if possible, for assessment areas that were constructed prior to 1980 and where there was no history or evidence of a complete lighting retrofit. The light fixtures were examined by removing any lenses and ballast covers to expose the ballast and identify information such as ballast make, model number, serial number, and date code. This information was then compared to the information provided in the Environment Canada document entitled *"Identification of Lamp Ballasts Containing PCBs" (Report EPS 2/CC/2 (revised) August 1991)* to aid in identification. Ballasts that could not be confirmed Non-PCB-containing

were assumed to contain PCBs. The light fixtures were not de-energized and ballasts were not removed to obtain manufacturer information that may be on the back of the ballast. If visual confirmation of ballast type could not be made it was assumed that light fixtures in areas constructed prior to 1980 that have not undergone a complete lighting retrofit have PCB-containing ballasts until proven otherwise.

No sampling of materials or fluids within equipment was conducted to verify the presence/absence of PCBs. Inspection and testing of other materials for PCB content, including (but not limited to) caulking, asphalt, oil-based paint, plastics, switches, electric cables and hydraulic fluids was beyond the scope of our assessment.

Ozone Depleting and Global Warming Substances

The presence of fixed equipment likely to contain ozone-depleting substances (ODS) and/or global-warming substances (GWS) was identified through visual inspection and knowledge of the timeline of historical use. This included equipment such as chillers, air-conditioners, walk-in refrigeration and freezer units and fixed dry-chemical fire extinguishers, where chemicals such as hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) or halons may be present. Where possible, information regarding the type and quantity of refrigerant present was obtained from the manufacturer nameplate. Our visual assessment was limited to fixed equipment within the area(s) assessed and did not include portable equipment such as stand-alone refrigerators, freezers, water coolers, air-conditioners and fire extinguishers, etc.

3.0 RESULTS

Results of our visual assessment and bulk sample analytical findings are summarized in the sections below. Photographs of conditions observed are referenced in the appropriate section where applicable (as **P#**) and are included in Appendix D.

3.1 Designated Substances

3.1.1 Asbestos

Results of bulk sample analysis for the determination of asbestos content are summarized in Table 1. Materials have been classified as “ACM”, “Non-ACM”, “Suspected ACM” or “Presumed Non-ACM” based on analytical results. Materials classified as Suspected ACM or Presumed Non-ACM may require further analysis (depending on site-specific conditions) to verify whether the material should be classified as ACM or Non-ACM. Please refer to the Limitations section of this report (Section 5.0) for additional details. The Laboratory Certificate of Analysis is included in Appendix B.

Table 1
Bulk Sample Analytical Results for Determination of Asbestos Content
Standby Generator Upgrade Project
R.C. Harris Water Treatment Plant – 2701 Queen Street East, Toronto, Ontario
Sample Collection Date: July 6, 2018

Sample No.	Material Description	Sample Location	Asbestos Content	Material Classification
1a	Brick Mortar	Filter Gallery	None Detected	Non-ACM
1b				
1c				
2a	Tile Grout	Screen Room	None Detected	Non-ACM
2b				
2c				

As per O.Reg. 278/05, ACM contains ≥0.5% asbestos by dry weight.

Materials assessed for asbestos content are summarized in Table 2 based on the type/use of the material. The condition and friability of materials confirmed or suspected to be asbestos-containing (based on our visual assessment, results of bulk sample analysis or from a review of previous analytical results) is provided. Condition (Cond.) ratings are provided as Good (G), Fair (F) or Poor (P) based on our Assessment Criteria provided in Appendix A. Estimates of quantity have only been provided for confirmed or suspected asbestos-containing materials that were deemed to have a potential to be disturbed as part of the Standby Generator Upgrade Project. Any quantities provided should be considered rough estimates only and should not be relied upon for bidding purposes. It is the responsibility of the selected Contractor to obtain actual quantities.

Table 2
Results of Assessment for Asbestos-Containing Materials
Standby Generator Upgrade Project
R.C. Harris Water Treatment Plant – 2701 Queen Street East, Toronto, Ontario

Sprayed and Loose Fill Insulating Materials	Location/Description	Cond.	Est. Quantity	Friability
Sprayed Fireproofing	None identified in area(s) assessed.	N/A	N/A	N/A
Sprayed Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Loose Fill / Vermiculite Insulation	None identified in area(s) assessed. Interior portions of concrete block walls could not be assessed. However, it is not expected that these walls are insulated with loose fill or vermiculite insulation	N/A	N/A	N/A

Thermal System Insulation	Location/Description	Cond.	Est. Quantity	Friability
Mechanical Pipe Insulation – Straights	None identified in area(s) assessed.	N/A	N/A	N/A
Mechanical Pipe Insulation – Fittings (elbows, valves, tees, hangars, etc.)	None identified in area(s) assessed.	N/A	N/A	N/A
HVAC Duct Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Breeching / Exhaust Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Tank Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Boiler Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Other Mechanical Equipment Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Architectural Finishes & Finishing Materials	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Sprayed Texture / Stucco Finishes	None identified in area(s) assessed.	N/A	N/A	N/A
Plaster Finishes	None identified in area(s) assessed.	N/A	N/A	N/A
Drywall Joint Compound	None identified in area(s) assessed.	N/A	N/A	N/A
Ceiling Tiles	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Lay-in Acoustic Ceiling Tiles	None identified in area(s) assessed.	N/A	N/A	N/A
Glued-on Acoustic Ceiling Tiles	None identified in area(s) assessed.	N/A	N/A	N/A
Transite Ceiling Panels	None identified in area(s) assessed.	N/A	N/A	N/A
Flooring	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Vinyl Floor Tiles	None identified in area(s) assessed.	N/A	N/A	N/A

Vinyl Sheet Flooring	None identified in area(s) assessed.	N/A	N/A	N/A
Asbestos Cement Products	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Piping	None identified in area(s) assessed.	N/A	N/A	N/A
Roofing, Siding, Wallboard	None identified in area(s) assessed.	N/A	N/A	N/A
Other Cement Products	Filter Gallery: Brick mortar was identified. Bulk sample analysis confirmed that the material does not contain asbestos (refer to sample set 1 in Table 1).	N/A	N/A	N/A
	Screen Room: Tile grout was identified. Bulk sample analysis confirmed that the material does not contain asbestos (refer to sample set 2 in Table 1).	N/A	N/A	N/A
Misc. Materials	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Mastics	None identified in area(s) assessed.	N/A	N/A	N/A
Firestop	None identified in area(s) assessed.	N/A	N/A	N/A
Refractory Materials	None identified in area(s) assessed.	N/A	N/A	N/A
Caulking	None identified in area(s) assessed.	N/A	N/A	N/A
Heat Shields	None identified in area(s) assessed.	N/A	N/A	N/A
Other Materials	Other materials observed within the investigated area(s) that are suspected or previously confirmed to be asbestos-containing but are not likely to be disturbed as part of the project includes interior and exterior caulking, pipe insulation, red floor coating, vinyl floor tile, light heat shields and hard textile breaker switch gear within electrical components. Since the above materials are not likely to be disturbed as part of the project bulk sampling was not conducted to verify asbestos content. However, based on the age of the materials they should be assumed to be asbestos-containing until proven otherwise.	**N/D**	**N/D**	**N/D**

Notes: N/A=Not Applicable; N/D=Not Determined

3.1.2 Lead

Laboratory analytical results for paints tested to determine lead content are summarized in Table 3. The Laboratory Certificate of Analysis is included in Appendix C. Refer to Section 4.1.2 of this report for recommended lead abatement procedures (if any) that correspond to the type of proposed construction, renovation, or demolition work.

Table 3
Results of Paint Condition and Lead Content Assessment
Standby Generator Upgrade Project
R.C. Harris Water Treatment Plant – 2701 Queen Street East, Toronto, Ontario
Sample Collection Date: July 6, 2018

Sample No.	Location	Surface	Paint Colour	Condition	Lead Conc. (% by wt.)	Material Classification
L-01	Watering Room	Concrete	White	Fair	0.068	LLLP

LCM: Lead-Containing Material (≥0.1% Lead Content); LLLP: Low Level Lead Paint (<0.1% Lead Content)

Additional suspect lead-containing materials visually identified within the investigated areas that may require disturbance as part of the Standby Generator Upgrade Project included the following:

- Possible lead-containing batteries in the form of emergency lighting.
- Paint finishes on concrete block walls and metal deck.
- A component of solder in pipe fittings and electrical equipment.

3.1.3 Mercury

Mercury is present within the area(s) assessed in the form of vapour within fluorescent lamps and High Intensity Discharge (HID) lamps.

Sealed liquid mercury is suspected within various gauges and thermometers associated with the other mechanical equipment.

3.1.4 Silica

A number of building materials were identified within the surveyed area(s) that are suspected to contain crystalline silica. This includes the following materials:

- Concrete;
- Concrete block and associated mortar;

3.1.5 Other Designated Substances

Acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride were not included in our assessment as these substances are not expected to be a significant component of building materials or present in a form that would represent an exposure concern. Additionally, no specific information regarding their use was provided to us.

3.2 Other Hazardous Materials

3.2.1 Chemical Hazards

No visible evidence of UFFI installation (i.e. injection openings) or overspray of foam insulation at wall/ceiling joints was identified. In addition, due to the age of construction and use of the building the presence of UFFI insulation within wall cavities is not suspected.

3.2.2 Biological Hazards

Mould Contamination

There was no visible evidence of obvious mould growth on building finishes within the surveyed area(s) at the time of our assessment. In addition, there was no visible evidence of any significant water staining or discolouration to building finishes within the surveyed area(s) that would suggest the potential for hidden mould growth behind these finishes.

Pest Infestation

There was no visible evidence of any significant pest infestation within the surveyed area(s). Only minor evidence of rodent droppings were observed above lay-in 2'x4' ceiling tiles, which are not considered to be significant enough to result in any exposure issue for renovation/demolition workers.

3.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

As per the previous THEM assessment report, PCB's may be present within fluorescent light fixtures and electrical equipment which was not accessible for inspection.

Fluorescent light ballasts designated for removal should have serial numbers and date stamps accessed to determine if ballasts are PCB containing. For all Canadian General Electric ballasts ending in T the ballast capacitor may contain PCB's. The date code stamped on the back of the ballast housing or on the name plate may help to more accurately determine whether the ballast contains PCBs. Ballasts manufactured before March 1978 could potentially contain PCB capacitors.

On November 11th, 2015, Safetech Environmental Limited (SEL) collected a bulk sample of the interior membrane liner (Black in colour) suspected to contain polychlorinated biphenyls (PCBs), from within Spool Pipe north of Pipe VO303C within the Basement of the High Lift Pumping Station. The sample was determined not to contain PCBs.

On January 20th, 2016, SEL collected bulk samples of interior Joint Fillers suspected to contain polychlorinated biphenyls (PCBs), from within a designated Settlement Basin. The samples were determined not to contain PCBs.

No bulk sampling of suspected PCB-containing materials was performed during this assessment.

Ozone Depleting and Global Warming Substances

No fixed equipment suspected to contain ODS/GWS were observed in the area(s) assessed.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Designated Substances

4.1.1 Asbestos

Results of our assessment indicated that no asbestos-containing materials are present within the specified project areas of the Filter Gallery and Screen Room that is likely to be disturbed as part of the Standby Generator Upgrade Project.

Removal or disturbance of identified asbestos-containing materials must be conducted in accordance with Ontario Regulation 278/05 (O.Reg. 278/05) Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations as made under the Occupational Health and Safety Act. Asbestos containing materials in Poor condition must be removed and/or repaired immediately following applicable asbestos abatement procedures. Asbestos-containing materials in Good condition can remain in place until major system upgrading, maintenance or demolition which could result in disturbance of this material.

No ACM

As results summarized in Table I indicate, no asbestos was detected in any of the bulk samples of brick mortar or tile grout retrieved for analysis. Therefore, the above materials are considered to be Non-ACM and there are no requirements for management, disturbance or removal of this material under O.Reg. 278/05.

Assumed Asbestos-Containing Materials

Other materials observed within the investigated area(s) that are suspected or previously confirmed to be asbestos-containing but are not likely to be disturbed as part of the project includes interior and exterior caulking, pipe insulation, red floor coating, vinyl floor tile, light heat shields and hard textile breaker switch gear within electrical components. Since

the above materials are not likely to be disturbed as part of the project bulk sampling was not conducted to verify asbestos content. However, based on the age of the materials they should be assumed to be asbestos-containing until proven otherwise.

General Recommendations

The removal or disturbance of ACM must follow the measures and procedures indicated in O.Reg. 278/05. This work should be conducted by workers who have received proper training by a "competent person" in the hazards of asbestos exposure, personal hygiene and work practices, and the use and care of respirators and protective clothing. Any worker/supervisor who works in a Type 3 operation must successfully complete the Asbestos Abatement Worker or Supervisor Training Program approved by the Ministry of Training, Colleges and Universities.

It is recommended that all work involving the removal or disturbance of ACM be subject to inspection and testing to document conformance with O.Reg. 278/05 requirements. The degree of inspection and testing is dependent on site-specific conditions such as the type, duration, size and location of the work. In most circumstances Type 3 operations require a visual inspection and clearance air testing to be conducted by a competent worker on completion of the work. The inspection should be conducted to ensure that the enclosure and the work area inside the enclosure are free from visible dust, debris or residue that may contain asbestos. Clearance air testing for Type 3 operations requires a minimum number of air samples to be taken (depending on the size of the work area) following specific sampling and analytical procedures and all samples taken must meet the clearance criteria set out in O.Reg. 278/05.

4.1.2 Lead

Paints and surface coatings not sampled are assumed to be lead-containing (>0.1% lead content). Any disturbance of the lead-containing paints or surface coatings should be conducted in accordance the procedures outlined in the Environmental Abatement Council of Ontario (EACO) "Lead Guideline" (October 2014) and/or the Ministry of Labour (MOL) "Lead on Construction Projects" guideline (April 2011). The extent of procedures (or Type of operation) necessary depends on the type of work to be conducted.

Result of paint chip analysis for the determination of lead content indicated that white paint associated with concrete walls is considered a 'low-level lead paint' (<0.1% based on requirements of the Environmental Abatement Council of Ontario (EACO) Lead Guideline (2014)). If the 'low-level lead paints' are disturbed in a non-aggressive manner (no use of power tools/abrasive blasting, grinding, welding, heating, etc.), then respirators are not considered necessary. However, Type 1 measures and procedures should still be implemented during the non-aggressive disturbance of 'low-level lead paints', including, but not limited to, no smoking, eating, drinking and chewing gum in the work area, dust suppression methods must be implemented, and facilities must be made available to that workers can wash their hands and face.

At this time the method of disturbance, if any, of lead-containing paints is unknown. It is recommended that any contractor whose work requires lead-containing paints to be disturbed consult the EACO or MOL guidelines prior to the start of work to determine the Class/Type of operation(s) and the corresponding control measures (engineering controls, work/hygiene practices, protective clothing and equipment and worker training) necessary to conduct the work in a manner that will prevent worker overexposure to lead. The following table outlines the classification of lead disturbance based on the EACO guideline.

Operation	Description
Class 1	1. Removal of lead-containing or lead-based paints and surface coatings with a chemical gel/stripper or paste; 2. Application of lead-containing or lead-based paints and surface coatings with a brush, roller or sponge. 3. Installation or removal of lead sheeting or flashing. 4. Installation or removal of lead-containing packing, babbitt, caulking, gasket or similar material. 5. Removal of materials coated with lead-containing or lead-based paints and surface coatings, using non-powered hand tools, where the material remains chiefly intact and is not crumbled, pulverized or powdered. 6. Operating construction or demolition equipment (e.g. excavator, bulldozer) during building renovation or demolition where lead-based paints or surface coatings are present on building materials and are being disturbed. 7. Soldering with lead solder. 8. Removing lead-containing or lead-based paints or surface coatings with a heat gun. 9. Removing lead-containing and lead-based paints and surface coatings using a high-pressure water jet (e.g. pressure washer).
Class 2a	1. Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool that has an effective dust collection system equipped with a HEPA filter. 2. Welding, torching or high temperature cutting of lead-containing materials indoors when using an effective fume collector or smoke eater that filters and exhausts lead fume and expels it directly outdoors (away from occupants, entrances, walkways, rest areas, etc.). Fume collector or smoke eater must have effective source control and capture velocity, minimum of 0.5 metres per second (100 feet per minute) at the work surface. 3. Welding, torching or high temperature cutting of lead-containing and lead-based paints and surface coatings or lead-containing materials outdoors. 4. Removal of lead-containing mortar using handheld non-powered tools. 5. Removal of lead-containing and lead-based paints and surface coatings or lead-containing materials by scraping or sanding (including wet sanding) using non-powered hand tools. 6. Demolition of plaster or building components that crumble, pulverize or powder and are covered with lead-containing or lead-based paints or surface coatings. 7. Clean up and removal of a significant amount of lead-containing dust and debris (that can be made easily airborne) using wet methods or HEPA vacuums.
Class 2b	1. Spray application of lead-containing paints and surface coatings

Operation	Description
Class 3a	1. Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool without an effective dust collection system equipped with a HEPA filter. 2. Welding, torching or high temperature cutting of lead-containing materials indoors or in a confined space (e.g. within a ditch or pit). 3. Removal of lead-containing mortar using a powered cutting device. 4. Burning of a material containing lead. 5. Removal, cleaning or repair of a ventilation system or ductwork used for controlling lead exposure. 6. Spray application of lead-based paints and surface coatings. 7. In the absence of an exposure assessment: a. demolition or cleanup of a facility where lead-containing products were manufactured and significant dust and debris, which can be made easily airborne, is present. b. cleanup of dust and debris down range of a firing station in an indoor firing range.an operation that may expose a worker to lead dust, fume or mist that is not a Class 1, Class 2, or Class 3B operation.
Class 3b	1. Abrasive blasting of lead-containing and lead-based paints and surface coatings or lead-containing materials (including wet, slurry and dry abrasive blasting and dry-ice blasting).

Emergency lighting present on perimeter walls within the project areas and general work area were observed. It is suspected that these emergency lights contain lead-acid batteries. If emergency lighting is removed/replaced as part of the scheduled work activities the batteries are recommended to be sent to a recycling facility for proper treatment.

Additional suspect lead-containing products not anticipated to be disturbed as part of the Standby Generator Upgrade Project include paints on various surfaces and solder on pipe fittings and electrical components. Future testing of these materials and specific handling/disposal requirements may be necessary if/when these materials are to be disturbed.

If practicable, all bulk lead waste materials should be separated from other wastes and sent to a recycling facility. If not practicable, lead-containing waste should be handled and disposed of according to Ontario Regulation 347 (O.Reg. 347), *"General – Waste Management"*, made under the Environmental Protection Act. Under this regulation (and depending on the quantity of waste generated) the waste may be subject to analysis following the Toxicity Characteristic Leaching Procedure (TCLP) to determine if it is a "leachate toxic waste" based on the leachate quality criteria provided in Schedule 4 of the regulation. Such wastes must meet specific treatment requirements (Schedule 5) or undergo alternative treatment for hazardous debris (Schedule 8) prior to land disposal.

4.1.3 Mercury

Fluorescent and HID lamps that require removal should be handled with care and kept intact to avoid potential exposure to mercury vapour present within the lamps. Under O.Reg. 347, waste mercury produced in amounts less than 5 kilograms (kg) in any month or otherwise accumulated in an amount less than 5 kg are exempt from hazardous waste registration, treatment and disposal requirements and can be disposed of in landfill as regular waste. Larger quantities of waste mercury must be treated and disposed of in accordance with the requirements of O.Reg. 347. Although it is anticipated that less than 5 kg of waste lamps will be produced as part of the Standby Generator Upgrade Project, to prevent the release of mercury into the environment it is recommended that all waste lamps are sent to a lamp recycling facility and are not disposed of in landfill.

Liquid mercury is suspected to be present in thermometers, barometers and other measuring devices (pressure gauges/sensors, vacuum gauges, manometers, etc.), thermostats and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.) associated with mechanical equipment. These items are expected to be removed as part of the Standby Generator Upgrade Project. Care should be taken not to disturb these items during the work as breakage could cause a spill of liquid mercury. If any of these items are to be removed it should be done so carefully to avoid spillage and stored/packaged in a manner that will prevent breakage or spillage. Any mercury-containing equipment that is to be removed is recommended to be recycled rather than disposed of in landfill.

Although no mercury was visibly identified in other equipment, dismantling of equipment was not conducted to verify the presence/absence of mercury. It is cautioned that thermometers, barometers and other measuring devices (pressure gauges/sensors, vacuum gauges, manometers, etc.), thermostats and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.) may contain mercury that may not be visible without dismantling the equipment. Such devices should be assumed to contain mercury until proven otherwise and similar precautions to those outlined above should be taken if any of these items are to be disturbed or taken out of service in the future.

4.1.4 Silica

Suspect silica-containing materials were identified to be present within the project-specific work area. In their current state, building materials containing silica do not represent a risk to building occupants or construction workers. Risks associated with exposure to silica arise during demolition activities that cause silica dust to be created (particularly grinding, drilling or cutting operations and during major demolition), resulting in a crystalline silica inhalation hazard.

If any materials suspected to contain silica are to be removed or otherwise disturbed as a result of renovation/demolition activities it is recommended that procedures be put in place to control the generation of dust (such as routine water misting) and thus reduce the potential for worker exposure. Workers that have the potential to be exposed to airborne silica should also wear appropriate protective clothing and respiratory protection.

Any work involving the disturbance of silica-containing materials should follow the procedures outlined in the MOL *"Silica on Construction Projects"* guideline (April 2011). The appropriate engineering controls, work practices, hygiene practices, personal protective measures and training necessary to conduct the work in a safe manner are provided in this guideline. The general measures and procedures (or Type of operation) necessary depends on the type of work to be conducted. The following table outlines the classification of silica disturbance based on the MOL guideline.

Operation	Description
Type 1	1. The drilling of holes in concrete or rock that is not part of a tunneling operation or road construction. 2. Milling of asphalt from concrete highway pavement 3. Charging mixers and hoppers with silica sand (sand consisting of at least 95% silica) or silica flour (finely ground sand consisting of at least 95% silica) 4. Any other operation at a project that requires the handling of silica-containing material in a way that may results in a worker being exposed to airborne silica. 5. Entry into a dry mortar removal or abrasive blasting area while airborne dust is visible for less than 15 minutes for inspection and/or sampling. 6. Working within 25 metres of an area where compressed air is being used to remove silica-containing dust outdoors.
Type 2	1. Removal of silica containing refractory materials with a jackhammer 2. The drilling of holes in concrete or rock that is part of a tunneling or road construction. 3. The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo or refractory materials. 4. The use of a power tool to remove silica containing materials. 5. Tunneling (operation of the tunnel boring machine, tunnel drilling, and tunnel mesh installation). 6. Tuckpoint and surface grinding 7. Dry mortar removal with an electric or pneumatic cutting device 8. Dry method dust cleanup from abrasive blasting operations 9. The use of compress air outdoors for removing silica dust 10. Entry into area where abrasive blasting is being carried out for more than 15 minutes
Type 3	1. Abrasive blasting with an abrasive that contains >1% silica 2. Abrasive blasting or a material that contains >1% silica

4.1.5 Other Designated Substances

No other designated substances are expected to be a component of building materials within the surveyed area(s) in a form that would represent an exposure concern. Therefore, no protective measures or procedures specific to acrylonitrile, arsenic,

benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride are considered necessary.

4.2 Other Hazardous Materials

4.2.1 Chemical Hazards

As no UFFI was identified or is suspected to be present within the surveyed area(s) no further action is required. However, given that no destructive testing was conducted, there is a remote possibility that UFFI could be hidden within locations such as exterior wall cavities. If suspect foam insulation is identified during renovation/demolition activities work should be stopped and the area should be re-assessed to evaluate conditions and determine appropriate control measures and worker protection, if necessary.

4.2.2 Biological Hazards

Mould Contamination

No mould contamination was identified in the surveyed area(s) and therefore no further action is required at this time. Although no obvious mould contamination or evidence to suggest possible hidden mould contamination was visibly identified within the surveyed area(s) there is still a potential for hidden mould growth to exist behind or underneath building finishes. Should suspect mould growth be discovered during the course of renovation or demolition work it is recommended that all work stop so that the area can be assessed to evaluate proper control measures and remediation protocols in order to avoid worker exposure to mould and possible contamination of adjacent areas.

Pest Infestation

No visual evidence of any significant pest infestation was observed within the area(s) assessed. Therefore, no additional precautionary measures are deemed necessary for protection against biological contaminants potentially associated with pest infestation.

4.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

As per the previous THEM assessment report, PCB's may be present within fluorescent light fixtures and electrical equipment which was not accessible for inspection.

Should fluorescent light ballasts to be removed, we recommend that suspect PCB-containing ballasts should be checked for model number, serial number, and date code and cross referenced with the *Environment of Canada Identification of Lamp Ballasts Containing PCB's - Report EPS 2/CC/2 (revised) August 1991*.

For all Canadian General Electric ballast code ending in T the ballast capacitor may contain PCB's. The date code stamped on the back of the ballast housing or on the name plate may help to more accurately determine whether the ballast contains PCBs. PCBs manufactured before March 1978 could contain PCB capacitors.

At the time of removal or replacement of transformers, capacitors and/or fluorescent light ballasts, the units should be inspected for PCB content.

All PCB waste must follow requirements of Ontario Regulation 362 Waste Management PCB's, amended to 33/07.

Ozone Depleting and Global Warming Substances

No fixed equipment suspected to contain ODS/GWS were observed in the area(s) assessed.

5.0 LIMITATIONS

The information and recommendations detailed in this report were carried out by trained professional and technical staff in accordance with generally accepted environmental and industrial hygiene work practices and procedures. Recommendations provided in this report have been generated in accordance with accepted industry guidelines and practices. These guidelines and practices are considered acceptable as of the date of this report.

In preparation of this report, Safetech Environmental Limited (SEL) relied on information supplied by others, including without limitation, information pertaining to the history and operation of the site, test results and reports of other consultants and testing services provided by independent laboratories. Except as expressly set out in this report, SEL has not made any independent verification of information provided by independent entities.

The collection of samples at the location noted was consistent with the scope of work agreed-upon with the person or entity to whom this report is addressed and the information obtained concerning prior site investigations. As conditions between samples may vary, the potential remains for the presence of unknown additional contaminants for which there were no known indicators.

The analytical method used for determination of asbestos content meets the requirements of O.Reg. 278/05. However, small asbestos fibres may be missed by PLM due to resolution limitations of the optical microscope. Interfering binder/matrix and/or low asbestos content may also hinder positive identification by PLM. These conditions are common for vermiculite attic insulation (VAI) and non-friable organically bound (NOB) materials such as vinyl floor tiles, roofing materials, mastics and caulking and can lead to "false negative" results. If PLM analytical results for these types of materials indicate no

asbestos detected they have been reported as “Presumed Non-ACM”. Due to limitations of the analytical method we cannot confirm that low quantities of asbestos are not present in these samples using solely PLM analysis. Additional analytical procedures should be considered for such materials to rule out false negative results.

Conclusions are based on site conditions at the time of inspection and can only be extrapolated to an undefined limited area around inspected locations. The extent of the limited area depends on building construction and conditions. Building materials that are not detailed within this survey due to inaccessibility during the time of survey and/or are uncovered during renovation/demolition activities should be properly assessed by a qualified person prior to their disturbance. SEL cannot warrant against undiscovered environmental liabilities. If any information becomes available that differs from the findings in this report, we request that we be notified immediately to reassess the conclusions provided herein.

No other person or entity is entitled to use or rely upon this report without the express written consent of Safetech Environmental Limited and the person or entity to who it is addressed. Any use that a third party makes of this report, or any reliance based on conclusions and recommendations made, are the responsibility of such third parties. SEL accepts no responsibility for damages suffered by third parties as a result of actions based on this report.

Appendix A

Condition Assessment Criteria for Asbestos-Containing Materials

The condition of asbestos-containing materials identified within the surveyed area(s) was assessed as Good (G), Fair (F) or Poor (P). The assessment criteria used to determine condition is dependent on material characteristics, such as friability. The following Table summarizes the criteria used by SEL to evaluate the condition of ACM.

Condition Assessment Criteria for Asbestos-Containing Materials

Sprayed Fireproofing, Sprayed Insulation and Sprayed Texture Finishes	
Good	• Surface shows no significant signs of damage, deterioration, or delamination (i.e. <1%). • Unencapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed. • Encapsulated fireproofing or texture finishes where encapsulation applied after damage or fallout.
Fair	• Not utilized as part of condition assessment for these materials.
Poor	• Greater than 1% damage, delamination, or deterioration to surface.
In areas where damage exists in isolated locations, both Good and Poor may be applicable.	
Mechanical Insulation (boilers, breeching, ductwork, piping, tanks, equipment, etc.)	
Good	• Insulation completely covered in jacketing and exhibits no evidence of damage or deterioration. • Jacketing may have minor damage (i.e. scuffs or stains), but is not penetrated.
Fair	• Minor penetrating damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination). • Undamaged insulation that had never been jacketed. • Insulation is exposed but not showing surface disintegration. • Extent of missing insulation ranges from minor to none. • Damage that can be repaired.
Poor	• Original insulation jacket is missing, damaged, deteriorated, or delaminated. • Insulation is exposed and significant areas have been dislodged. • Damage that cannot be easily repaired.
Non-Friable and Potentially Friable Materials (includes materials such as plaster finishes, drywall compound, ceiling tiles, asbestos cement products, vinyl asbestos tile and asbestos paper backed vinyl sheet flooring, etc., which have the potential to become friable when handled)	
Good	• No significant damage. • Material may be cracked or broken but is stable and not likely to become friable upon casual contact. • No friable debris present
Fair	• Not utilized as part of condition assessment for these materials.
Poor	• Material is severely damaged. • Debris is present or binder has disintegrated to the point where the material has become friable.
Asbestos-Containing Debris (noted separately from the presumed source material)	
Poor	• Debris is always considered to be in Poor condition.

Appendix B

Laboratory Certificate of Analysis - Asbestos

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order 551807961
Customer ID: 55SELI62
Customer PO: 169018
Project ID:

Attn: James Macklin
Safetech Environmental
3045 Southcreek Road
Unit 14
Mississauga, ON L4X 2X7

Proj: 169018 - RC Harris

Phone: (905) 624-2722
Fax: (905) 624-4306
Collected:
Received: 7/06/2018
Analyzed: 7/09/2018

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Client Sample ID: 1a ***Lab Sample ID:*** **551807961-0001**
Sample Description: Filter Gallery / Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	7/09/2018	Gray	0%	100%	None Detected	

Client Sample ID: 1b ***Lab Sample ID:*** **551807961-0002**
Sample Description: Filter Gallery / Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	7/09/2018	Gray	0%	100%	None Detected	

Client Sample ID: 1c ***Lab Sample ID:*** **551807961-0003**
Sample Description: Filter Gallery / Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	7/09/2018	Gray	0%	100%	None Detected	

Client Sample ID: 2a ***Lab Sample ID:*** **551807961-0004**
Sample Description: Screen Room / Tile Grout

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	7/09/2018	Gray	0%	100%	None Detected	

Client Sample ID: 2b ***Lab Sample ID:*** **551807961-0005**
Sample Description: Screen Room / Tile Grout

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	7/09/2018	Gray	0%	100%	None Detected	

Client Sample ID: 2c ***Lab Sample ID:*** **551807961-0006**
Sample Description: Screen Room / Tile Grout

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	7/09/2018	Gray	0%	100%	None Detected	

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

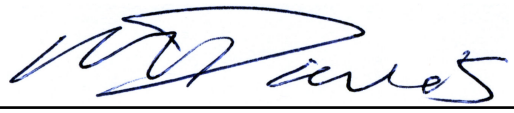
EMSL Canada Order 551807961
Customer ID: 55SELI62
Customer PO: 169018
Project ID:

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Analyst(s):

Anne Balayboa PLM (2)
Michelle Lung PLM (4)

Reviewed and approved by:



Matthew Davis or other approved signatory
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 07/09/201814:07:00

Appendix C
Laboratory Certificate of Analysis - Lead

EMSL Canada Inc.
2756 Slough Street, Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

EMSL Canada Or	551807950
CustomerID:	55SELI62
CustomerPO:	169018
ProjectID:	

Attn: **James Macklin**
Safetech Environmental
3045 Southcreek Road
Unit 14
Mississauga, ON L4X 2X7

Phone:	(905) 624-2722
Fax:	(905) 624-4306
Received:	07/06/18 4:00 PM
Collected:	

Project: **169018 -RC HARRIS**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client SampleDescription	*Collected*	*Analyzed*	*Weight*	*RDL*	*Lead Concentration*
L-01		7/7/2018	0.2410 g	0.0083 % wt	0.068 % wt
551807950-0001	Site: DE-WATERING ROOM - WHITE PAINT - CONCRETE				

Rowena Fanto, Lead Supervisor
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/10/2018 11:52:54

Appendix D
Site Photographs

P1 – Watering Room

Typical view of white paint on concrete that was found to contain 0.068% lead, which is considered as a low level lead paint (refer to sample L-01 in Table 3).

Appendix E

Background Information on Designated Substances and Other Hazardous Materials

DESIGNATED SUBSTANCES

The Occupational Health and Safety Act of Ontario (OHSA) allows for certain toxic substances to be especially designated. The OHSA defines a designated substance as "a biological, chemical or physical agent or combination thereof prescribed as a designated substance to which the exposure of a worker is prohibited, regulated, restricted, limited or controlled." Ontario Regulation 490/09 - Designated Substances (O.Reg. 490/09), made under the Occupational Health and Safety Act outlines required steps to control exposure of workers to designated substances. Under O.Reg. 490/09 there are eleven (11) designated substances; acrylonitrile, arsenic, asbestos, benzene, coke oven emissions, ethylene oxide, isocyanates, lead, mercury, silica and vinyl chloride. This regulation applies to every employer and worker at a workplace where the designated substances are present, produced, processed, used, handled or stored and at which a worker is likely to be exposed to the designated substance.

Section 14 of O.Reg. 490/09 exempts an employer and the workers of an employer who engage in construction from the requirements of the regulation. However, designated substances are still required to be identified prior to the beginning of a demolition or renovation project to ensure that construction workers (and potentially building occupants) are adequately protected from the hazards posed by the presence of these materials if the planned work may cause them to be disturbed. Accordingly, under Section 30 of the OHSA building owners are required to perform an assessment to determine whether any designated substances are present at the project site before the beginning of the project. The owner is also required to prepare a list of designated substances that are present at the site and provide this list to prospective constructors before entering into a binding contract with the constructor. This way, contractors and construction workers are made aware of designated substances present within the work area so that appropriate measures can be taken during the work to limit exposure to these substances.

Designated Substances and Hazardous Materials Assessments are conducted to conform to the requirements of Section 30 of the OHSA. The assessments are performed to identify designated substances (and other hazardous materials) within the work area that may present a hazard to workers if disturbed. These substances are commonly a component of building materials or equipment found in buildings. Additional information regarding the eleven designated substances including their properties, uses and health effects are provided below.

Acrylonitrile

Acrylonitrile (ACN) is a clear, colourless or pale yellow liquid with a pungent onion- or garlic-like, irritating odour. It is highly flammable and as such is a severe fire and explosion hazard.

Acrylonitrile is used mainly as a monomer or comonomer in the production of acrylic fibres, plastics, resins and nitrile rubbers. Historically, a mixture of acrylonitrile and carbon tetrachloride was used as a pesticide; however, all pesticide uses have stopped. Based on its use as a chemical intermediate, exposure to acrylonitrile is primarily occupational, via inhalation during its manufacture and use. Therefore, this designated substance is not expected to be encountered in buildings where it is not either produced or used in a manufacturing process.

Acute (short-term) exposure of workers to acrylonitrile has been observed to cause mucous membrane irritation, headaches, dizziness, and nausea. More significant exposures may lead to symptoms such as limb weakness, labored and irregular breathing, impaired judgment, cyanosis, collapse, and convulsions. Exposure of the skin to high concentrations of acrylonitrile in the air may irritate the skin and cause it to turn red while direct skin contact with acrylonitrile may cause the skin to blister and peel. The International Agency for Research on Cancer (IARC) concluded that there is inadequate evidence in humans for the carcinogenicity of acrylonitrile, but has classified it as possibly carcinogenic to humans (Group 2B).

Arsenic

Arsenic is a naturally occurring mineral, widely distributed in the earth's crust. Elemental arsenic (sometimes referred to as metallic arsenic) is a silver-gray or white brittle metal. However, arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic has no odor and is almost tasteless.

Arsenic and its compounds have a variety of commercial uses. Inorganic arsenic compounds are mainly used as a wood preservative. Copper chromated arsenic (CCA) is used to make "pressure-treated" lumber. CCA-treated wood is no longer used for residential applications but may still be used in industrial applications. Arsenic is also used in metallurgy for hardening copper, lead and certain metal alloys, in pigment production, in the manufacture of certain types of glass, and in semiconductors and light-emitting diodes. Inorganic arsenic compounds are no longer used as pesticides in agriculture; however, organic arsenic compounds, namely cacodylic acid, disodium methylarsenate (DSMA), and monosodium methylarsenate (MSMA), are used, as yet, as pesticides – principally on cotton.

Today, workplace exposure to arsenic may still occur in some occupations that use arsenic, such as copper or lead smelting, wood treating, or pesticide application. Exposure to arsenic within buildings other than where it is used as part of the manufacturing process is unlikely and therefore arsenic is not expected to be encountered as part of a routine hazardous building materials assessment.

Human exposure to arsenic can cause both short and long term health effects. Short-term or acute effects can occur within hours or days of exposure. If you breathe high levels of inorganic arsenic, then you are likely to experience a sore throat and irritated lungs. Longer exposure at lower concentrations can lead to skin effects (such as darkened patches of skin and areas of thickened skin), and also to circulatory and peripheral nervous disorders. An important concern is the ability of inhaled inorganic arsenic to increase the risk of cancer. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. The IARC classifies arsenic and arsenic compounds as "carcinogenic to humans" (Group 1).

Asbestos

Asbestos is the name given to a number of naturally occurring fibrous minerals found in the environment. Ontario Regulation 490/09 (Designated Substances) defines asbestos as any one of the following fibrous silicates: actionlite; amosite; anthophyllite; chrysotile; crocidolite; and tremolite. Asbestos fibres have several desirable characteristics such as high textile strength, the ability to be spun and woven, and resistance to heat and most chemicals. These characteristics have resulted in the historical use of asbestos in a wide variety of building materials and other manufactured goods. Examples of products where asbestos has been used include roofing shingles, ceiling and floor tiles, insulation, sprayed fireproofing, gaskets, and friction products such as automotive brakes and clutches.

The peak years for asbestos use were in the 1960s and early 1970s. Therefore, asbestos is commonly found in building materials of this era. The use of asbestos in building materials and other products has decreased significantly since this time. Friable asbestos-containing materials (material that when dry can be crumbled, pulverized or powdered by hand pressure), such as sprayed fireproofing and sprayed insulation, ceased use circa 1973. Mechanical thermal system insulation ceased use circa 1981 while sprayed acoustic texture coat finishes ceased use circa 1982. Non-friable asbestos-containing materials were generally manufactured for a longer period of time (with the exception of plaster finishes which ceased use circa 1960's). Asbestos-containing drywall joint compound ceased use circa 1980. Vinyl floor tiles, vinyl sheet flooring and acoustic ceiling tile ceased use 1982. Other non-friable materials continued to be produced into the 1990's, including roofing materials (ceased use circa 1991) and floor adhesives (ceased use circa 1992). Today, asbestos is a controlled substance, and is banned for use in most products sold in Canada under the Hazardous Products Act (with the exception of certain roof shingles, clutch facings and brake linings).

Potentially harmful exposure to asbestos occurs through inhalation of air containing asbestos fibres. The greatest risk for workplace exposure to airborne asbestos is in occupations that produce and use asbestos, such as in mining and milling operations or in the manufacture of products containing asbestos. Exposure to airborne asbestos fibres may also occur to construction workers, trades people, maintenance workers and other building occupants in buildings constructed with asbestos-containing materials; especially during building renovations or repairs or if the materials are in poor condition or are otherwise disturbed.

Health risks associated with asbestos exposure are dependent on several factors such as the type and airborne concentration of asbestos, and period of exposure. In general, the greater the exposure to asbestos, the greater the chance of developing harmful health effects. Typically, chronic, daily exposure to elevated airborne concentrations of asbestos over a period of years is required for health effects to eventually manifest themselves. Health effects associated with exposure to asbestos can result in asbestosis (a scarring of the lungs which makes breathing difficult), mesothelioma (a rare cancer of the lining of the chest or abdominal cavity) and lung cancer. The link between exposure to asbestos and other types of cancers and health effects is less clear.

Benzene

Benzene is a clear, colourless liquid with a characteristic, sweet or aromatic hydrocarbon odour. It is a liquid at room temperature but evaporates into the air very quickly, making it a highly flammable vapour as well as an extremely flammable liquid.

Benzene is formed from both natural processes and human activities. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke. It is produced from petroleum and coal sources and is used mainly in the manufacture of other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides.

Exposure to pure benzene within buildings other than where it is produced or used as part of a manufacturing process is unlikely. Therefore benzene is not expected to be encountered as part of a routine hazardous building materials assessment.

Exposure to benzene primarily occurs through inhalation of airborne vapours. Short-term (acute) health effects associated with overexposure to benzene vapours can result in symptoms such as headache, nausea, dizziness, drowsiness and confusion, with unconsciousness or even death at very high levels. Long-term (chronic) exposure to Benzene may cause blood and bone marrow effects which can lead to anemia and leukemia (cancer of the blood-forming organs) as well as cause damage to the immune

system, increasing the chance for infection. The IARC classifies benzene as "carcinogenic to humans" (Group 1).

Coke Oven Emissions

Coke Oven Emissions refers to the benzene soluble fraction of total particulate matter emitted during the destructive distillation or carbonization of coal for the production of coke (pure carbon). These emissions are a mixture of coal tar, coal tar pitch, volatiles (including benzene, toluene and xylene), creosote, polycyclic aromatic hydrocarbons (PAHs – including benzo(a)pyrene, benzanthracene, chrysene and phenanthrene), and metals (including cadmium, arsenic, beryllium and chromium). Condensed coke oven emissions are a brownish, thick liquid or semisolid with a naphthalene-like odor, while uncondensed coke oven emissions are vapors that escape when the ovens are changed and emptied and are a component of fugitive emissions.

The coke produced is used as a component in the manufacturing of iron and steel. Coke is also used to synthesize calcium carbide and to manufacture graphite and electrodes. Additional chemicals recovered from the coke oven emissions (such as benzene, toluene, naphthalene, sulfur, and ammonium sulfate) are used as raw materials for plastics, solvents, dyes, drugs, waterproofing, paints, pipecoating, roads, roofing, insulation, and as pesticides and sealants.

Coke oven emissions would only be present within facilities producing or using coke as part of the manufacturing process and thus occupational exposure is limited to those workers in the aluminum, steel, graphite, electrical, and construction industries. Therefore, coke oven emissions are not a contaminant of concern during a routine hazardous building materials assessment.

Chronic (long-term) exposure to coke oven emissions can result in chronic bronchitis (particularly those who smoke) and additional health effects such as conjunctivitis, severe dermatitis, and lesions of the respiratory system and digestive system. However, the greatest concern regarding chronic exposure to coke oven emissions is the increased risk of cancer. The IARC classifies coke production as "carcinogenic to humans" (Group 1). The site at which excess cancer rates have been identified most commonly among workers in coke production is the lung. Excess risk for kidney cancer has also been associated with work in coke plants. Additional studies have also reported excess risks for other types of cancers such as cancer of the large intestine and pancreas.

Ethylene Oxide

Ethylene oxide is colourless gas with a somewhat sweet odour. It is extremely flammable and also dangerously reactive. Ethylene oxide exists as a compressed gas that has been produced since the early 1900s. It is used primarily as a chemical intermediate in the production of ethylene glycol, glycol ethers, nonionic surfactants and other industrial chemicals. Much smaller amounts are used as a non-explosive mixture with nitrogen or carbon dioxide for sterilizing medical instruments and supplies in hospitals and industrially for the fumigation of spices.

Most people are not likely to be exposed to ethylene oxide because it is not commonly found in the environment. Exposure to ethylene oxide is generally limited to those facilities where it is made or used. Therefore, ethylene oxide is not a contaminant of concern during a routine hazardous building materials assessment, although the presence of it should be determined in buildings such as hospitals if construction activities are to occur in or adjacent to areas where it is used or stored.

Exposure to ethylene oxide can result in irritation to the skin or eyes; however, the greatest risk for health effects is through inhalation. This can result in irritation to the nose, throat and respiratory tract, with damage to the central nervous system at higher concentrations. Exposure to high concentrations may cause headache, nausea, dizziness, drowsiness, and incoordination. Exposure to ethylene oxide is also a cancer hazard and possible reproductive hazard. In epidemiological studies of exposure to ethylene oxide, the most frequently reported association has been with lymphatic and haematopoietic cancer. The IARC has concluded that there is limited evidence for the carcinogenicity of ethylene oxide in humans and sufficient evidence for carcinogenicity in experimental animals, classifying ethylene oxide as “carcinogenic to humans” (Group 1).

Isocyanates

Isocyanates are a family of highly reactive, low molecular weight, manufactured chemicals containing one or more isocyanate groups (-NCO). An isocyanate that has two isocyanate groups is known as a diisocyanate, which are the most common type of isocyanates used for manufacturing other products. The most commonly used diisocyanates include methylene diphenyl diisocyanate (MDI), toluene diisocyanate (TDI), and hexamethylene diisocyanate (HDI).

When isocyanates are combined with other compounds that contain free hydroxyl functional groups (i.e. –OH) they react and begin to form polyurethane polymers. These polyurethanes find significant application in the manufacture of rigid and flexible foams. Flexible foam is primarily used for cushioning, while rigid foam is used mainly for insulation. Polyurethanes are also used in the production of adhesives, elastomers, and coatings and are increasingly used in the automobile industry, autobody repair, and building insulation materials.

This diversity of applications means that exposures to isocyanates can occur in a broad range of production facilities from small workshops to automated production lines. Jobs that may involve exposure to isocyanates include painting, foam-blowing, and the manufacture of many polyurethane products. Exposure to isocyanates within buildings where it is not produced or used as part of manufacturing is unlikely, as products such as rigid foam insulation that may be used in buildings has already undergone the curing process. Completely cured products are fully reacted and therefore are considered to be inert and non-toxic. However, some products such as spray foams, coatings, sealants and adhesives may be sold and used in an uncured form. An example would be an adhesive, which is sold to be initially applied in an uncured form and as it cures (hardens), bonds two pieces of wood together. Such products can provide potential exposure to building occupants and construction workers during the application and use of these products. However, for the purposes of a routine hazardous building materials assessment, products that may have contained isocyanate as part of the manufacturing process (e.g. rigid foam) or during the application/installation process (e.g. spray foam, adhesives and sealants) are assumed to be fully cured and would no longer contain free isocyanate.

Direct skin contact with isocyanates can cause marked skin irritation, resulting in reddening, swelling and blistering. However the greatest route of exposure to isocyanates is through inhalation of fine vapours or droplets. Airborne exposure to isocyanates can result in irritation to the mucous membranes of the eyes and respiratory tracts. This results in symptoms such as excessive tear secretion, dry throat, dry cough, chest pains and difficulty in breathing. Isocyanates are also a major cause of work-related asthma worldwide. Increased exposure to isocyanates can lead to sensitization. Once sensitized, individuals are subject to severe asthma attacks (which in some cases has been reported to result in death) if they are re-exposed.

Lead

Lead is a naturally occurring metal found in small amounts in the earth's crust. It is usually found in ore with zinc, silver and (most abundantly) copper, and is extracted together with these metals. Metallic lead is bluish-white in colour but soon tarnishes to a dull grey when exposed to air. When melted into liquid form it has a shiny chrome-silver appearance.

Lead is soft, dense, highly malleable and resistant to corrosion, with poor electrical conductivity as compared to most other metals. Such properties have resulted in lead being used in many applications, including products and materials commonly found in buildings. It is present as a component of lead-acid batteries, ammunition, PVC plastics, and older brass and chrome-plated brass faucets. As a building component, lead has been used in water distribution piping, as an alloy in solder, in electrical conduits, roofs and roofing details, and as an additive to paints, ceramic glazes and mortars as pigments

or for anti-corrosion properties. Lead has also used as sheeting inside buildings for shielding X-rays and for sound attenuation.

Exposure to lead can occur for workers in workplaces that produce the above materials but also to construction workers, building maintenance personnel and the general population due to the widespread historical use of lead in building materials and consumer products. Most exposure to lead occurs through ingestion or inhalation, with the health effects being the same. Overexposure to lead can result in damage to nervous connections and can cause blood and brain disorders, severe damage to the kidneys and ultimately death. Infants and young children are especially vulnerable to the health effects of lead, as overexposure has been proven to result in the permanent reduction in cognitive capacity. In pregnant women, high levels of exposure to lead may cause miscarriage. The IARC has concluded that lead and inorganic lead compounds are “possibly carcinogenic to humans” (Group 2B).

The known serious health effects associated with lead exposure has brought about widespread reduction in its use. The use of lead in building materials and consumer products has decreased substantially since the 1970s to where lead is no longer being used in building materials and consumer products or is present at significantly lower concentrations. For example, unleaded gasoline was introduced in Canada in 1975, after which leaded gasoline was phased out and banned in 1990. Lead-based solder has been banned since the1980s and most solder used today is either lead-free or has very low lead concentrations. Up until the 1960s, lead was added to paints in significant quantities. Since that time, the concentration of lead in paint has decreased. The federal government began reducing the amount of lead allowed in interior paint in 1976 (to 0.5% by weight). By 1991, paint manufacturers in Canada and the U.S. voluntarily stopped adding lead to paint, reducing lead concentrations to background levels. In 2005 the *Surface Coating Materials Regulations* came into effect to limit the concentration of lead in paint (to 0.06% by weight) for both interior and exterior paints sold to consumers. This was since amended in 2011 to further reduce the allowable lead limit (to 0.009% by weight) and extended to include all consumer paints and coatings.

Mercury

Mercury is a naturally occurring element found in the earth's crust, with natural deposits generally found as a vermilion red ore called cinnabar. Mercury can exist as metallic mercury, organic mercury or inorganic mercury. Metallic or elemental mercury has unique properties as compared to other metals. It is the only pure metal that is a liquid at room temperature, having a silvery-white, shiny appearance. Mercury is the densest liquid known, which produces a colourless, odourless vapour at room temperature.

The unique properties of mercury have resulted in it being used in a wide variety of applications. Properties such as its coefficient of expansion and ability to conduct electricity has resulted in mercury being used in thermometers, barometers and other

measuring devices (blood pressure gauges, vacuum gauges, manometers, etc.), thermostats and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.). Mercury is also used in antifouling paints, dry cell or button batteries and numerous lighting products, including fluorescent lamps and a variety of High Intensity Discharge (HID) lamps such as mercury vapor, metal halide and high pressure sodium lamps. HID lamps are used for street lights, floodlights and industrial lighting applications. Because of the wide variety of uses mercury can be found as a component of machinery, equipment and lighting within buildings; although many of its uses have been phased out over the years.

The health effects of mercury exposure depend on its chemical form (elemental, inorganic or organic), the route of exposure (inhalation, ingestion or skin contact), and the level of exposure. Vapours from liquid elemental mercury and methyl mercury are more easily absorbed than inorganic mercury salts and can, therefore, cause more harm. Exposure to mercury occurs mainly from breathing contaminated air or ingesting contaminated water and food. Mercury is a neurotoxin, which means it can adversely affect the central nervous system. Upon exposure, mercury tends to accumulate quickly in the brain where it tightly binds with the tissue and is released at a very slow rate. The nervous system effects of mercury toxicity are sometimes referred to as "Mad Hatter's Disease" since mercurous nitrate was used in making felt hats. High levels of exposure to mercury can also lead to harmful effects on the digestive and respiratory systems, and the kidneys. Many mercury compounds may also be teratogenic or capable of causing birth defects.

Mercury compounds can also be toxic at low levels in the environment. The characteristics of mercury that make it an environmental problem are its toxicity and persistence in the environment, and its ability to accumulate and bioconcentrate as methyl mercury in fish and fish-eating predators such as large fish or loons. Therefore, proper disposal of mercury-containing materials is essential. The improper disposal of mercury-containing products such as fluorescent light bulb tubes, high intensity discharge lamps, mercury vapour lamps, mercury thermometers and thermostats can lead to the release of mercury from municipal landfills. Used fluorescent and HID lamps may be classified as hazardous waste due to their mercury content and should be recycled if possible rather than being disposed of in landfill.

Silica

Silica (silicon dioxide) is the name of a group of minerals that contain silicon and oxygen in a chemical combination and have the general formula SiO_2. It is one of the most common minerals in the earth's crust. Silica can be present as crystalline silica (free silica) or amorphous silica (combined silica), and exists in many forms. The three most common crystalline forms of silica encountered in the workplace environment are quartz, tridymite, and cristobalite. Quartz is by far the most common crystalline silica found in nature, being abundant in most rock types, notably granites, sandstones, quartzites and in sands and soils. Cristobalite and tridymite are found in volcanic rocks. Amorphous

silica is found in nature as biogenic silica and as silica glass of volcanic origin. One form of biogenic silica, diatomaceous earth, originates from the skeletons of diatoms deposited on sea floors. From a health perspective it is the crystalline silica forms that raise the biggest concerns.

Silica is present in numerous building materials and products, including concrete, brick, stone, terrazzo, refractory brick, etc. Low concentrations of silica are also possible in plaster, drywall, acoustical ceiling tiles, drywall joint compound, mortars and adhesives. Because of the wide usage of quartz-containing materials, workers may be exposed to crystalline silica in a large variety of industries and occupations. Occupational exposure to silica dust occurs in cement and brick manufacturing, asphalt pavement manufacturing, china and ceramic manufacturing and the tool and die, steel and foundry industries. Exposure to silica also occurs during many different construction and maintenance activities. The most severe exposures to crystalline silica result from abrasive blasting activities using silica sand. Other activities that may produce crystalline silica dust include jack hammering, rock/well drilling, concrete mixing, concrete drilling, tuck pointing, and brick and concrete block cutting and sawing. Additionally, crystalline silica exposures occur in the maintenance, repair and replacement of refractory brick furnace linings.

Adverse health effects associated with silica exposure result from inhalation of the respirable fraction of crystalline silica, which can arise from many of the activities outlined above. The main health effects associated with silica exposure are lung cancer and silicosis. The IARC has concluded that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is “carcinogenic to Humans” (Group 1). Silicosis is caused by scarring of the lung tissue from breathing in silica dust. This scarring is permanent and causes a reduction in the lungs’ ability to take in oxygen, making it difficult to breathe and in severe cases can be disabling, or even fatal. Since silicosis affects lung function, it also makes one more susceptible to lung infections like tuberculosis.

Vinyl Chloride

Vinyl chloride is a manufactured substance that does not occur naturally. It is used as a chemical intermediate and not an end product. Vinyl chloride exists in liquid form if kept under high pressure or at low temperatures. At room temperature, it is a colourless gas. It burns easily and is not stable at high temperatures.

Most of the vinyl chloride produced is used to make a polymer called polyvinyl chloride (PVC). PVC is used to make a variety of plastic products including pipes, wire and cable coatings, vinyl flooring, vinyl wallpaper and window frames. It is also used to make furniture, upholstery and packaging materials. One of the concerns regarding PVC is that upon burning it will emit toxic fumes. Contaminants emitted when PVC is burned include hydrochloric acid, carbon monoxide and carbon dioxide, along with lesser amounts of dioxin and furan.

Vinyl chloride is reported to be slightly irritating to the eyes and respiratory tract in humans. Central nervous system effects (including dizziness, drowsiness, fatigue, headache, visual and/or hearing disturbances, memory loss, and sleep disturbances) as well as peripheral nervous system symptoms (peripheral neuropathy, tingling, numbness, weakness, and pain in fingers) have been reported in workers exposed to vinyl chloride. Short-term (acute) exposure to extremely high levels of vinyl chloride has also reportedly caused loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans. The most significant health effect associated with exposure to vinyl chloride is that it is a known human carcinogen that causes a rare cancer of the liver. It has been classified by the IARC as “carcinogenic to humans” (Group 1). Brain cancer, lung cancer, and some cancers of the blood also may be connected with breathing vinyl chloride over long periods.

OTHER HAZARDOUS MATERIALS

CHEMICAL HAZARDS

Urea Formaldehyde Foam Insulation

Urea-formaldehyde foam insulation (UFFI) was developed in as an improved means of insulating difficult-to-reach cavities. It was typically made at the construction site from a mixture of urea-formaldehyde resin, a foaming agent and compressed air. When the mixture is injected into the wall, urea and formaldehyde unite and "cure" into an insulating foam plastic. Its appearance is like ordinary shaving cream. Dry, it can be a white or tan colour, and fluffy like styrofoam. Over time UFFI shrinks significantly and may begin to degrade due to its crumbly texture.

UFFI was installed primarily in wall cavities during the 1970's as an energy conservation measure. The insulation was used most extensively from 1975 to 1978, during the period of the Canadian Home Insulation Program (CHIP), when financial incentives were offered by the government to upgrade home insulation levels. In addition to detached homes it can be found in common areas and walls of semi-detached homes, apartment buildings and condominiums. UFFI was also used to a lesser degree in some commercial and industrial buildings.

UFFI installation has been banned in Canada under the Hazardous Products Act (HPA) since December, 1980 due to concerns regarding the health effects of exposure to formaldehyde. Formaldehyde is a colourless, pungent-smelling gas. Health effects include eye, nose, and throat irritation; wheezing and coughing; fatigue; skin rash; nausea; headache; dizziness; and severe allergic reactions.

Sometimes, a slight excess of formaldehyde was often added to ensure complete "curing" with the urea to produce the urea-formaldehyde foam. The excess formaldehyde was given off after installation during the initial curing process, which typically took a few days

to a week to complete. UFFI was sometimes improperly installed or used in locations where it should not have been, resulting in continued off-gassing of formaldehyde past the initial curing stage. Since UFFI was last installed in 1980, it should have little effect on indoor formaldehyde levels today. However, if UFFI comes in contact with water or moisture, it could begin to break down. Due to the age of the insulation UFFI may also begin to degrade and crumble into a fine powder. Under these conditions UFFI may release more formaldehyde and consideration should be given to removing the material using properly trained remediation personnel.

BIOLOGICAL HAZARDS

Mould

Mould is part of the fungi kingdom, which also includes mushrooms and yeasts. They are a naturally occurring and essential part of our environment since they break down dead organic material in the outdoor environment (such as leaves, wood and other plant debris), which they use as a food source.

Mould reproduces by means of tiny spores that are so small they can't be seen by the naked eye. Because of their small size mould spores easily become airborne and can travel long distances, entering indoor environments through ventilation systems, open windows or doors, or tracked in on footwear. Therefore, mould spores are a commonly detected in indoor air and as a component of settled dust.

Under normal conditions, the presence of indoor mould is not an issue. However, if conditions exist that allow it to grow and multiply indoors it can become a potential hazard. Several factors will affect what moulds will grow within a building and how fast they will grow. This includes parameters such as temperature, airflow, and the pH (i.e. acidity/alkalinity) of the food substrate. However, the most important parameter affecting mould growth is water availability, as all moulds need some amount of moisture for them to be able to grow. Buildings that have had a history of water damage are at greater risk of indoor mould growth.

Indoor mould growth may present a risk to the building structure itself through decomposition of building materials. Health risks to building occupants may also occur as a result of indoor mould growth. Construction or renovation work which disturbs mould-contaminated materials increases this risk of exposure to building occupants and the construction workers themselves. Health effects associated with exposure to mould most commonly results in allergic type reactions such as runny nose, cough, congestion, eye irritation and aggravation of asthma, headache and fatigue. Exposure to very high concentrations of airborne mould spores (such as those that may be observed during disturbance of mould-contaminated building materials) can result in more serious health effects such as Organic Dust Toxic Syndrome (ODTS) or Hypersensitivity Pneumonitis (HP), where flu-like symptoms (fever, chills, cough, fatigue, shortness of breath, body

aches, etc.) are exhibited. The chronic form of HP may occur from long-term exposure to lower levels of mould and results in a continued worsening in shortness of breath or cough. A variety of species of mould have also been documented to cause serious invasive infections, which are generally limited to individuals whose immune systems are already somehow compromised.

Pest Infestation

Areas currently or previously infested by pests (including birds, bats, rodents, raccoons, cockroaches, etc.) can result in potential exposure to numerous biological hazards that can be viral, bacterial, fungal or parasitic in nature. This can occur through exposure to their droppings, urine or saliva.

Bird and bat droppings should be presumed to be contaminated with the fungi Histoplasma capsulatum and/or Cryptococcus neoformans. These fungi grow well in the high nutrient content of accumulated bird and bat excrement and can cause respiratory infections in workers exposed during construction or maintenance activities that cause the droppings to be disturbed and the fungi to become airborne.

Histoplasmosis is an infectious disease caused by inhaling the spores of Histoplasma capsulatum. After an exposure, how ill a person becomes varies greatly and most likely depends on the number of spores inhaled and a person's age and susceptibility to the disease. The mildest form of histoplasmosis produces no signs or symptoms, but severe infections can cause serious problems throughout your body as well as in your lungs. Otherwise healthy people who've had intense exposure to H. capsulatum may experience a form of the disease known as acute symptomatic pulmonary histoplasmosis. Typical symptoms include fever, muscle aches, headache, dry cough, chest pain, sweating and loss of appetite.

Cryptococcosis is an infectious disease caused by inhaling the spores of Cryptococcus neoformans. Once inhaled, infection with cryptococcosis may go away on its own, remain in the lungs only, or spread throughout the body. Most cases occur to people with a weakened immune system, such as those with HIV infection, taking high doses of corticosteroid medications, cancer chemotherapy, or who have Hodgkin's disease. In people with a normal immune system, the lung (pulmonary) form of the infection may have no symptoms. In people with weakened immune systems, the cryptococcus organism may spread to the brain. Most people with this infection have meningoencephalitis (swelling and irritation of the brain and spinal cord) when they are diagnosed.

Rodents such as deer mice may be infected with Hantavirus, which can be shed in their urine, saliva and droppings. Exposure to Hantavirus can result in a serious respiratory illness called hantavirus pulmonary syndrome (HPS). Initially, infected individuals exhibit flu-like symptoms, including fever and body aches which progresses to shortness of

breath and coughing which rapidly becomes more severe. Exposure to Hantavirus in Canada is rare and Health Canada has only found the virus in a very small percentage of deer mice tested in Northern Ontario.

A raccoon latrine (i.e. an area where they repeatedly deposit fresh feces on top of old feces) may contain microscopic roundworm (*Baylisascaris procyonis*) eggs that can potentially be hazardous to human health. Once deposited in the environment, the eggs develop into an infectious form; and if inadvertently ingested by humans, the larvae hatch out of the eggs and may penetrate the body's organs. Larvae travel through the body and may cause serious eye disease, spinal cord or brain damage or death. Raccoon roundworm disease is not contracted by inhalation nor has any case of inhalation of roundworm eggs been documented.

Exposure to animal dander, scales, fur, urine, feces and saliva can also result in exposure to certain proteins that can act as allergens and can also cause asthmatic reactions. Some common sources of pest-related allergens include cockroaches, dust mites and rodents. The protein in urine from rats and mice is a potent allergen. Cockroach allergens are also potent and are derived from several sources, such as saliva, fecal material, secretions, cast skins, debris, and dead bodies. Allergic reactions occur when sensitized persons inhale, swallow or touch traces of the allergen, resulting in an exaggerated reaction of the body's immune system to the foreign protein. Typical allergic reactions result in nasal, eye, and throat irritation as well as possible skin hives. These proteins may also trigger asthma attacks when sensitive individuals inhale the proteins, resulting in symptoms such as coughing, wheezing, chest tightness, and breathing difficulties.

ENVIRONMENTAL HAZARDS

Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are a class of man-made organic chemicals known as chlorinated hydrocarbons. They vary in consistency from thin, light-coloured liquids to yellow or black waxy solids. They were manufactured in the United States from 1929 until their manufacture was banned in 1979. Although PCBs were not manufactured in Canada, they were imported from the U.S. over the years. Canada banned the import, manufacture and sale of PCBs in 1977.

PCBs are non-flammable, chemically stable over a wide range of temperature and physical conditions, not soluble in water, unaffected by acids, base or corrosive chemicals, and have a high dielectric or electrical insulating capacity. Due to these unique properties PCBs were used in hundreds of industrial and commercial applications, most commonly in electrical transformers and capacitors, including those capacitors found in light ballasts. They were also used as coolants, fire retardants and as insulation and in a number of other commercial applications including carbonless copy paper, dust

suppressors for roads, hydraulic fluids, caulking compounds, plasticizers and lubricating oils and heat-transfer applications.

Although PCBs were found to be extremely useful in many industrial and commercial applications some of their chemical properties also made them an environmental and health hazard. PCBs are nearly indestructible and therefore persist if released into the natural environment. Their high fat and low water solubility result in a build-up (bioaccumulation) of PCBs in the fatty tissue of animals and humans if ingested/inhaled. Because PCBs persist in the fatty tissue of animals their concentration will tend to increase the higher up the food chain.

Most of what is known about the human health effects of PCBs is based on exposures due to accidental releases or job-related activities. These exposures are much higher than the levels normally found in the environment. The adverse health effects include a severe form of acne (chloracne), swelling of the upper eyelids, discolouring of the nails and skin, numbness in the arms and/or legs, weakness, muscle spasms, chronic bronchitis, and problems related to the nervous system. The International Agency for Research on Cancer (IARC) classifies PCBs as “probably carcinogenic to humans” (Group 2A) based on limited evidence that long-term, high-level occupational exposure can lead to increased incidence of liver and kidney cancers. The long-term impact of low-level exposures to PCBs that is common in the general population is unclear. The current state of knowledge suggests that low-level exposures to PCBs are unlikely to cause adverse health effects. However, people eating large amounts of certain sports fish, wild game and marine mammals are at increased risk for higher exposures and possible adverse health effects.

Ozone Depleting and Global Warming Substances

There are several different types of chemicals that are being or have been used as refrigerants in commercial, home and vehicle air conditioners and refrigerators or as fire extinguishing agents in portable and fixed fire extinguishing equipment. This includes groups of chemical compounds known as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and halons. Some of these chemicals have also been used as foam blowing agents, as cleaning solvents for electrical components, as aerosol spray propellants, and in hospital sterilization procedures. Fixed halon fire extinguishing systems have historically been used in areas such as data centers, IT rooms, museums, libraries, surgical suites, and other locations where use of water-based suppressants could irreparably damage electronics or vital archival collections. There is a large number of halon fire extinguishing systems still in service in Canada.
The concern regarding past and present use of many of the chemicals used as refrigerants or fire extinguishing agents is that they are ozone-depleting substances (ODS). When released into the environment these chemicals break down in the stratosphere and release chlorine or bromine, which destroy the stratospheric ozone layer. The ozone layer screens the earth from some of the sun's harmful ultraviolet rays (UVB). As the ozone layer is depleted, higher UVB levels reach the earth, resulting in

increased exposure to UVB. Increased exposure to UVB can cause skin cancer and plays a major role in malignant melanoma development. It can also increase the likelihood of cataracts and may also suppress proper functioning of the body's immune system and the skin's natural defences.

CFCs, HCFCs and halons are also known to be greenhouse gases and contribute to global warming due to the build-up of these heat-trapping gases in the atmosphere. Hydrofluorocarbons (HFCs) are a common replacement chemical for CFC and HCFC refrigerants; and although they do not have any ozone depleting potential they are a potent greenhouse gas.

Due to the ozone-depleting potential and/or global warming potential of CFCs, HCFCs, HFCs and halons it is important to control their use and emission into the environment. The manufacture and use of CFCs has stopped while transitional refrigerants (HCFCs) are scheduled to be phased out of production. No phase-out dates are currently planned for any HFCs. In Ontario, Regulation 463/10, “Ozone Depleting Substances and Other Halocarbons” (made under the Environmental Protection Act) enhances the control and management of substances that deplete the ozone layer and contribute to global warming. This regulation has requirements to prevent or minimize ozone-depleting substances and other halocarbons emissions, which serves a dual environmental benefit of lowering emissions that destroy the ozone layer and contribute to climate change.

Appendix C
Division 2 – A – R.C. Harris Treatment Plant Re-Survey 2024

Hazardous Building Materials Re-assessment 2024

The City of Toronto – Water Division
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, Ontario
M4E 1J1

Presented to:

The City of Toronto – Water Division
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, Ontario
M4E 1J1

December 2024

OHE Project No.: 30308

Submitted by:

OHE Consultants
Occupational Hygiene & Engineering
311 Matheson Blvd. East
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OHE Consultants (OHE) was retained by The City of Toronto - Water Division to conduct a Hazardous Building Materials Re-assessment Survey within the accessible areas at R.C. Harris Treatment Plant located at 2701 Queen Street East, Toronto, Ontario (herein referred to as the "Subject Location"). The purpose of the re-assessment survey was to fulfil the annual update requirement of the Asbestos Management Program (AMP) for Asbestos-Containing Materials (ACMs) and for due diligence purposes for the other hazardous materials identified at the Subject Location.

The site survey was conducted by Muneeb Khan, Senior Project Specialist of OHE on November 28, 2024. The reassessment survey consisted of a review of the previous survey report "2017 Hazardous Materials Re-Assessment", Project number 17069, dated December 11, 2017 by T. Harris Environmental Management (THEM); a one-page laboratory analysis report issued by EMC Scientific Inc., dated March 1, 2018, provided by the client; "Hazardous Material Reassessment Survey 2018", Project number 23650, issued by OHE Consultants dated November 2018; "Hazardous Material Reassessment Survey 2019", Project number 24827, issued by OHE Consultants dated November 2019; "Bulk Sampling for the Presence of Asbestos in Suspect Materials and for Lead in Paint – Summary Report", Project number 24964, issued by OHE Consultants dated October 2019; "Bulk Sampling for the Presence of Asbestos in Suspect Materials – Summary Report", Project number 25042 issued by OHE Consultants dated November 2019; "Hazardous Building Materials Re-Assessment 2020", Project number 26090, issued by OHE Consultants dated November 2020; "Hazardous Building Materials Survey", Project number 26723-006, issued by OHE Consultants dated September 2021, "Hazardous Building Materials Re-Assessment 2021", Project number 27219, issued by OHE Consultants dated December 2021; "Designated Substances and Hazardous Building Materials Assessment Report", Project number 1-3210982, issued by Safetech Environmental Ltd. dated December 28, 2021; "Hazardous Building Materials Re-Assessment 2022", Project number 28271, issued by OHE Consultants dated December 2022; "Hazardous Building Materials Re-Assessment 2023", Project number 29388, issued by OHE Consultants dated December 2023; "Bulk Sampling Report 2024" Project number 1-3240629, issued by Safetech Environmental Ltd. dated August 20, 2024; and a visual re-inspection of previously identified hazardous building materials.

A summary of the reassessment survey is presented as follows:

<u>Asbestos</u>

The following Asbestos-Containing Materials (ACMs) were identified at the Subject Location.

- Mechanical linear pipe insulation;
- Mechanical pipe fitting insulation;
- Vinyl floor tiles;
- Mastic;
- Window caulking;
- Door caulking;
- Plaster;
- Red flooring with black layer underneath;

- Patch; and
- Red flooring with black underlayer.

The following assumed ACMs were identified at the Subject Location:

- Assumed fire door;
- Assumed lighting heat shield;
- Assumed mechanical systems insulation; and
- Assumed brake pads.

Asbestos-containing materials were noted to be in good to poor condition. Refer to Appendix A, Table 1 for quantity, location and condition details.

Lead

Lead-containing paint was identified at the Subject Location. Refer to Appendix A, Table 2 for description, location, and condition details.

Lead may be present in wiring connectors, electric cable sheathing and lead piping; in solder joints on copper piping; and within batteries of emergency lighting that were not sampled as part of this re-assessment survey.

Lead is often present in ceramic building products such as floor or wall tiles. Workers performing demolition or alterations to these tiles should be informed of the potential for lead to be present.

Mercury

Mercury may be present in thermostats, as a vapour in fluorescent light bulbs, in paints and as a component in electrical equipment, such as silent, position dependent switches.

Silica

Silica is presumed to be present in materials such as fillers for paints and mastic and in masonry products such as bricks, ceramics, masonry, concrete, and mortar.

Benzene

Benzene is suspected to be present as a component in the fuel present throughout the Subject Location.

PCBs

Fluorescent light fixtures were observed throughout the Subject Location during the survey. It is assumed

that the light fixtures contain PCBs within the ballasts until further inspection is completed to prove otherwise.

Ozone Depleting Substances

Ozone depleting substances are suspected to be present as a refrigerant within HVAC units at the Subject Location.

Water and Mould Damaged Building Materials

Water damaged and/or mould impacted building materials were observed on the walls in the basement, on the walls on the 2nd, 3rd, 4th and 5th floors of the North-East stairwell in the Service Building; on the floor in the basement, and on the floor, walls and ceiling in the sub-basement of the Pump Building; on the metal pipes in the chlorination room on the 1st floor in the Filter Building; and on the walls and pipes in the tunnel at the Subject Location.

Suspect mould growth was observed on the west and south wall of the boiler room in the basement of the Service Building at the Subject Location.

Hazardous building materials may be present in areas not accessible for view and identification. In situations where hazardous building materials extend into a non-accessible area, the materials were assumed to also be present in those areas and have been reported as such. Contractors and maintenance personnel should be warned of the possibility of undisclosed hazardous building materials in enclosed areas. All suspect building materials discovered in these areas should be treated as hazardous until proven otherwise as per all applicable regulations and guidelines.

OHE's recommendations, based on the findings of the survey, are as follows:

- Remove all ACMs that are likely to be disturbed during planned renovations or demolitions activities.

- Remediate (cleanup and repair, remove, enclose or encapsulate) all the damaged asbestos-containing materials (i.e., those noted to be in fair or poor condition) as per the requirements of Ontario Regulation (O. Reg.) 278/05.

- Removal of asbestos-containing materials will require removal operation procedures as specified in O. Reg. 278/05.

- Renovations and/or demolition operations that are likely to generate lead-containing dust shall be carried out in accordance with the following requirements:
  - Guideline: Lead on Construction Projects, issued September 2004 (updated April 2011) by the Ontario Ministry of Labour (Lead Guideline)
  - Ontario Regulation 490/09 (as amended) - "Designated Substances" (O. Reg. 490/09)

- Ontario Regulation 213/91 (as amended) - "Construction Projects" (O. Reg. 213/91)

- Renovations and/or demolition operations that are likely to disturb mercury-containing equipment shall be carried out in a manner to minimize the potential for spills in accordance with the following regulations:
  - O. Reg. 490/09
  - O. Reg. 213/91

- Renovations and/or demolition operations that are likely to generate silica-containing dust shall be carried out in accordance with the following requirements:
  - Guideline: Silica on Construction Projects, issued September 2004 (updated April 2011) by the Ontario Ministry of Labour (Silica Guideline)
  - O. Reg. 490/09
  - O. Reg. 213/91

- Examine all light ballasts after dismantling and prior to disposal to determine their PCB content. PCB-containing light ballasts should be disposed of following procedures specified in applicable regulations.

- Examine all equipment suspected to contain ozone depleting substances prior to disposal to determine their content. Equipment identified to contain ozone depleting substances should be transported and disposed of following procedures specified in applicable regulations.

- Suspect mould growth and water damaged building materials shall be remediated following remediation procedures as outlined in the Canadian Construction Association Standard construction document CCA 82-2004 "*Mould Guidelines for the Canadian Construction Industry*".

- Disposal of hazardous building materials shall be completed as per all applicable regulations.

- Should suspect hazardous building materials be discovered during any demolition or renovation work in the Subject Location, the contractor shall stop all work in the immediate vicinity of the suspected hazardous material and immediately notify personnel from both **The City of Toronto - Water Division** and OHE Consultants.

This executive summary provides a brief overview of the survey findings. It is not intended to substitute for the complete survey report, nor does it discuss specific issues documented in the report. The executive summary should not be used as a substitute to reading the complete report.

1 INTRODUCTION

OHE Consultants (OHE) was retained by The City of Toronto - Water Division to conduct a Hazardous Materials Reassessment Survey within the accessible areas at R.C. Harris Treatment Plant located at 2701 Queen Street East, Toronto, Ontario (herein referred to as the "Subject Location"). The purpose of the reassessment survey was to fulfil the annual update requirement of the Asbestos Management Program (AMP) for Asbestos-Containing Materials (ACMs) and for due diligence purposes for the other hazardous materials identified at the Subject Location.

The site reassessment was conducted by Muneeb Khan, Senior Project Specialist of OHE on November 28, 2024.

1.1 Scope of Work

The following details the scope of work:

- A review of the previous survey report "2017 Hazardous Materials Re-Assessment" by T. Harris Environmental Management (THEM), Project number 17069, dated December 11, 2017;
- A review of one-page laboratory analysis report issued by EMC Scientific Inc., provided by the client, dated March 1, 2018;
- A review of the previous survey report "Hazardous Materials Reassessment Survey 2018", Project number 23650, by OHE Consultants, dated November 2018;
- A review of the previous survey report "Hazardous Materials Reassessment Survey 2019", Project number 24827 by OHE Consultants, dated November 2019;
- A review of the previous survey report "Bulk Sampling for the Presence of Asbestos in Suspect Materials and for Lead in Paint – Summary Report", Project number 24964 issued by OHE, Consultants dated October 2019;
- A review of the previous survey report "Bulk Sampling for the Presence of Asbestos in Suspect Materials – Summary Report", Project number 25042 issued by OHE Consultants, dated November 2019;
- A review of the previous survey report "Hazardous Building Materials Re-Assessment 2020", Project 26090, issued by OHE Consultants, dated November 2020;
- A review of the previous survey report "Hazardous Building Materials Survey", Project number 26723-006, issued by OHE Consultants, dated September 2021;
- A review of the previous survey report "Hazardous Building Materials Re-Assessment 2021", Project number 27219, issued by OHE Consultants, dated December 2021;
- A review of the previous survey report "Designated Substances and Hazardous Building Materials Assessment Report", Project number 1-3210982, issued by Safetech Environmental Ltd., dated December 28, 2021;

- A review of the previous survey report "Hazardous Building Materials Re-Assessment 2022", Project number 28271, issued by OHE Consultants, dated December 2022;
- A review of the previous survey report "Hazardous Building Materials Re-Assessment 2023", Project number 29388, issued by OHE Consultants, dated December 2023;
- A review of the previous survey report "Bulk Sampling Report", Project number 1-3240629, issued by Safetech Environmental Ltd., dated August 20, 2024;
- A visual inspection of accessible areas of the Subject Location to identify/reassess hazardous building materials;
- Bulk sampling and analysis of materials suspected to be asbestos-containing, if requested by the client;
- An assessment of the condition of ACMs and lead-containing paints, including recommendations for appropriate corrective action (if required);
- Recommendations for removal of hazardous building materials prior to renovation and/or demolition activities; and,
- Preparation of a report summarizing the findings and results of the hazardous building materials reassessment survey.

1.2 Appendices Outline

The following is an outline and description of the attached appendices:

- Inventory tables of identified ACMs and lead-containing paint are attached in Appendix A.
- Selected site photographs are attached in Appendix B.
- Drawings for the survey are attached in Appendix C.
- Background information on hazardous building materials, including a brief discussion of the properties, uses, and hazards associated with exposure, is attached in Appendix D.
- The summary of applicable provincial regulations and guidelines pertaining to hazardous building materials is attached in Appendix E.
- The survey methodology including bulk sample analysis methodology and assessment of hazardous building materials methodology is attached in Appendix F.
- Limitations of the project are attached in Appendix G.

2 SURVEY FINDINGS AND DISCUSSION

The locations of identified ACMs are indicated on Drawings 1.1 to 1.21 (Appendix C).

2.1 ACMs

The following Asbestos-Containing Materials (ACMs) were identified at the Subject Location.

- Mechanical linear pipe insulation;
- Mechanical pipe fitting insulation;
- Vinyl floor tiles;
- Mastic;
- Window caulking;
- Door caulking;
- Plaster;
- Red flooring with black layer underneath;
- Patch; and
- Red flooring with black underlayer.

The following assumed ACMs were identified at the Subject Location:

- Assumed fire door;
- Assumed lighting heat shield;
- Assumed mechanical systems insulation; and
- Assumed brake pads.

The identified asbestos-containing materials were noted to be in good to fair condition. Refer to Appendix A Table 1 for quantity, location and condition details.

Prior to the disturbance of ACMs, the materials should be removed using appropriate asbestos removal operation as per applicable regulations.

Where ACMs have been identified to be in fair or poor condition, the materials should be removed or repaired using the appropriate type of asbestos removal operation as per applicable regulations.

Where ACMs are in good condition and will remain in place, an AMP is required.

2.2 Lead

Lead-containing paints were identified at the Subject Location. Lead-containing paints were noted

to be in good to poor condition. Refer to Appendix A, Table 2 for description, location and condition details.

Lead may be present in wiring connectors and electric cable sheathing and lead piping, in solder joints on copper piping and within batteries of emergency lighting that were not sampled as part of this re-assessment survey.

Lead is often present in ceramic building products such as floor or wall tiles. Workers performing demolition or alterations to these tiles should be informed of the potential for lead to be present. Prior to disturbance of lead-containing materials, the materials should be removed using the appropriate removal operation as specified in the applicable guidelines and regulations.

Where lead has been identified to be in poor condition, the materials should be removed by using the appropriate type of lead removal operation as per applicable regulations and guidelines.

2.3 Mercury

Mercury may be present in thermostats, as a vapour in fluorescent light bulbs, in paints and as a component in electrical equipment, such as silent, position dependent switches.

Prior to disturbance of mercury-containing materials, the materials should be removed and disposed as specified in the applicable guidelines and regulations. Simple personal hygiene practices will be sufficient to protect workers from possible mercury exposure.

2.4 Silica

Silica is presumed to be present in materials such as fillers for paints and mastic and in brick, concrete and mortar.

Silica-containing materials should be handled using the appropriate type of operation as specified in the applicable guidelines and regulations. No adverse effects from exposure to silica are likely to occur unless silica in the material is reduced to a respirable size and the airborne concentrations exceed the 8-hour time-weighted average.

2.5 Isocyanates

Based on 2017 THEM Report, isocyanates were not previously identified within the Subject Location.

2.6 Vinyl Chloride

Based on 2017 THEM Report, vinyl chloride was not previously identified within the Subject Location.

2.7 Benzene

Based on 2017 THEM Report, benzene is suspected to be present as a component in the fuel present throughout the Subject Location.

2.8 Acrylonitrile

Based on 2017 THEM Report, acrylonitrile was not previously identified within the Subject Location.

2.9 Coke Oven Emissions

Based on 2017 THEM Report, coke oven emissions were not previously identified within the Subject Location.

2.10 Arsenic

Based on 2017 THEM Report, arsenic was not previously identified within the Subject Location.

2.11 Ethylene Oxide

Based on 2017 THEM Report, ethylene oxide was not previously identified within the Subject Location.

2.12 PCBs

Fluorescent light fixtures were observed throughout the Subject Location during the survey. It is assumed that the light fixtures contain PCBs within the ballasts until further inspection is completed to prove otherwise.

PCB-containing equipment should be handled using appropriate procedures as specified in the applicable guidelines and regulations.

2.13 Ozone Depleting Substances

Ozone depleting substances are suspected to be present as a refrigerant within HVAC units within

the Subject Location.

ODS-containing equipment should be handled using appropriate procedures as specified in the applicable guidelines and regulations.

2.14 Water and Mould Damaged Building Materials

Water damaged and/or mould impacted building materials were observed on the walls in the basement, on the walls on the 2nd, 3rd, 4th and 5th floors of the North-East stairwell in the Service Building; on the floor in the basement, and on the floor, walls and ceiling in the sub-basement of the Pump Building; on the metal pipes in the chlorination room on the 1st floor in the Filter Building; and on the walls and pipes in the tunnel at the Subject Location.

Suspect mould growth was observed on the west and south wall of the boiler room in the basement of the Service Building at the Subject Location.

Hazardous building materials may be present in areas not accessible for view and identification. In situations where hazardous building materials extend into a non-accessible area, the materials were assumed to also be present in those areas and have been reported as such. Contractors and maintenance personnel should be warned of the possibility of undisclosed hazardous building materials in enclosed areas. All suspect building materials discovered in these areas should be treated as a hazardous until proven otherwise as per all applicable regulations and guidelines.

3 RECOMMENDATIONS

OHE's recommendations, based on the findings of the survey, are as follows:

- Remove all ACMs that are likely to be disturbed during planned renovations or demolitions activities.

- Remediate (cleanup and repair, remove, enclose or encapsulate) all the damaged asbestos-containing materials (i.e., those noted to be in fair or poor condition) as per the requirements of Ontario Regulation (O. Reg.) 278/05.

- Removal of asbestos-containing materials will require removal operation procedures as specified in O. Reg. 278/05.

- Renovations and/or demolition operations that are likely to generate lead-containing dust shall be carried out in accordance with the following requirements:
  - Guideline: Lead on Construction Projects, issued September 2004 (updated April 2011) by the Ontario Ministry of Labour (Lead Guideline)

- Ontario Regulation 490/09 (as amended) - "Designated Substances" (O. Reg. 490/09)
- Ontario Regulation 213/91 (as amended) - "Construction Projects" (O. Reg. 213/91)

- Renovations and/or demolition operations that are likely to disturb mercury-containing equipment shall be carried out in a manner to minimize the potential for spills in accordance with the following regulations:
  - O. Reg. 490/09
  - O. Reg. 213/91

- Renovations and/or demolition operations that are likely to generate silica-containing dust shall be carried out in accordance with the following requirements:
  - Guideline: Silica on Construction Projects, issued September 2004 (updated April 2011) by the Ontario Ministry of Labour (Silica Guideline)
  - O. Reg. 490/09
  - O. Reg. 213/91

- Examine all light ballasts after dismantling and prior to disposal to determine their PCB content. PCB-containing light ballasts should be disposed of following procedures specified in applicable regulations.

- Examine all equipment suspected to contain ozone depleting substances prior to disposal to determine their content. Equipment identified to contain ozone depleting substances should be transported and disposed of following procedures specified in applicable regulations.

- Suspect mould growth and water damaged building materials shall be remediated following remediation procedures as outlined in the Canadian Construction Association Standard construction document CCA 82-2004 "*Mould Guidelines for the Canadian Construction Industry*".

- Disposal of hazardous building materials shall be completed as per all applicable regulations.

- Should suspect hazardous building materials be discovered during any demolition or renovation work in the Subject Location, the contractor shall stop all work in the immediate vicinity of the suspected hazardous material and immediately notify personnel from both **The City of Toronto -Water Division** and OHE Consultants.

4 GENERAL STATEMENT OF LIMITATIONS

The information and opinions rendered in this report are for use exclusively by **The City of Toronto – Water Division**. OHE reserves the right to review and comment on any interpretation of the data or conclusions derived by **The City of Toronto – Water Division**. No other representation, either expressed or implied, is included in this report.

The scope of this report is limited to possible hazardous building materials found within (or part of) the subject spaces included in the survey only. The survey only considered issues of the building structure, mechanical equipment, and their finishes. The survey did not consider current or past use of the property or occupant articles within the building (i.e. furniture, stock items, etc.), nor does it report on possible contaminants in the soil and groundwater of the site, vessels, drums, underground storage tanks, etc. The survey consisted of accessible areas only; samples were not collected if accessibility was restricted.

The field observations and analysis are considered sufficient in detail and scope to form a reasonable basis for the findings presented in this report. OHE warrants that the findings and conclusions contained herein have been made in accordance with generally accepted evaluation methods in the industry and applicable regulations at the time of the performance of the survey.

It is possible, due to the nature of building construction, that conditions may exist which could not be reasonably identified within the scope of the survey or which were not apparent during the site investigation. OHE believes that the information collected during the survey period concerning the property is reliable. No other warranties are implied or expressed.

OHE Consultants
Occupational Hygiene & Engineering

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Original Signed by:

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Vice President

Asbestos Inspection - 2024

Table 1
Summary of Asbestos-Containing Materials Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

November 2024

Location Description	Material	Quantity	Type of Asbestos	Condition	Friable	Photographs
Administration Building (Filter Building)						
Hallway, 2nd floor	Linear mechanical pipe insulation – "Air-cel"	12 linear feet	Chrysotile	Good	Y	1
	Interior window caulking – painted brown	5 linear feet	Chrysotile	Good	N	2
Control room, 2nd floor	Vinyl floor tiles (beige and grey) ****	-	-	-	N	-
Control room, 2nd floor	Mastic under the vinyl floor tiles ****	-	-	-	N	-
Sever room, 2nd floor	Vinyl floor tiles (beige and grey)	150 ft^2	Chrysotile	Fair	N	3
Sever room, 2nd floor	Mastic	150 ft^2	Chrysotile	Fair	N	3
West stairwell	Linear mechanical pipe insulation – "Air-cel"	100 Linear feet	Chrysotile	Good	Y	4
Corridor, Basement	Fire Door	1 door	Suspect	Good	N	5
Washroom, 1st floor	Mechanical pipe fitting insulation*	N/Q	Chrysotile	-	Y	-
	Linear mechanical pipe insulation – "Air-cel"*	N/Q	Chrysotile	-	Y	-
	Grey interior window caulking*	N/Q	Chrysotile	-	N	6
Lobby, Stairwell, Common areas, 1st floor	Grey interior window caulking	100 linear feet	Chrysotile	Good	N	7
	Plaster ceiling (above stairwell)	225 ft^2	Chrysotile	Good	N	8
	Linear mechanical pipe insulation – "Air-cel"*	N/Q	Chrysotile	-	Y	-
	Mechanical pipe fitting insulation*	N/Q	Chrysotile	-	Y	-
Ceiling space, Lobby, 1st floor	Linear mechanical pipe insulation – "Air-cel"	N/Q	Chrysotile	Good	Y	9
Office/control room, 1st floor	Grey Interior Window Caulking[1]	100 linear feet	Chrysotile	Good	N	10
Crawl space above raw water flume, 1st floor	MSI – "Parging cement"***	N/Q	Chrysotile	-	Y	-
	MSI – "Air-cel debris"***	N/Q	Chrysotile	-	Y	-

Table 1 (Continued)

Summary of Asbestos-Containing Materials Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

Location Description	Material	Quantity	Type of Asbestos	Condition	Friable	Photographs
Filtration Building						
North-west filter gallery	Red floor coating ^^^	500 ft^2	Chrysotile	Good	N	11
	Lighting heat shield^	100 units	Suspect	Good	Y	-
South-west filter gallery	Red floor coating ^^^	500 ft^2	Chrysotile	Good	N	12
	Lighting heat shield^	100 units	Suspect	Good	Y	-
Corridor, Ground floor	Red flooring with black layer underneath ^^	300 ft^2	Chrysotile	-	Y	-
Chlorine rooms, Office and workshop, 1st floor	Skim coat on cork insulation *^*^	2000 ft^2	Non-Asbestos-Containing	Good	Y	-
		100 ft^2		Fair		-
Chlorine room and workshop, 1st floor	Mechanical systems insulation	40 ft^2	Suspect	Good	Y	13
Pump Building						
West end office, 1st floor	Vinyl floor tile, 1'x1', beige with brown dimples	250 ft^2	Chrysotile	Good	N	14
		2 ft^2		Fair		14
Building exterior	Grey window caulking	2000 linear feet	Chrysotile	Good	N	15
Floor, Storage room, 1st floor	Red flooring material with black layer	1400 ft^2	Chrysotile	Fair	N	16
Men's washroom, 2nd floor	Mechanical pipe insulation in form of magnesia block	19 linear feet	Chrysotile Crocidolite	Good	Y	17
Men's washroom, 2nd floor	Mechanical pipe insulation in form of parging cement	3 fittings	Chrysotile	Good	Y	18
Around conduit penetration into the ceiling, Storage room, 1st floor	Patch	8 ft^2	Chrysotile	Good	N	19
Exterior door frame, Pump house west door[2]	Caulking	NQ	10.7% Chrysotile	-	N	-

Table 1 (Continued)

Summary of Asbestos-Containing Materials Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

Location Description	Material	Quantity	Type of Asbestos	Condition	Friable	Photographs
Service Building						
1st floor	Black door caulking**	N/Q	Chrysotile	-	N	-
Training room, 1st floor	Green interior door caulking**	400 linear feet	Chrysotile	-	N	-
Men's washroom, 2nd floor	Linear mechanical pipe insulation – "Air-cel"*	N/Q	Chrysotile	-	Y	-
Corridor ceiling in front of men's washroom, 2nd floor	Mechanical pipe insulation	4 fittings and 10 linear feet	Suspect	Good	Y	20
Between the brick wall and window frames, Exterior	Grey caulking	1800 linear feet	Chrysotile	Good	N	-
3rd floor and 5th floor	Black door caulking	100 linear feet	Chrysotile	Good	N	21
	Green interior door caulking	200 linear feet	Chrysotile			-
4th floor (Alum Tower)	Interior window caulking (grey, brown & black)	100 linear feet	Chrysotile	Good	N	22
Throughout service building	Lighting heat shield ^	8 units	Suspect ACMs	Good	Y	23
	Elevator brake pads ^	2 units	Suspect ACMs	Good	N	24
Exterior door frame, Boiler room	Caulking	20 linear feet	23.6% Chrysotile	Good	N	25
Exterior door frame, Maintenance shaft [2]	Caulking	NQ	23.3% Chrysotile	-	N	-
Exterior door frame, Alum door [2]	Caulking	NQ	0.80% Chrysotile	-	N	-
Tunnel						
West Stairwell	Linear mechanical pipe insulation – "Air-cel"	100 Linear feet	Chrysotile	Good	Y	4

* Material not observed, suspected to be present behind inaccessible ceiling/wall space

** Material not observed during the previous re-assessment survey
*** Accessible Material was reportedly abated by client, but still present behind inaccessible wall space.
^ Material not sampled – assumed to contain asbestos
^^ Material encapsulated with protective layer as reported in previous reassessment
^^^ Visual remnants of the materials that were reportedly abated
N/Q= Not Quantified
****Material was reportedly abated by client during recent renovation.
^^ This materials was classified as suspected ACMs during a previous re-assessment. Before the start of 2021 re-assessment, the client reported that it was tested and identified as non-asbestos-containing.
1. As reported by the client, new windows were installed, however ACM is still potentially present
2. Material was inaccessible at the time 2024 reassessment survey

Lead Inspection - 2024

Table 2

Summary of Lead-Containing Paint Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario
November 2024

Location	Description	Lead Content	Condition
THEM Project #14220			
Pumping building, Floor area	4"x 4" red square ceramic floor tiles	0.03 mg/cm^2	Good
#5 screen valve/actuator	Light grey paint	0.14 mg/cm^2	Fair
Wall area adjacent #5 screen mechanism	Green ceramic wall tiles	54.5 mg/cm^2	Fair
THEM Reassessment Survey 2010, Project #14044			
1st floor, Storage room 5	Grey floor paint	0.02mg/cm^2	Fair
1st floor, Storage room 5	Green door paint	1.83 mg/cm^2	Good
1st floor, Welding shop	Black door paint	0.00 mg/cm^2	-
1st floor, Work shop	Light grey wall paint	0.07 mg/cm^2	Good
1st floor, North corridor	Red door paint [ab]	0.25 mg/cm^2	Good
1st floor, Renovated electrical shop	White wall paint	0.01 mg/cm^2	Good
1st floor, Exit 1	Tile surface glazing	0.02 mg/cm^2	Fair
1st floor, Area 2	Red/brown ceramic tile surface glazing	0.03 mg/cm^2	Fair
1st floor, Area b (recycling room)	Blue equipment room	0.00 mg/cm^2	-
North east stairwell	Cream wall paint	0.33 mg/cm^2	Good
North east stairwell	Brown railing paint [c]	4.17 mg/cm^2	-
2nd floor	Green wall paint [ab]	0.27 mg/cm^2	Fair
Basement, Training room	Red ceramic floor tile surface glazing	0.00 mg/cm^2	-
Basement, Low lift pump area	Yellow brick surface glazing	1.9 mg/cm^2	Good
Basement, Low lift pump area	Red ceramic tile surface glazing	0.01 mg/cm^2	Fair

Table 2 (Continued)

Summary of Lead-Containing Paint Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

Location	Description	Lead Content	Condition
Basement area 3	Yellow stair paint	1.93 mg/cm^2	Fair
Basement area 3	Light brown door paint	0.7 mg/cm^2	Good
Basement, Transformer room 2	White wall paint	0.01 mg/cm^2	Poor
1st floor, Pump room	Light brown ceramic wall tile surface glazing	0.03 mg/cm^2	Good
1st floor, Women's locker room	Yellow ceramic floor tile surface glazing	0.02 mg/cm^2	Good
1st floor, Women's locker room	Grey brick wall surface glazing	0.00 mg/cm^2	-
1st floor, Janitor's room	Grey floor paint	0.06 mg/cm^2	Poor
1st floor, Janitor's room	Peach wall paint	0.01 mg/cm^2	Fair
1st floor, Men's washroom	White wall ceramic tile surface glazing	7.9 mg/cm^2	Good
2nd floor, Men's locker room	Dark green wall paint [ab]	0.37 mg/cm^2	Good
3rd floor, Change room	Beige & white floor Ceramic tile surface glazing	0.05 mg/cm^2	Good
3rd floor, Change room	White wall paint	0.00 mg/cm^2	-
Stairwell	Green railing paint	2.0 mg/cm^2	Good
Stairwell	Grey floor paint	0.04 mg/cm^2	Good
2nd floor, Office 3	Light green wall paint [c]	0.09 mg/cm^2	-
2nd floor, Ups room	Off-white wall paint	0.03 mg/cm^2	Good
2nd floor, Old control room	Light blue wall paint [b]	0.01 mg/cm^2	-
1st floor, Washroom	Black window paint	1.7 mg/cm^2	Fair
1st floor, Area 5	Yellow wall paint	0.1 mg/cm^2	Good
1st floor, Control room	Kaki wall paint	0.01 mg/cm^2	Good
1st floor, Chlorination room	White wall paint	0.15 mg/cm^2	Poor

Table 2 (Continued)

Summary of Lead-Containing Paint Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

Location	Description	Lead Content	Condition
THEM (2008)			
1st floor, Service building, Stairwell to basement	White wall paint	0.46 % by weight	Good
Basement, Service building, Training room	Pink wall paint [ab]	1.4 % by weight	Good
Basement, Service building, Corridor	Red floor paint	0.43 % by weight	Good
Basement, Pumping building	Dark grey pipe paint	0.052 % by weight	Poor
THEM (2009)			
Filter building east side	Exterior black window frame paint [ab]	0.045 % by weight	Fair
Filter building, Interior	Green/brown frame paint	1.5 % by weight	Fair
Filter building	White window paint – on glass	<0.018 % by weight	-
Administration main lobby	White ceiling paint	<0.010 % by weight	-
Pump station north entrance	Black gate paint [ab]	0.43 % by weight	Good
North pump station door	Green door paint	8.9 % by weight	Good
Alum tower stairwell	Interior brick mortar	<0.013 % by weight	-
Alum tower	Exterior brick mortar	0.020 % by weight	Good
Alum tower	Exterior stone mortar	<0.023 % by weight	-
Service building exterior	Brick mortar	<0.014 % by weight	-
Service building	Exterior stone mortar	<0.002 % by weight	-
Pump station, East wall	Interior green glazed brick mortar	0.023 % by weight	Good
Pump station, East wall	Interior yellow brick mortar	<0.014 % by weight	-
Pump station east interior wall	Lighter green surface mortar	<0.019 % by weight	-
Pump station east wall	Stone mortar	<0.010 % by weight	-

Table 2 (Continued)

Summary of Lead-Containing Paint Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

Location	Description	Lead Content	Condition
Pump station, East wall	Brick wall mortar	<0.025 % by weight	-
Pump station, East wall	Interior wall green glazing on brick	<0.012 % by weight	-
Alum tower windows	Black frame paint [b]	18 % by weight	-
Filter building, East	Interior brick mortar	<0.022 % by weight	-
Filter building	West interior brick	<0.012 % by weight	-
Filter building, West	Exterior stone mortar	<0.020 % by weight	-
East elevation, Filter building	Brick mortar	<0.016 % by weight	-
Filter building (west)	Exterior brick mortar	<0.018 % by weight	-
East side wash water tank	Exterior brick mortar	<0.029 % by weight	-
Wash water tank	West exterior brick mortar	<0.011 % by weight	-
Admin tower, West side	Exterior stone mortar	<0.015 % by weight	-
Admin tower, West	Exterior brick mortar	<0.023 % by weight	-
Bulk Sample Analysis Results (November 13th & 14th, 2007)			
Service building north, East stairwell	Cream wall paint	0.16 % by weight	Good
Service building, Basement training room	Green wall paint	1.2 % by weight	Good
1st floor, Work shop	Yellow floor stripe paint	6.3 % by weight	Fair
Basement, West area	Ceiling off white paint	0.47 % by weight	Poor
1st floor, Electrical shop	Off white wall paint	<0.14 % by weight	-
Pump building, Basement, Transformer room 2	White wall paint	<0.01 % by weight	-
Pump building, 1st floor, Janitor's room	Peach wall paint	<0.05 % by weight	-
Basement, Low lift pump	White wall paint	0.097 % by weight	Good

Table 2 (Continued)

Summary of Lead-Containing Paint Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

Location	Description	Lead Content	Condition
Basement, Low lift pump	Grey paint on pump stands	4.4% by weight	Good
Basement, Low lift pump	Grey paint on pumps*	4.9% by weight	-
Basement, Low lift pump	Yellow paint on pumps*	4.2 % by weight	-
Basement, Low lift pump	Bright yellow paint on pumps*	3.4 % by weight	-
1st floor, Screen room	Grey paint on equipment	12 % by weight	Poor
1st floor, Open area	Dark brown railing paint [b]	22 % by weight	-
1st floor, South corridor	Off-white wall paint [ab]	0.28 % by weight	Good
1st floor, Stores	Burgundy floor paint	3.3 % by weight	Fair
2nd floor, Locker room	Turquoise wall paint [ab]	0.68 % by weight	Good
Admin building, 3rd floor, Women's locker room	White ceiling paint	0.03 % by weight	Good
Admin building, 3rd floor, Stairwell	Green railing paint	0.22 % by weight	Good
1st floor, Pipe galleries	Grey catwalk paint	0.38 % by weight	Poor
1st floor, Washroom	Black window paint	8.2 % by weight	Fair
1st floor, Chlorine room	Light grey floor paint	0.28 % by weight	Fair
2nd floor, Corridor	White wall paint	0.0089 % by weight	Good
Chlorine stores	Burgundy door paint	13 % by weight	Fair
Access tunnel	White wall paint	0.011 % by weight	Good
Access tunnel	Dark grey wall paint [ab]	0.11 % by weight	Good
OHE Bulk Sampling Summary Report, October 2019, Project #24964			
Pipe, Crawl space above raw water flume, 1st floor, Filter building	White paint**	0.052% by weight	-

Table 2 (Continued)

Summary of Lead-Containing Paint Inventory
Hazardous Building Materials Re-assessment
R.C. Harris Treatment Plant, Toronto, Ontario

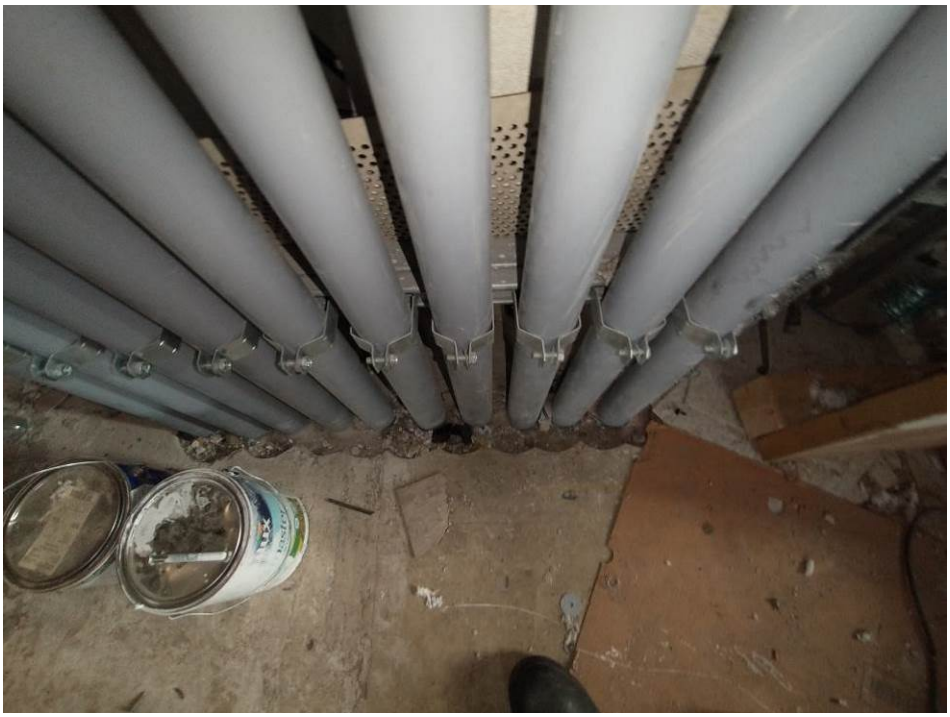
Location	Description	Lead Content	Condition
OHE Hazardous Building Material Survey Report, October 2021, Project 26723-006			
Floor, Storage room, 1st Floor, Pumping building	Wine red paint	0.92% by weight	Fair
Ceiling, Storage room, 1st Floor, Pumping building	Cream paint	0.095% by weight	Good
Southeast door frame, Storage room, 1st floor, Pumping building	Green paint	4.5% by weight	Good
Top section of the east wall, Transform Room 2, Basement, Pumping building	Light grey paint	0.070% by weight	Good
Southwest ceiling, Server room, 2nd floor, Admin building (Filter building)	Beige paint	0.050% by weight	Fair
Southwest ceiling, Server room, 2nd floor, Admin building (Filter building)	White paint	0.040% by weight	Fair
Ceiling, Computer room (WMS Room), 1st floor, Service building	White paint	0.25% by weight	Poor
West section of the north wall, Computer room (WMS Room), 1st floor, Service building	Beige paint	<0.0080% by weight	-
SEL, DSHBM Assessment Report, December 28, 2021, Project 1-3210982			
Scrubber area, Concrete	White paint	0.0099% by weight	Good
Feeder room, Concrete	White paint	0.25% by weight	Good
Chlorine storage, Concrete	White paint	0.050% by weight	Fair
Scrubber area, Pipe	Green paint	0.49% by weight	Fair
Chlorine storage, Chlorine tank	Red paint	<0.0081 by weight	-
Chlorine storage, Concrete block	Brown paint	0.11% by weight	Fair

*--Material was reportedly abated (blasted) and repainted by the client.
**-- Material was reportedly abated by client and section still present behind inaccessible wall space.
a--Paint not observed on the sampled source (location) but paint is present on other surfaces (i.e. floor, walls, ceilings, equipment, etc.).
b--Paint not observed on the sampled source (location) but paint may be present under the existing paint.
c--Paint not observed on the sampled source (location) and not on other surfaces (i.e. floor, walls, ceilings, equipment, etc.).

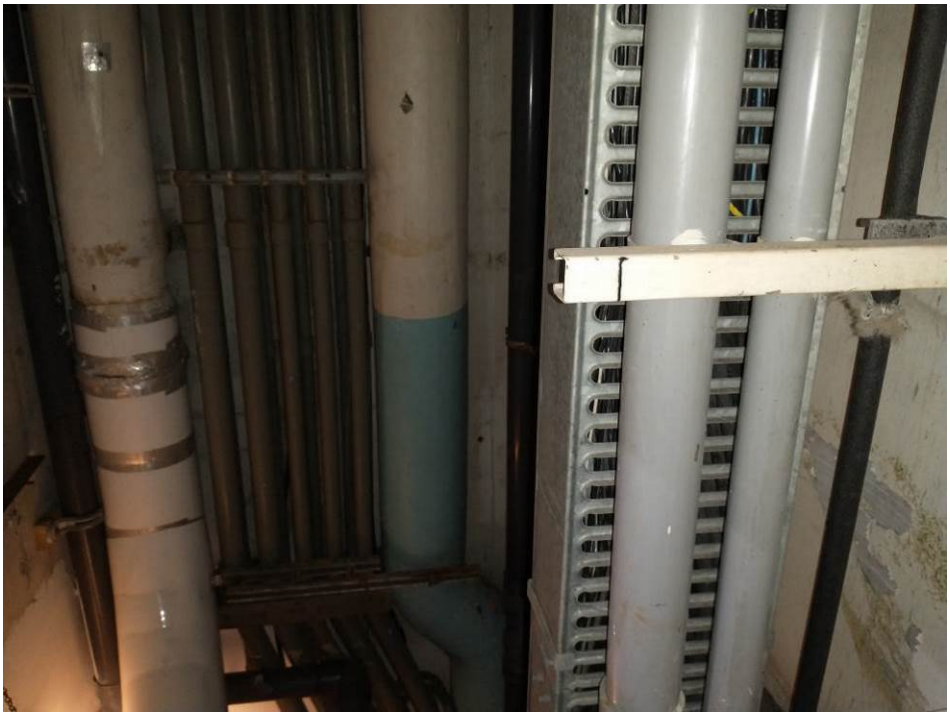
Site Photographs

Photograph 1: View of the asbestos-containing mechanical linear pipe insulation observed in the hallway on the 2nd floor of the Filter Building.

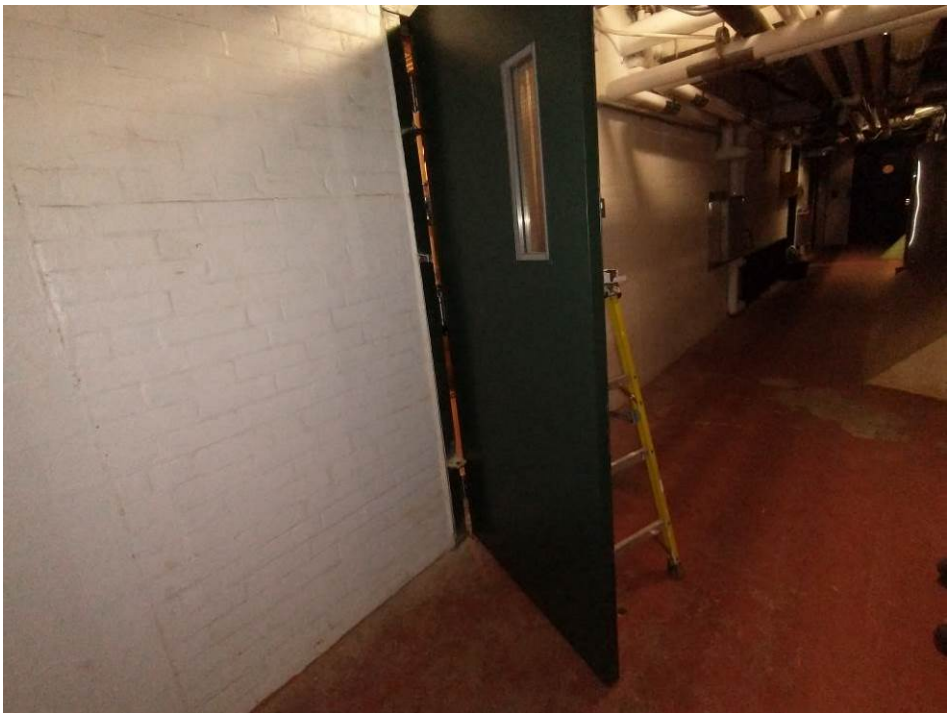
Photograph 2: View of the asbestos-containing interior window caulking painted brown observed in the hallway on the 2nd floor of the Filter Building.



Photograph 3: View of the asbestos-containing vinyl floor tiles and mastic present in the server room on the 2nd floor of the Administration Building (Filter Building).



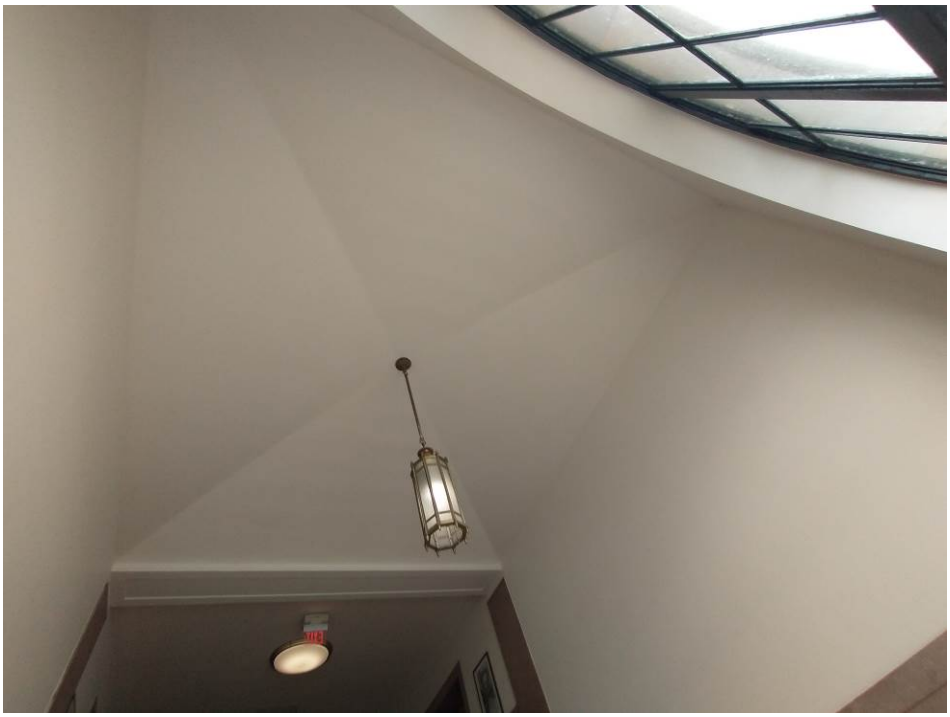
Photograph 4: View of the asbestos-containing mechanical linear pipe insulation observed within the west stairwell in the Filter Building adjacent to the tunnel.



Photograph 5: View of the suspect asbestos-containing fire rated door observed in the basement corridor of the Filter Building.

Photograph 6: View of the window in the 1st floor washroom in the Filter Building. The previously reported damaged asbestos-containing window caulking was not observed directly since it was covered with new finishes.

Photograph 7: View of the asbestos-containing grey interior window caulking observed in the stairwell on the 1st floor of the Filter Building.



Photograph 8: View of the asbestos-containing plaster observed on the dome above the stairwell in the Filter Building.

Photograph 9: Previous **v**iew of the asbestos-containing mechanical systems insulation in the form of air-cel present in the ceiling space (ceiling space now covered with drywall) in the lobby on the 1st floor in the Administration Building (Filter Building).

Photograph 10: View of the new windows where asbestos-containing window caulking is still potentially present in the control room of the Filter Building.

Photograph 11: View of the remnants of red floor coating observed in the northwest filter gallery of the Filtration Building.

Photograph 12: View of the remnants of red floor coating observed in the southwest filter gallery of the Filtration Building.

Photograph 13: View of a pipe reported by onsite staff to have mechanical systems insulation suspected of containing asbestos observed in the workshop in the Filtration Building.

Photograph 14: View of the asbestos-containing 12” x 12” vinyl floor tiles observed in the west end office on the 1st floor of the Pump Building.

Photograph 15: View of the asbestos-containing grey window caulking observed on the exterior of the Pump Building.

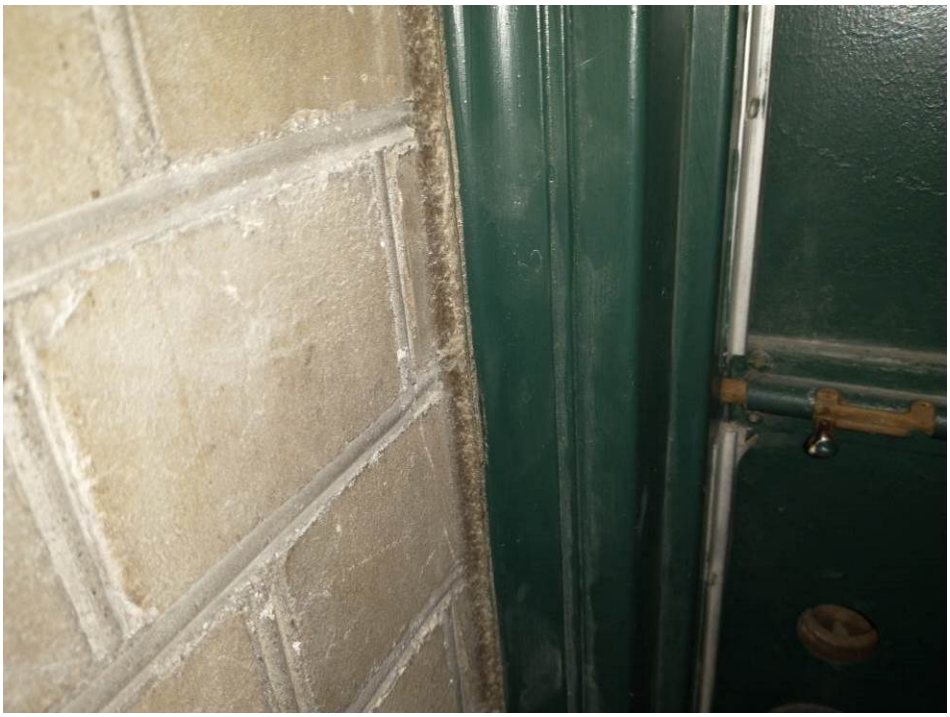
Photograph 16: View of the asbestos-containing red flooring with black layer on the floor of the storage room on the 1st floor of the Pump Building.

Photograph 17: Previous view of the asbestos-containing mechanical system insulation in form of magnesia block (covered with drywall) observed on the pipe straights in the men's washroom on 2nd floor of the Pump Building.

Photograph 18: Previous view of the asbestos-containing mechanical system insulation in form of parging cement (covered with drywall) observed on the pipe fittings in the men's washroom on the 2nd floor of the Pump Building.

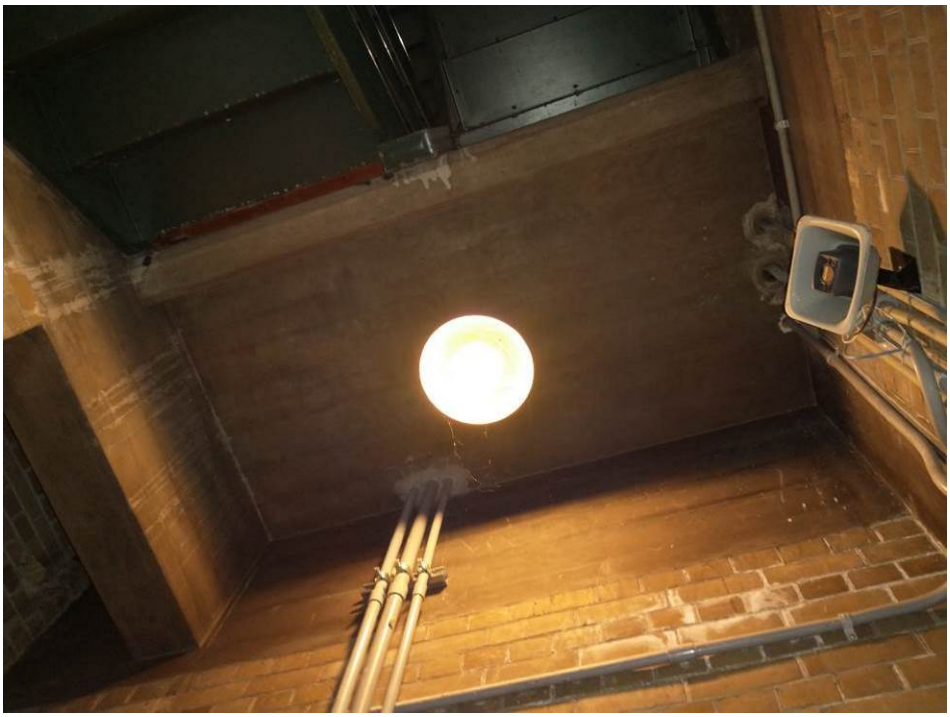
Photograph 19: Previous view of the asbestos-containing patch on the ceiling around the conduit penetrations into the ceiling of the storage room on the 1st floor of the Pump Building.

Photograph 20: View of the suspect asbestos-containing mechanical system pipe insulation previously observed concealed above the drywall ceiling at the entrance to the men's washroom in the hallway on the 2nd floor of the Service Building.



Photograph 21: View of the asbestos-containing black caulking between the door frame and the masonry wall observed on the 3rd floor of the Service Building.

Photograph 22: View of the asbestos-containing interior window caulking observed on the 4th floor of the Service Building.



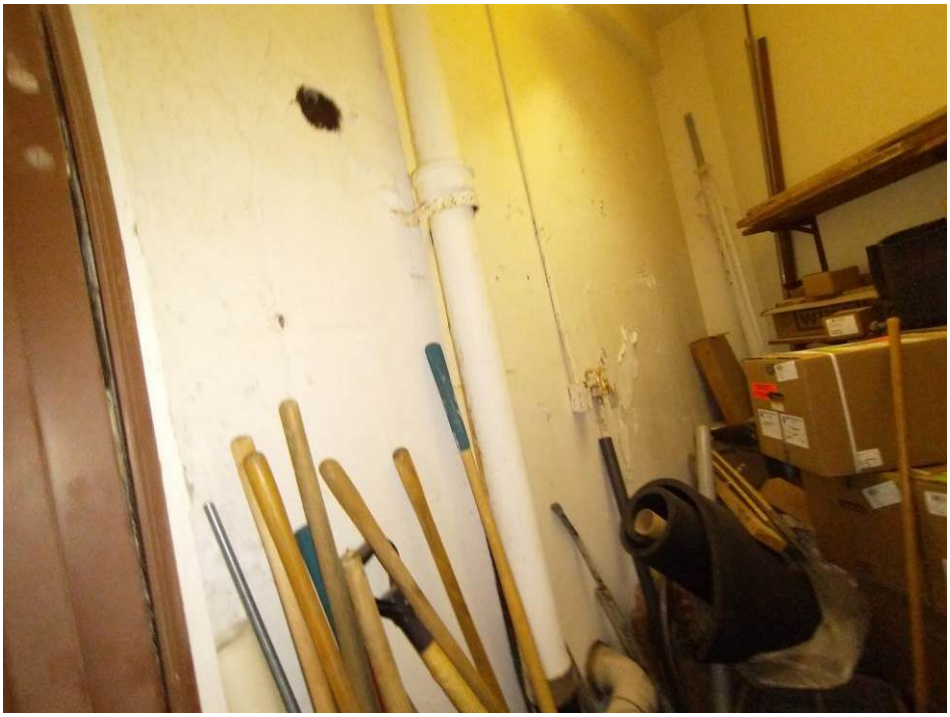
Photograph 23: View of the light fixture previously reported by onsite staff to have heat shields suspected of containing asbestos within the stairwell of the Service Building.

Photograph 24: View of the suspect asbestos-containing elevator brake pads observed on the 5th floor of the Service Building.

Photograph 25: View of the asbestos-containing white caulking observed around the exterior side of the door frame of boiler room of the Service Building.

Photograph 26: View of the lead-containing green paint (newly painted) observed on the door of the storage room on the 1st floor of the Service Building.

Photograph 27: View of the lead-containing yellow stair paint observed in the treated water pump room in the basement of the Pump Building.

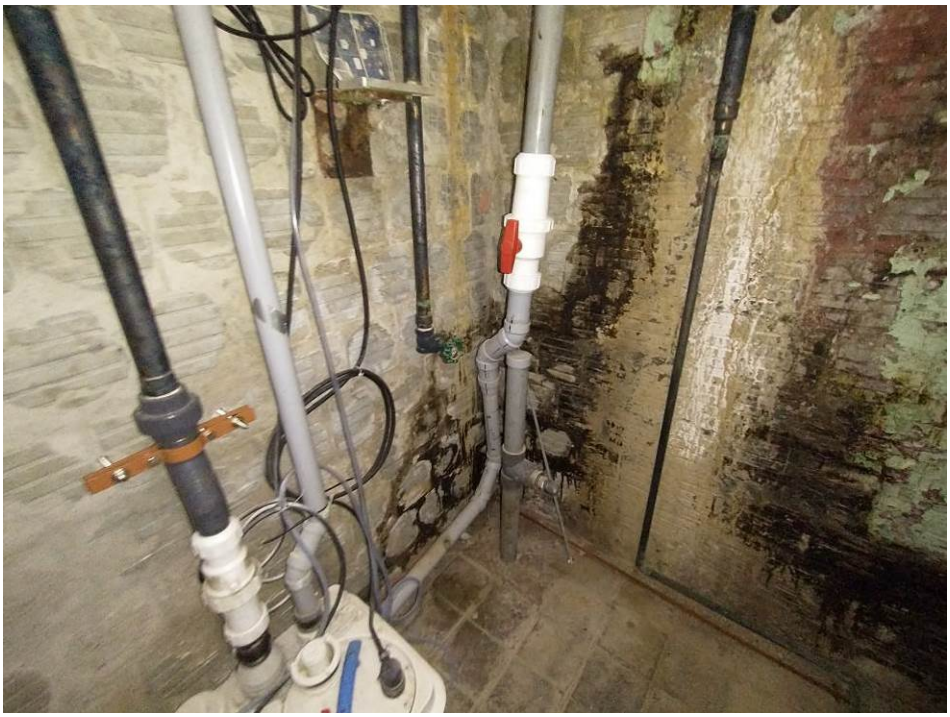


Photograph 28: View of the lead-containing white paint observed on the concrete wall in the basement of the Chlorine Storage Room in the Filter Building.

Photograph 29: View of the lead-containing brown paint observed on the concrete block wall on the ground floor of the Chlorine Storage Room in the Filter Building.

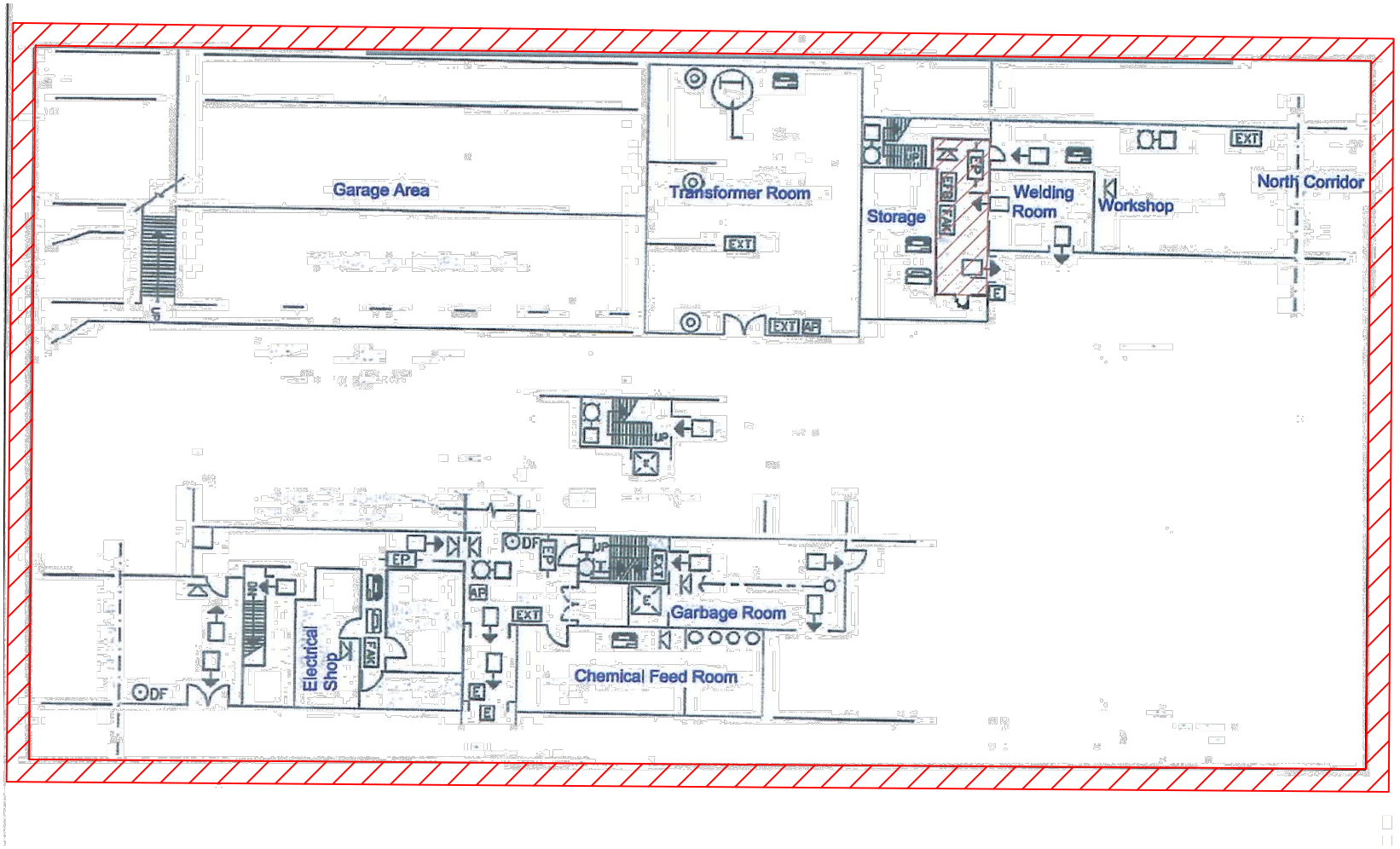
Photograph 30: View of the lead-containing green paint observed on pipe in the basement of the scrubber area in the Filter Building.

Photograph 31: View of the water damage (i.e. staining and efflorescence) observed on the wall in the stairwell on the 4th floor of the Service Building.



Photograph 32: View of the suspect mould growth observed on the wall in the basement of the Service Building.

Drawings



Legend:

Asbestos-Containing Caulking

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
1st Floor
Service Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

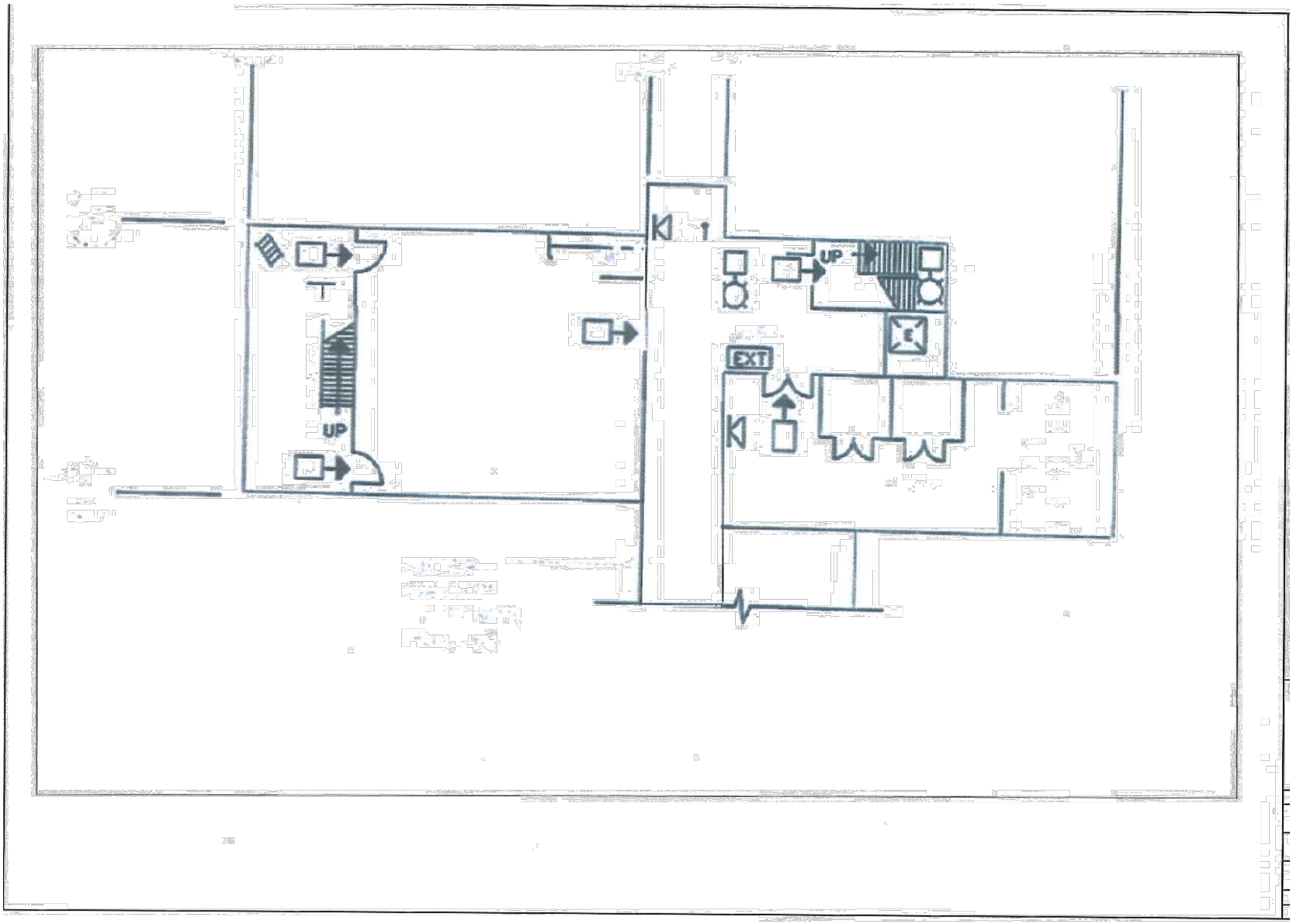
Drawn By: AF

Approved By: FA

Drawing No:

1.1

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
Basement
Service Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

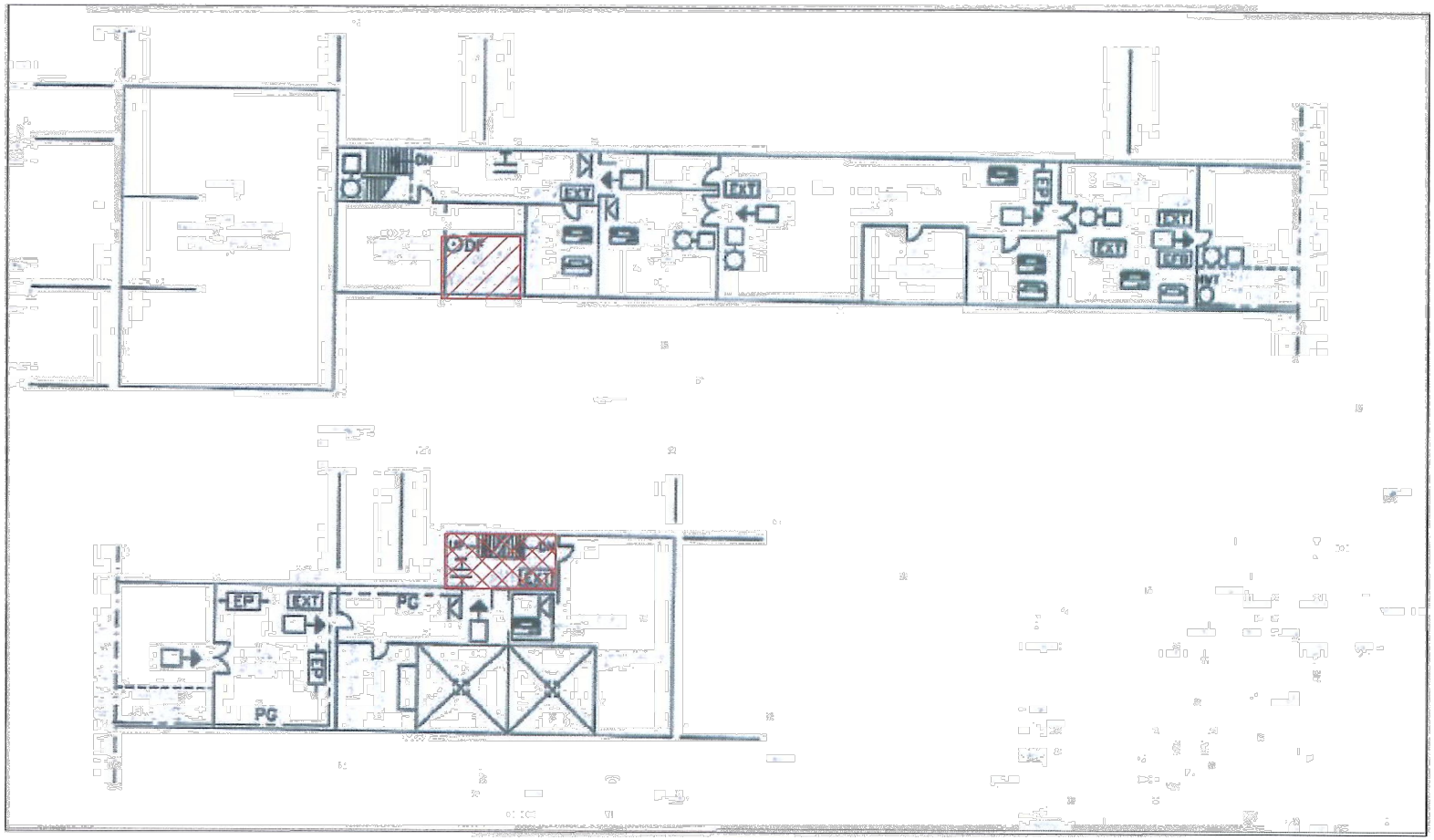
Drawn By: AF

Approved By: FA

Drawing No:

1.2

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

Asbestos-Containing Mechanical Pipe Insulation Previously Identified Within Closed Wall and/or Ceiling Spaces

Locations of Light Heat Shields Assumed to be Asbestos-Containing Materials

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
2nd Floor
Service Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

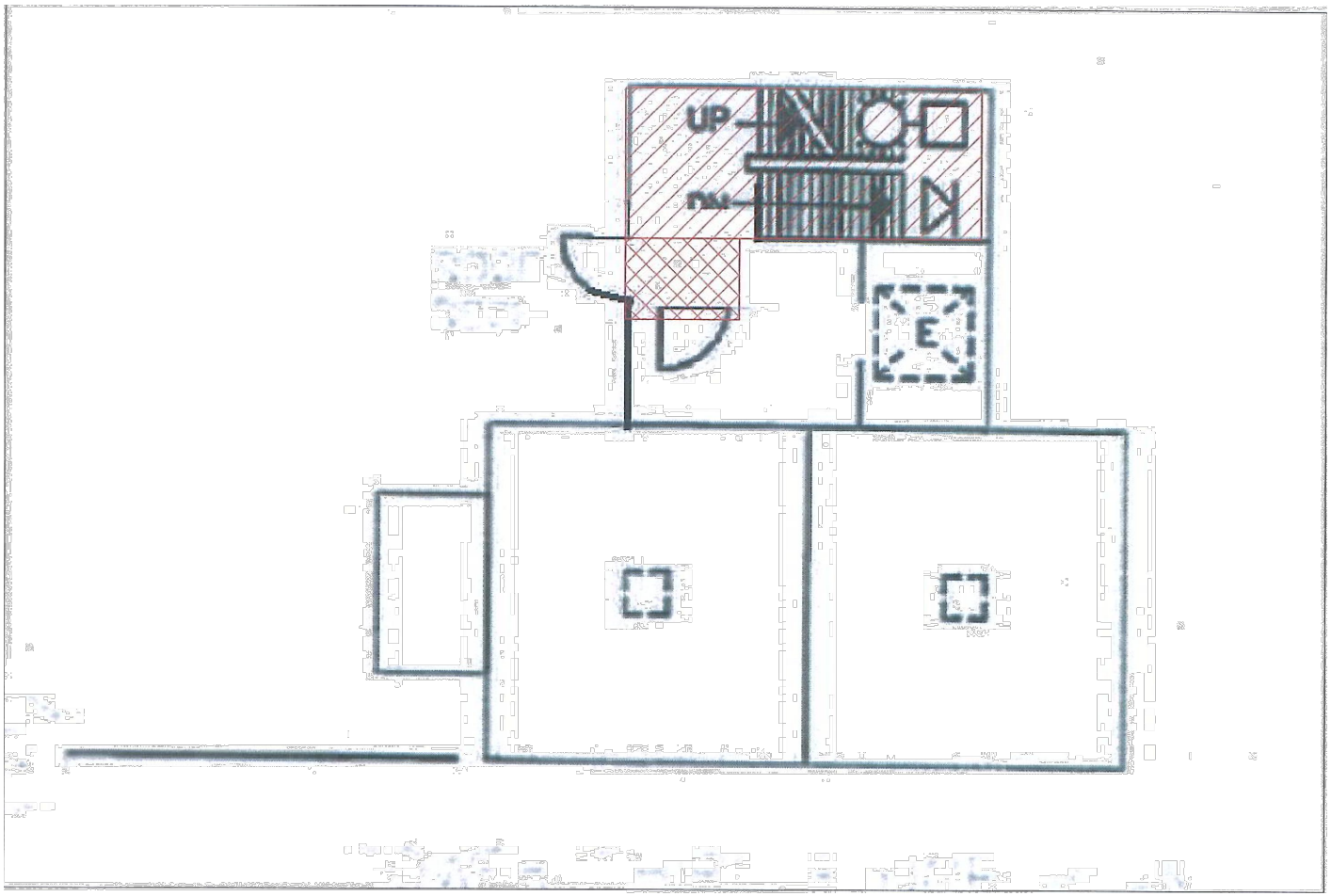
Drawn By: AF

Approved By: FA

Drawing No:

1.3

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

- Asbestos-Containing Caulking on Window Frames
- Light Heat Shields Assumed to be Asbestos-Containing Material

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
3rd Floor
Service Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

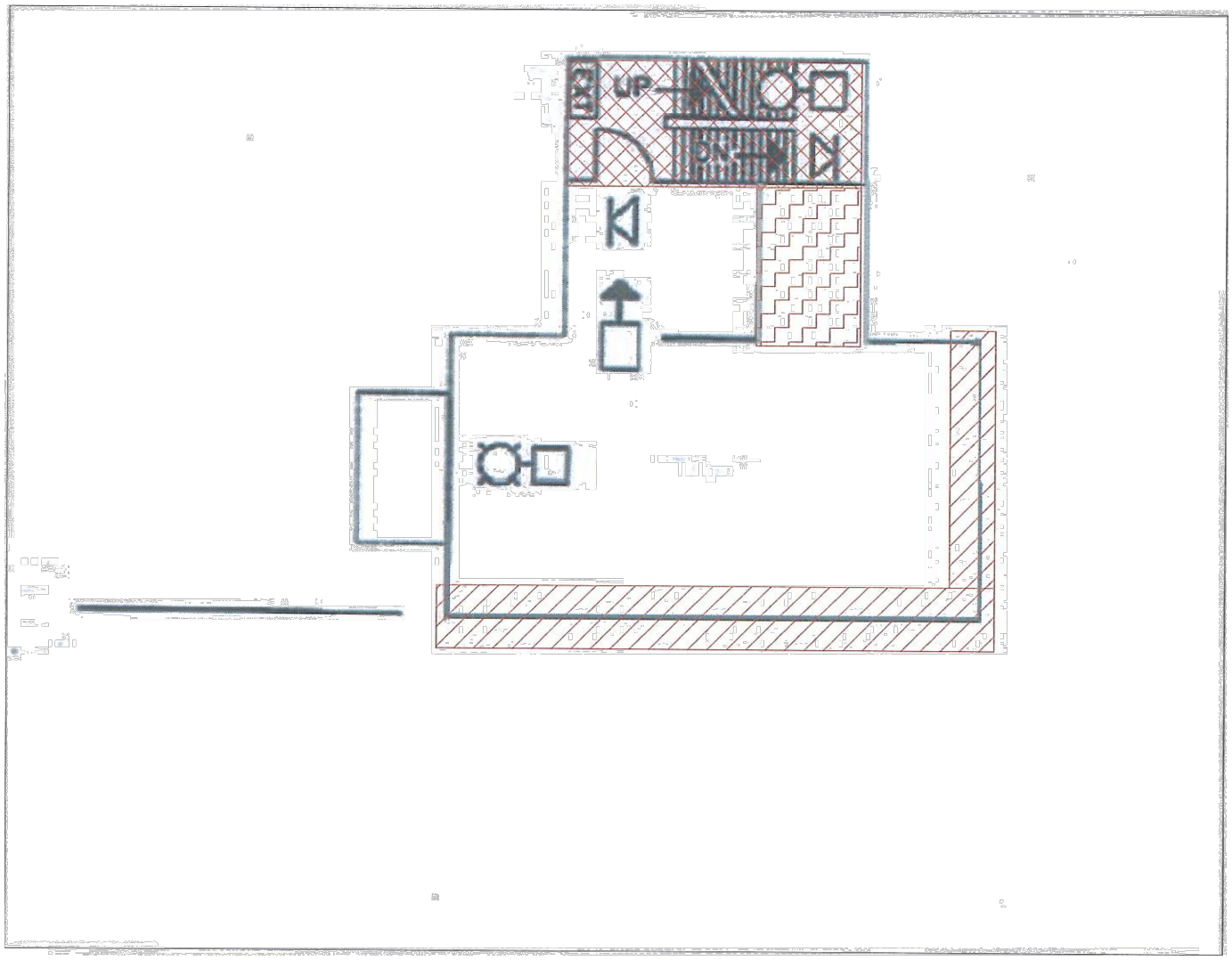
Drawn By: AF

Approved By: FA

Drawing No:

1.4

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

- Asbestos-Containing Caulking on Window Frames
- Light Heat Shields Assumed to be Asbestos-Containing
- Suspect Asbestos-Containing Elevator Brake Pads

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
4th Floor
Service Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

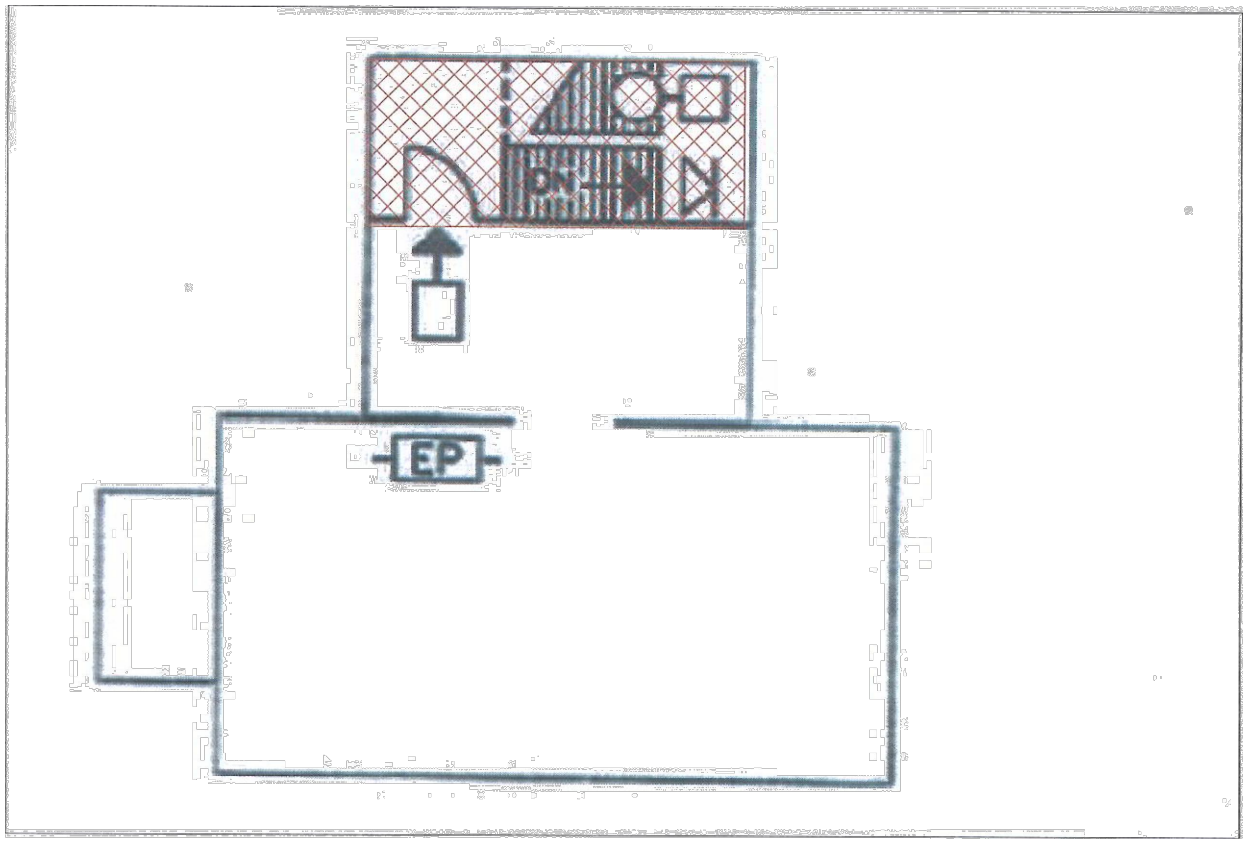
Drawn By: AF

Approved By: FA

Drawing No:

1.5

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

Light Heat Shields Assumed to be Asbestos-Containing

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
5th Floor
Service Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

Drawn By: AF

Approved By: FA

Drawing No:

1.6

CONSULTANTS
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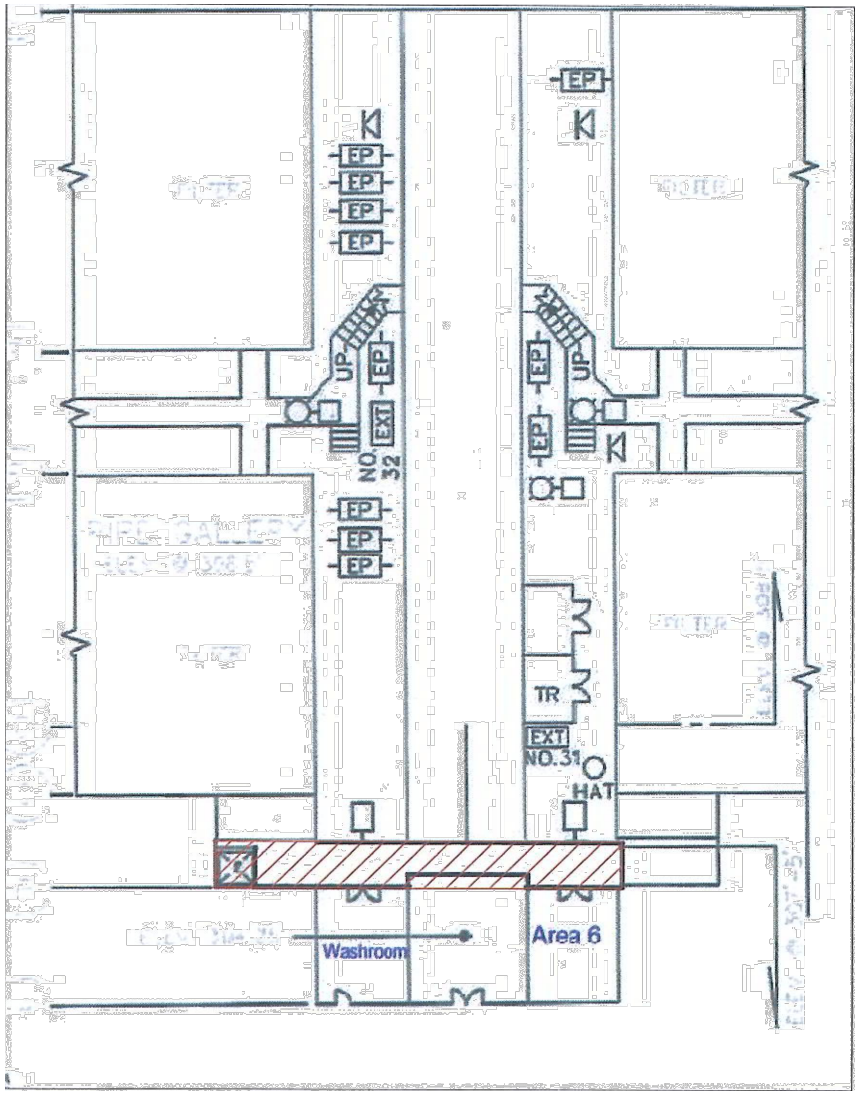


Legend:

Encapsulated Asbestos-Containing Red Flooring

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
Ground Floor
Filter Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

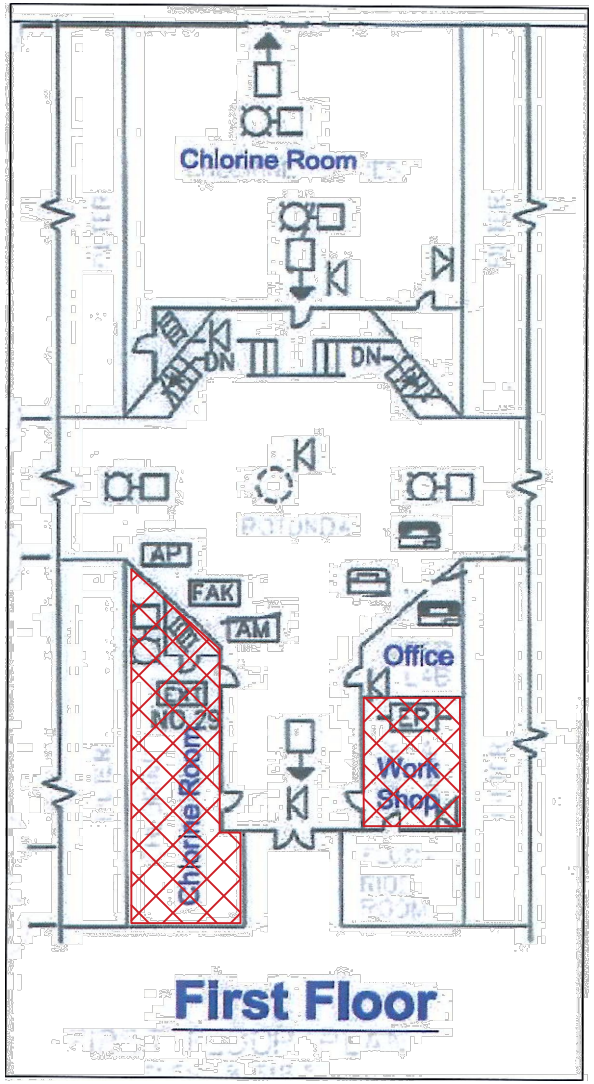
Drawn By: AF

Approved By: FA

Drawing No:

1.7

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

Suspected Asbestos-Containing Mechanical System Insulation

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
1st Floor
Filter Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

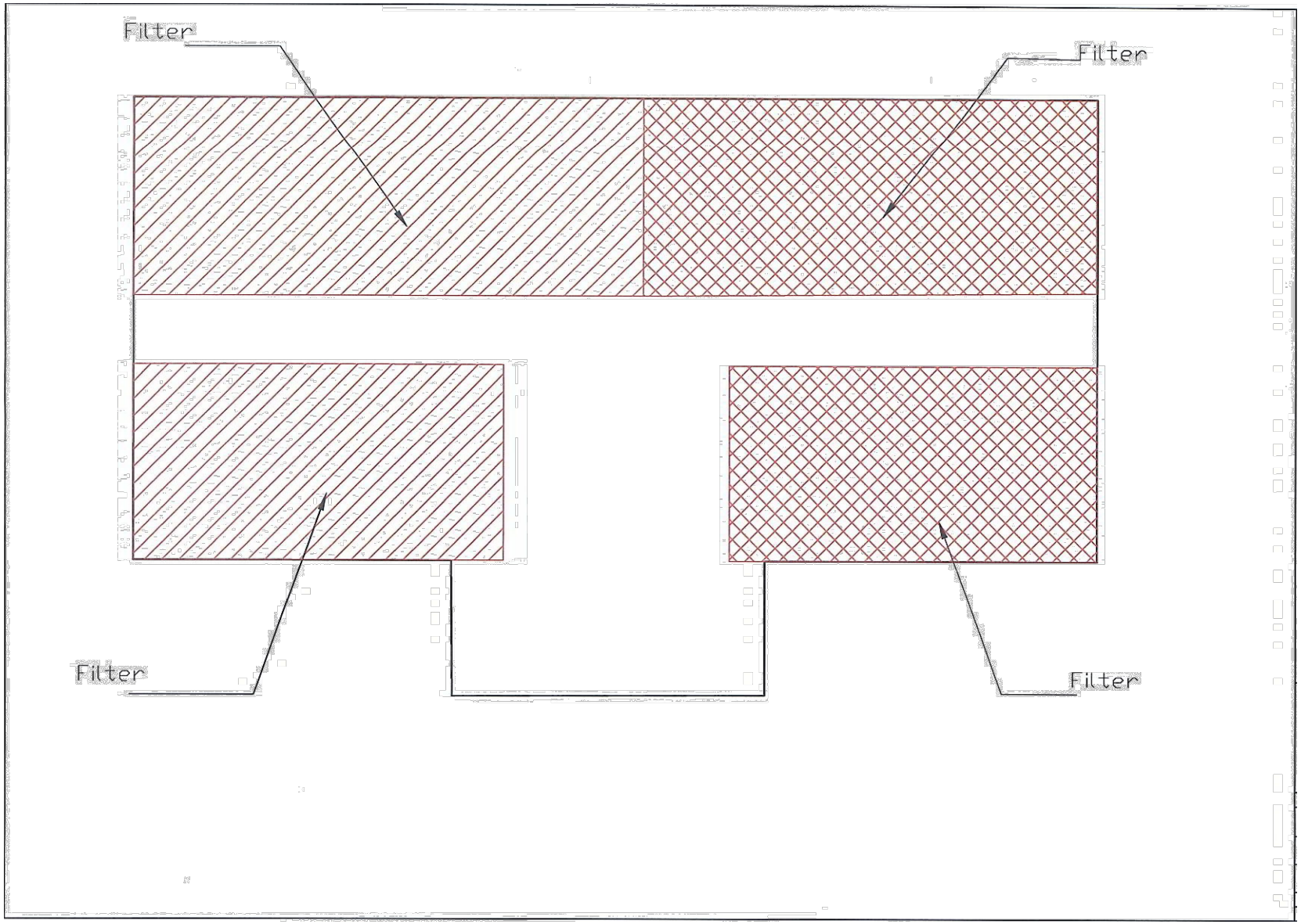
Drawn By: AF

Approved By: FA

Drawing No:

1.8

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

Asbestos-Containing Red Floor Coating and Light Heat Shields

Asbestos-Containing Light Heat Shields

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:

Filter Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

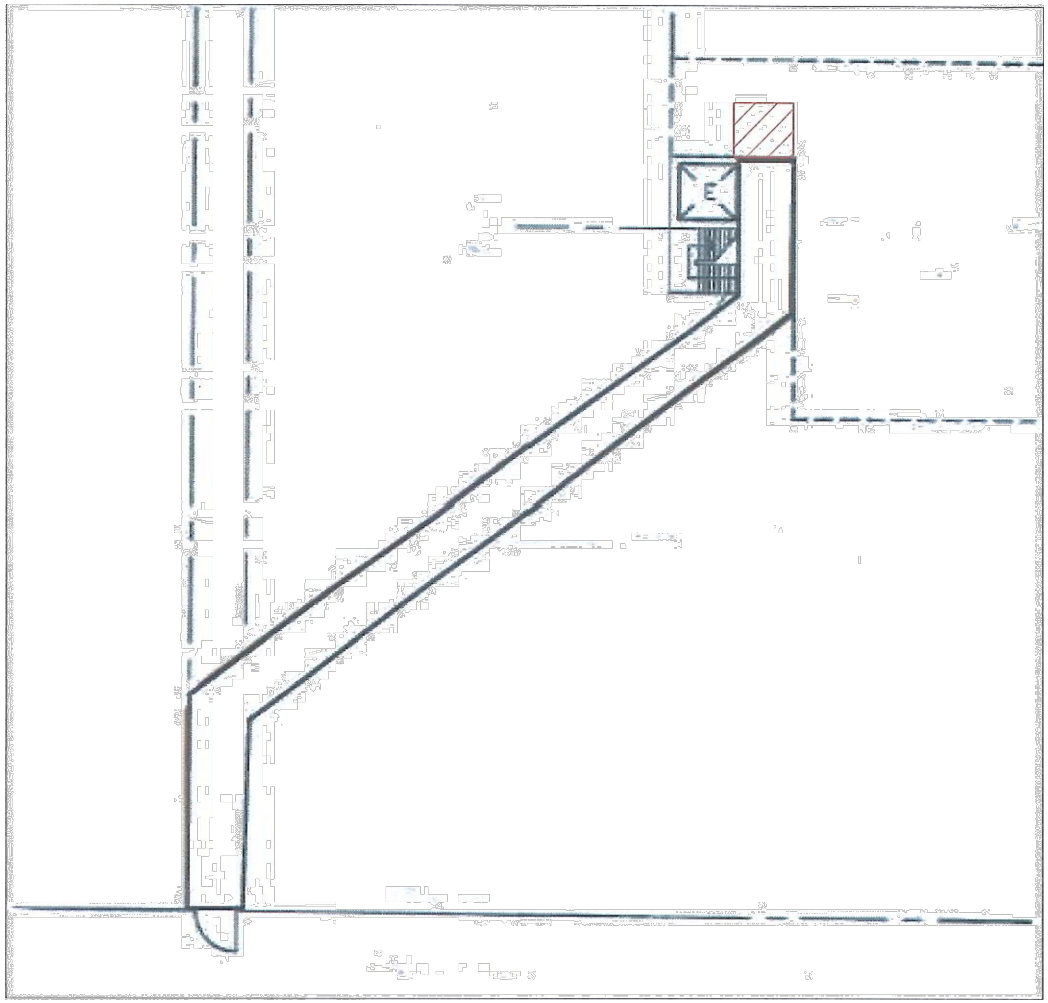
Drawn By: AF

Approved By: FA

Drawing No:

1.9

CONSULTANTS
Occupational Hygiene & Environment



Legend:

Asbestos-Containing Linear Mechanical Pipe Insulation

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:

Access Tunnel
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

Drawn By: AF

Approved By: FA

Drawing No:

1.10

MB CONSULTANTS
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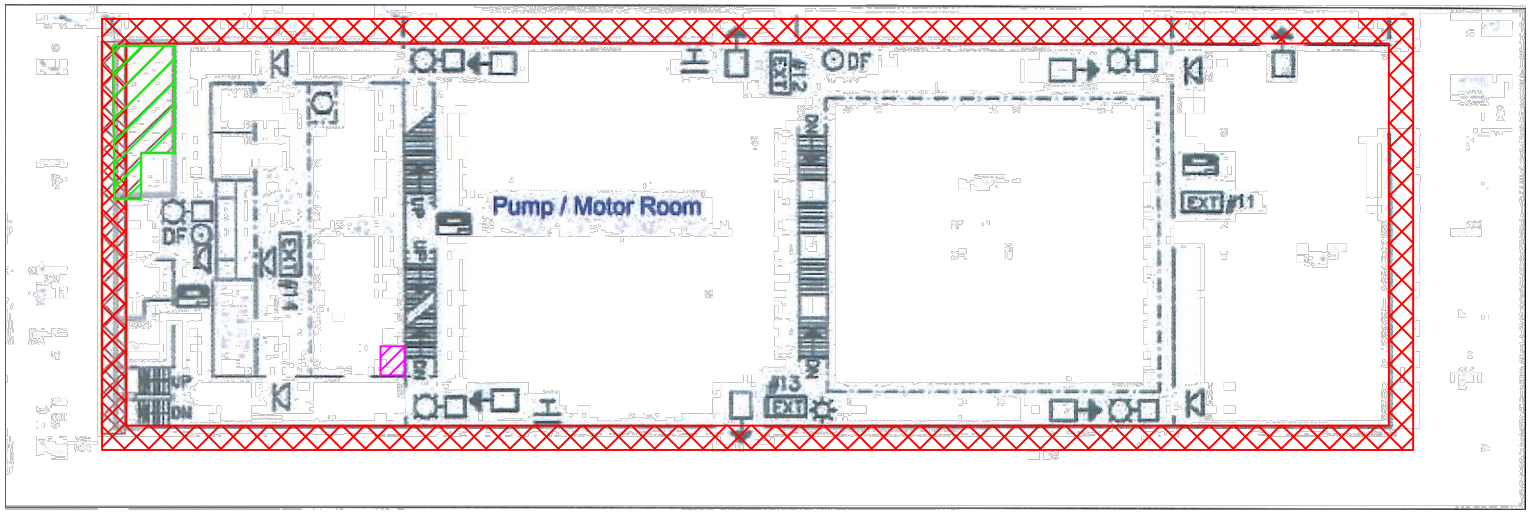


Legend:

- Asbestos-Containing Vinyl Floor Tiles
- Asbestos-Containing Window Caulking
- Asbestos-Containing Patch

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
1st Floor
Pumping Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

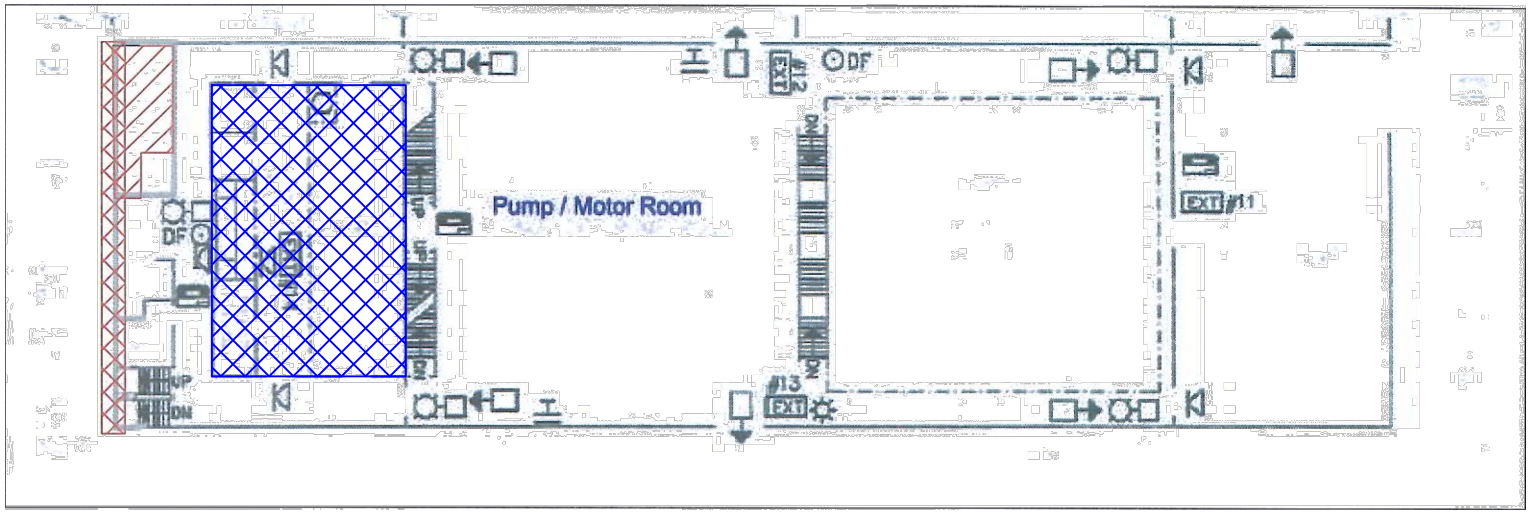
Drawn By: AF

Approved By: FA

Drawing No:

1.11

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

Asbestos-Containing Red Flooring w/ Black Layer

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:

1st Floor
Pumping Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

Drawn By: AF

Approved By: FA

Drawing No:

1.12

CONSULTANTS
Occupational Hygiene & Environment

Legend:

Asbestos-Containing Window Caulking

Asbestos-Containing Mechanical System Insulation

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
2nd Floor
Pumping Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

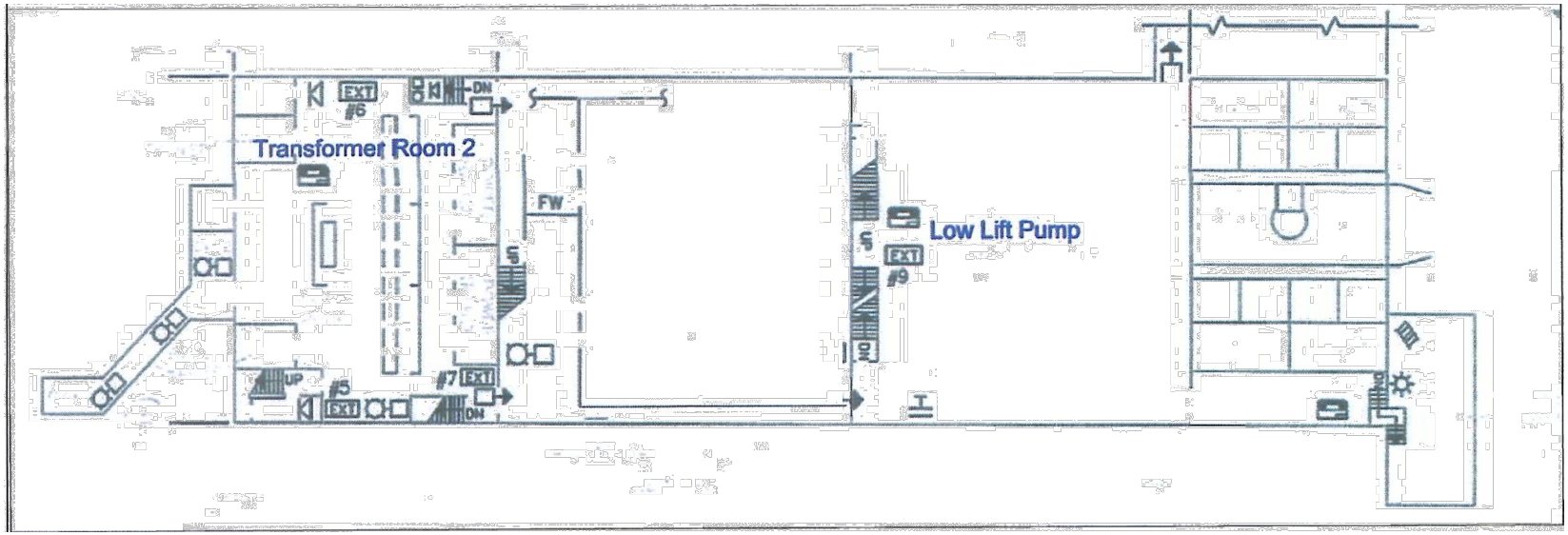
Drawn By: AF

Approved By: FA

Drawing No:

1.13

CONSULTANTS
Occupational Hygiene & Environment



Legend:

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
Basement
Pumping Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

Drawn By: AF

Approved By: FA

Drawing No:

1.14

CONSULTANTS
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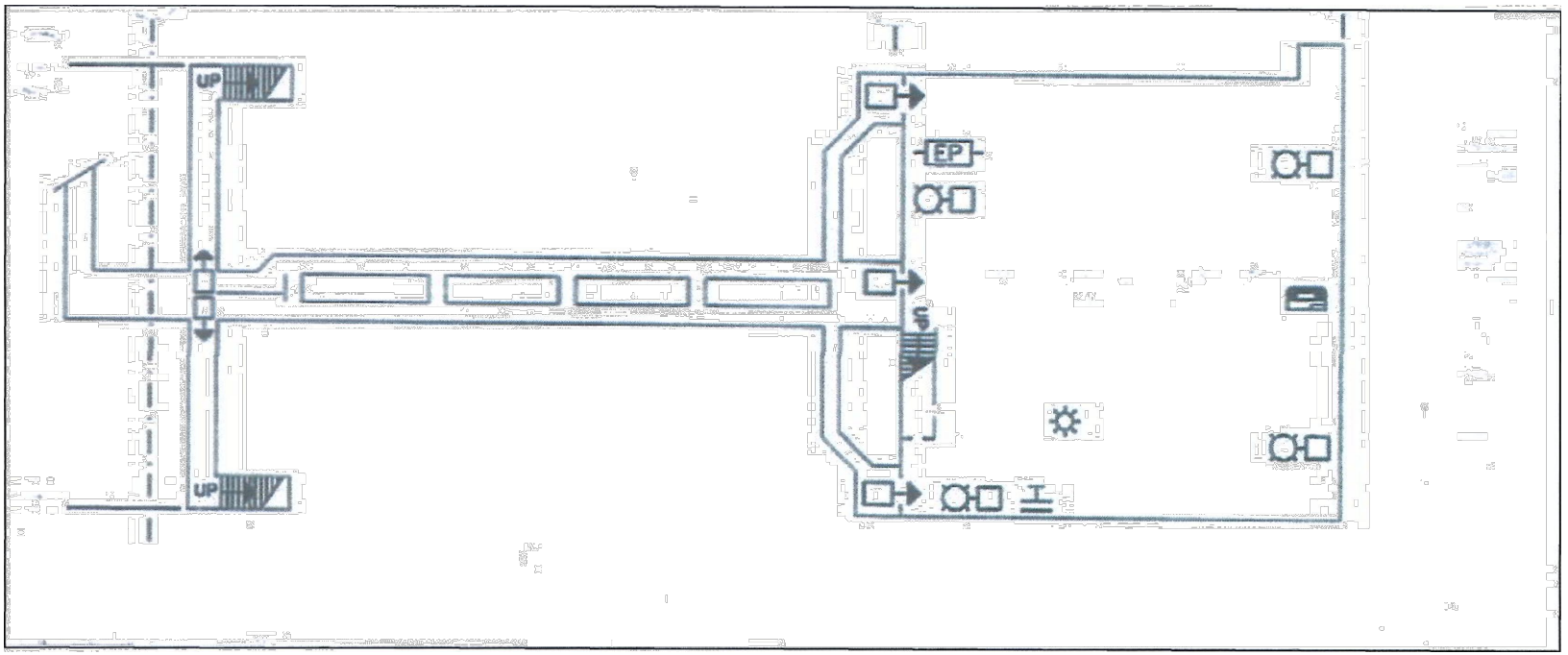


Legend:

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
Sub Basement
Pumping Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

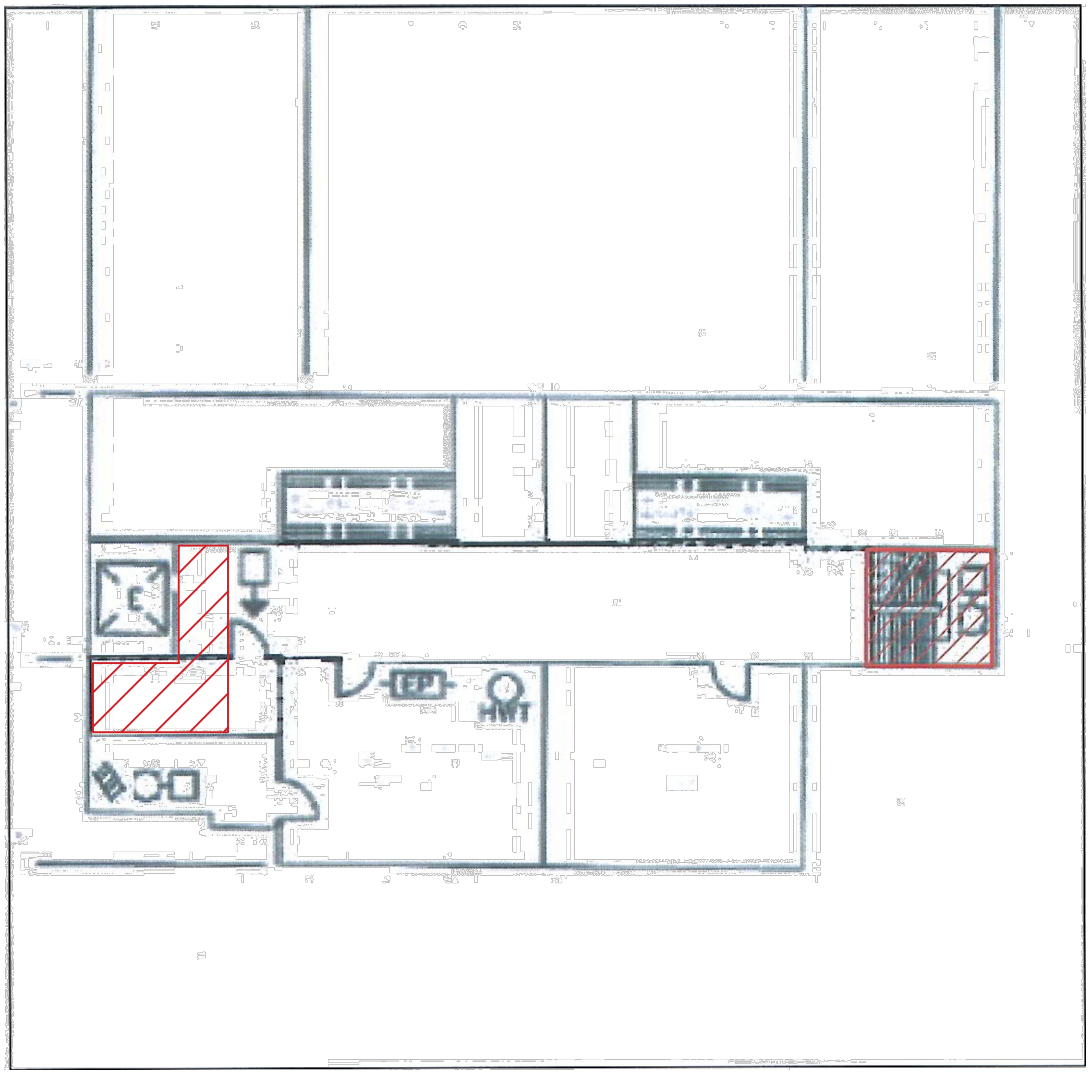
Drawn By: AF

Approved By: FA

Drawing No:

1.15

CONSULTANTS
Occupational Hygiene & Environment



Legend:

Asbestos-Containing Linear Pipe Insulation

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
Basement
Admin Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

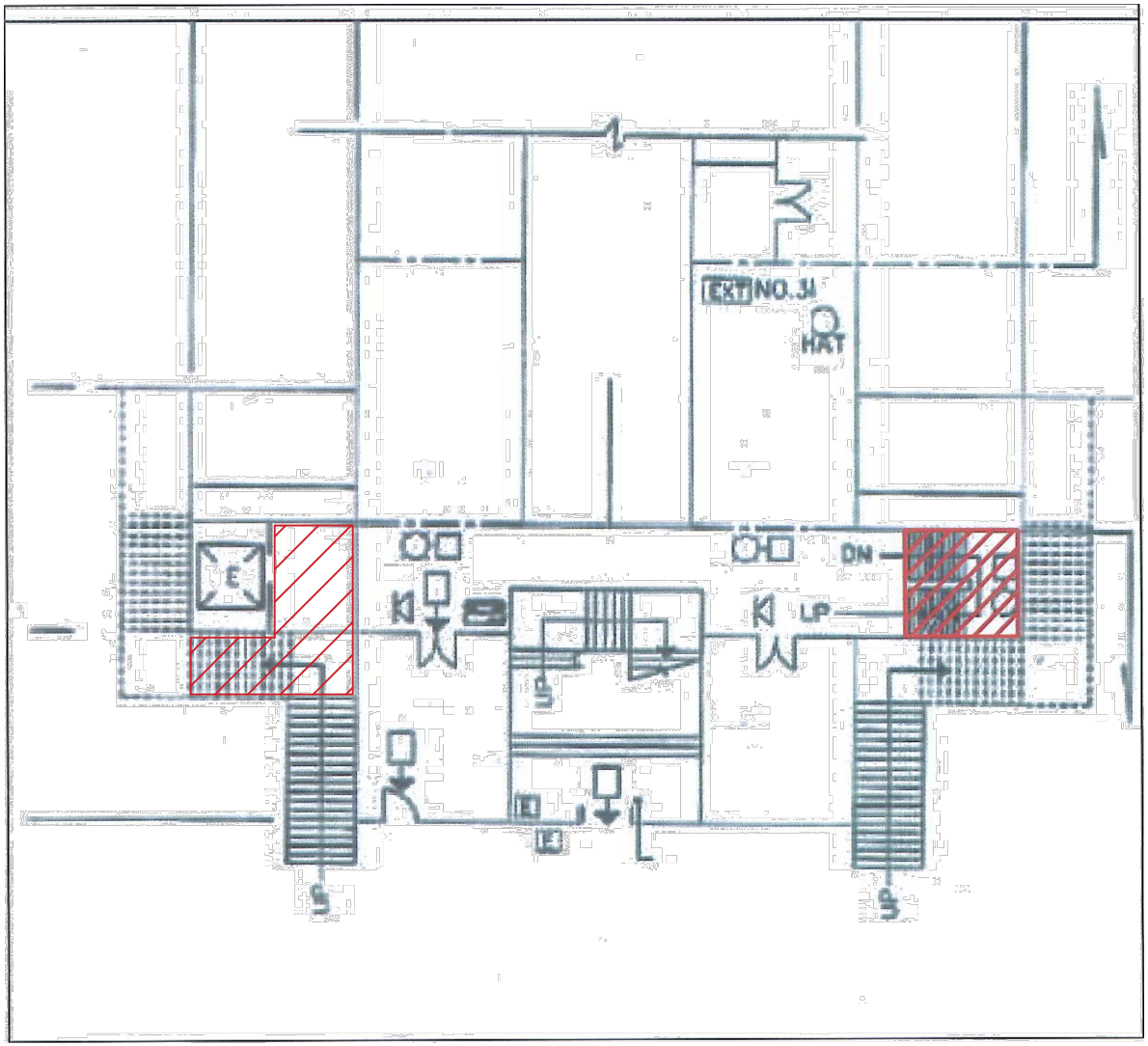
Drawn By: AF

Approved By: FA

Drawing No:

1.16

CONSULTANTS
Occupational Hygiene & Environment



Legend:

Asbestos-Containing Linear Pipe Insulation

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
1st Floor-1
Admin Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

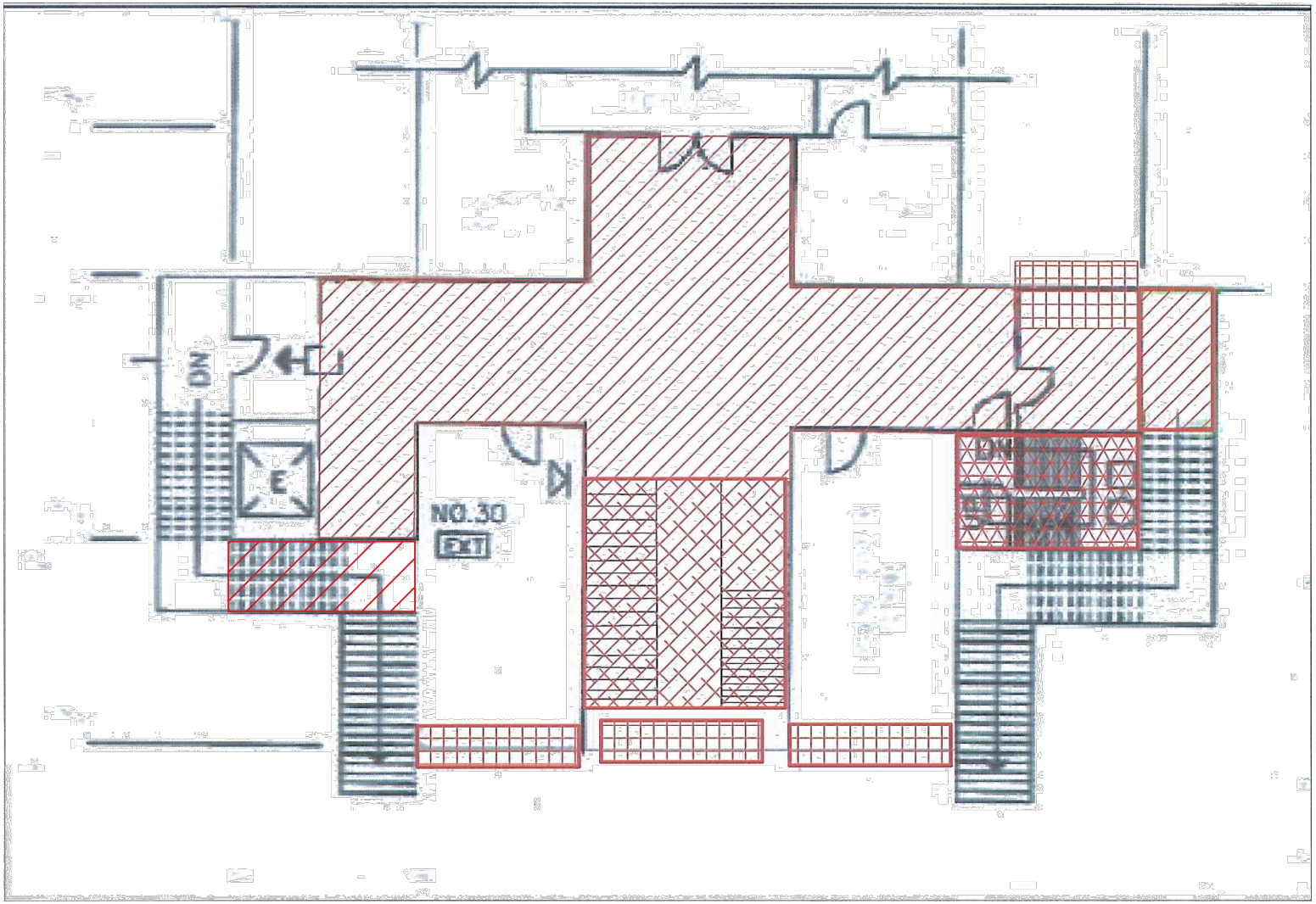
Drawn By: AF

Approved By: FA

Drawing No:

1.17

CONSULTANTS
Occupational Hygiene & Environment



Legend:

- Suspected Asbestos-Containing Pipe Fitting and Linear Pipe Insulation within Ceiling Space.
- Asbestos-Containing Caulking
- Asbestos-Containing Plaster Dome Ceiling Above Stairs
- Asbestos-Containing Linear Pipe Insulation

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
1st Floor-2
Admin Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

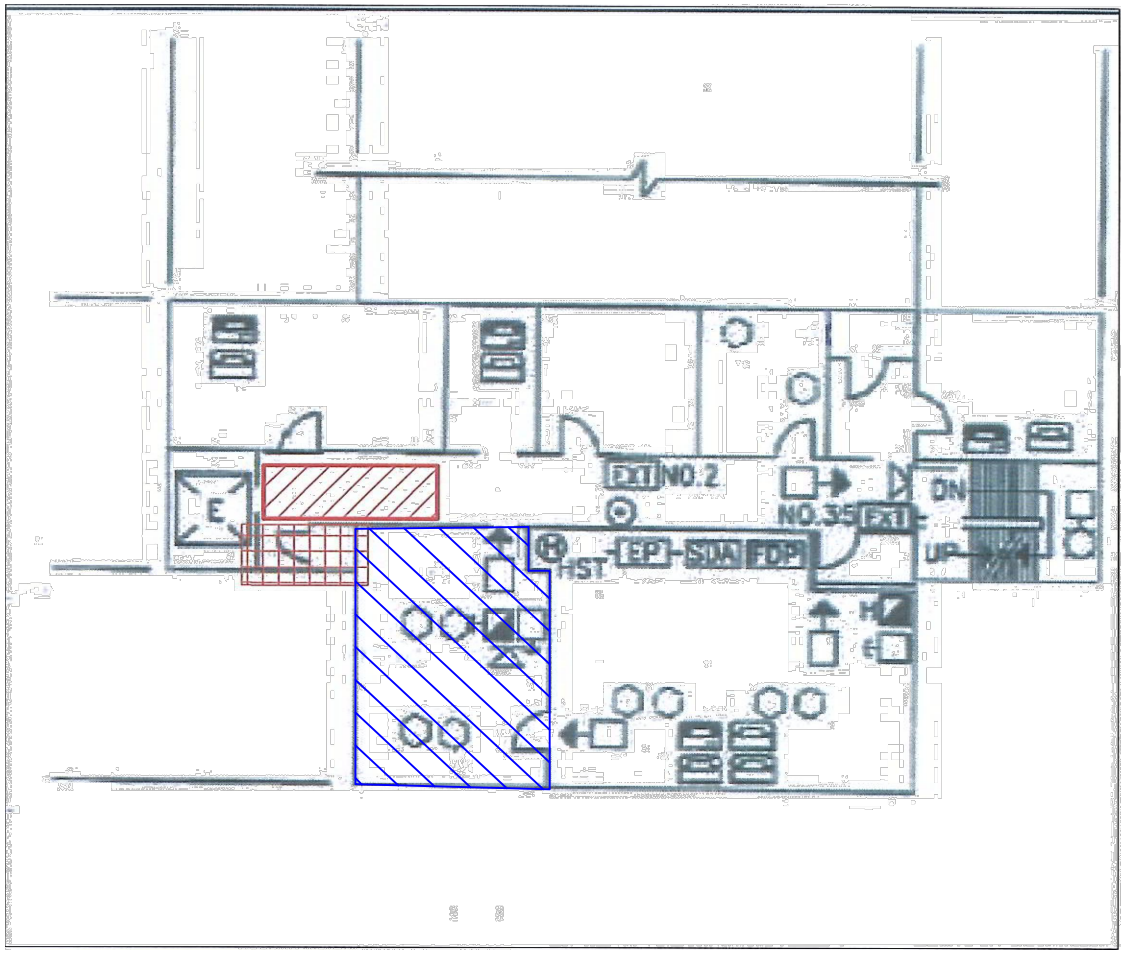
Drawn By: AF

Approved By: FA

Drawing No:

1.18

CONSULTANTS
Occupational Hygiene & Environment



Legend:

- Suspected Asbestos-Containing Pipe Fitting and Linear Pipe Insulation within Ceiling Space
- Asbestos-Containing Caulking
- Asbestos-Containing Vinyl Floor Tiles

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
2nd Floor
Admin Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

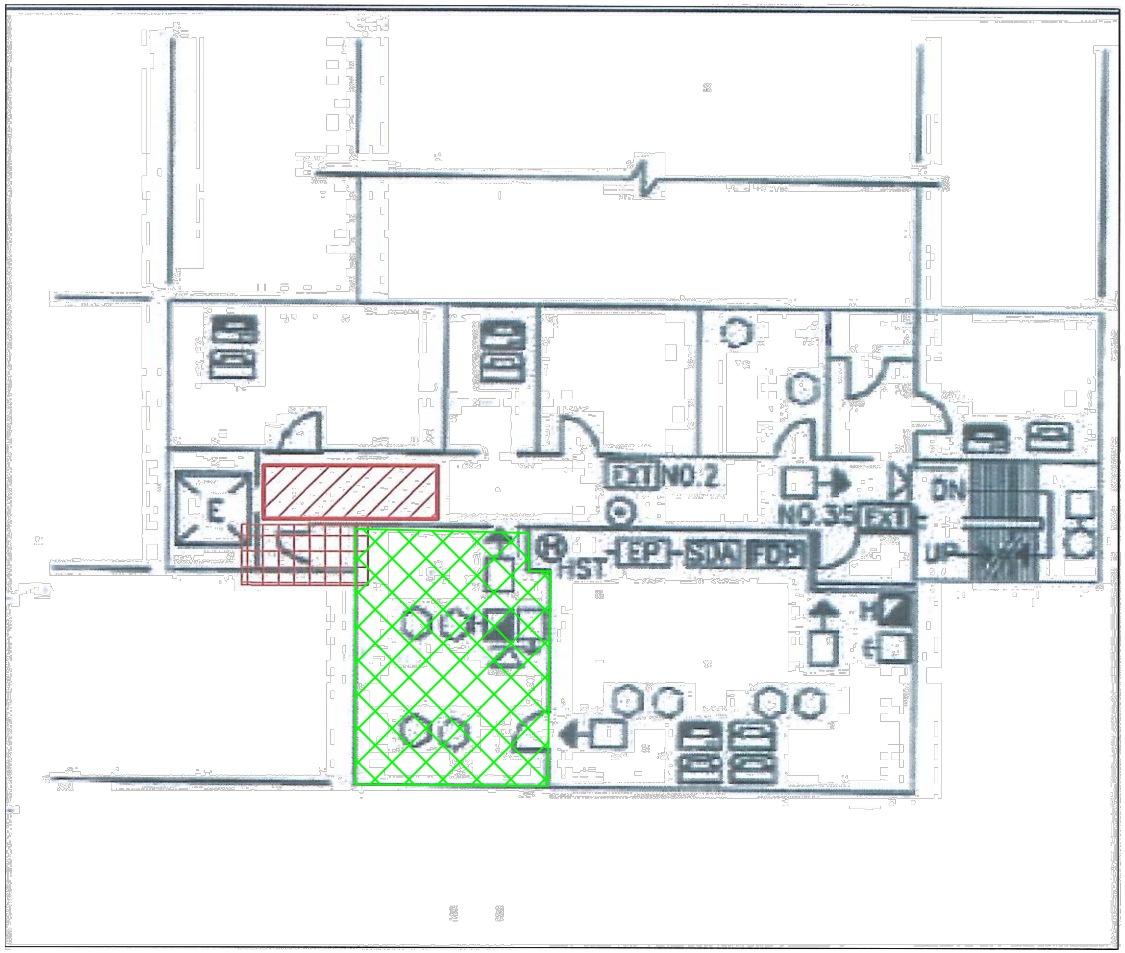
Drawn By: AF

Approved By: FA

Drawing No:

1.19

MB CONSULTANTS
Occupational Hygiene & Environment



Legend:

- Suspected Asbestos-Containing Pipe Fitting and Linear Pipe Insulation within Ceiling Space
- Asbestos-Containing Caulking
- Asbestos-Containing Mastic

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:

2nd Floor
Admin Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

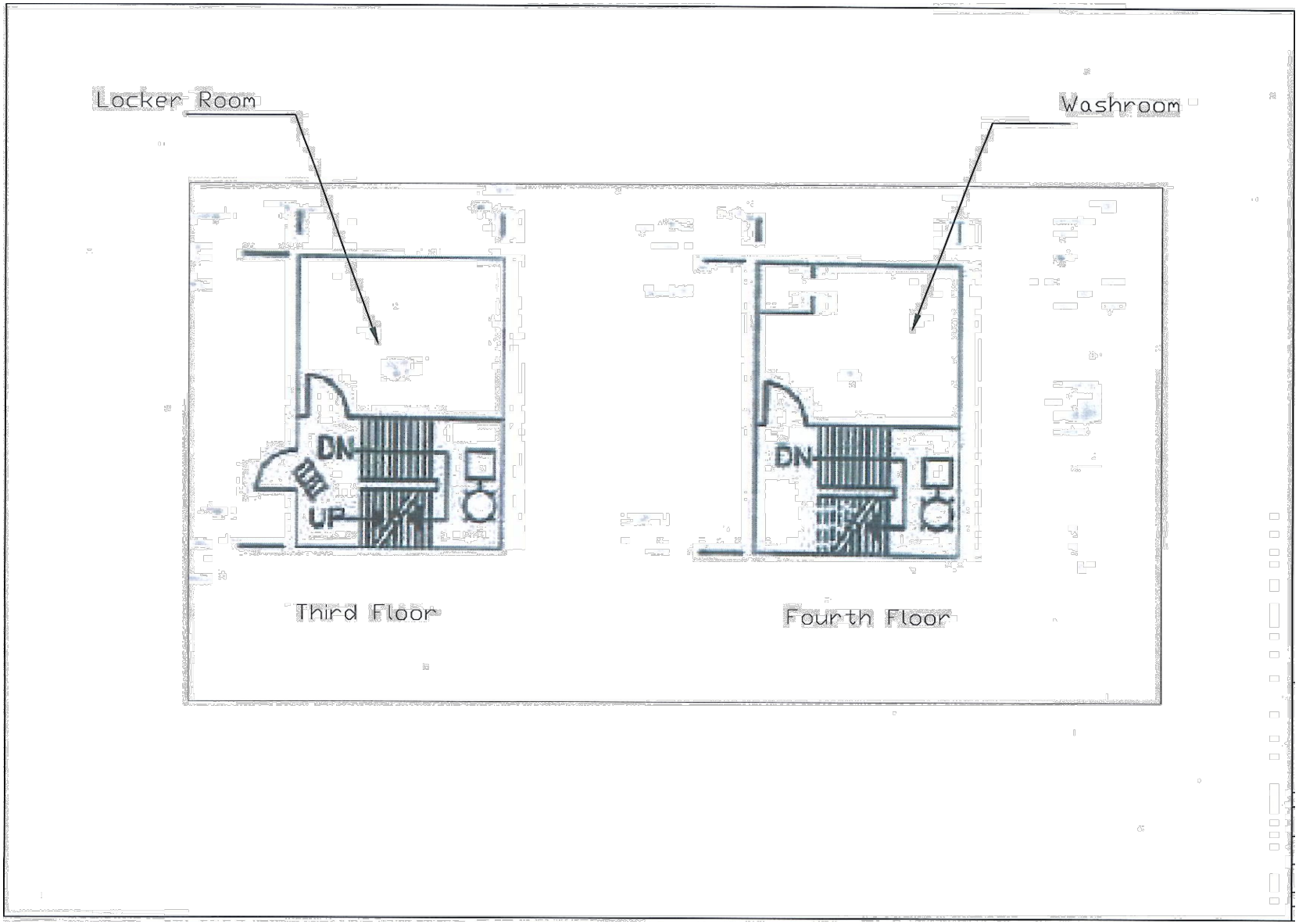
Drawn By: AF

Approved By: FA

Drawing No:

1.20

CONSULTANTS
Occupational Hygiene & Environment



Legend:

Notes:
Locations of site features are approximate and may vary from that shown

Drawing Title:

Hazardous Building Materials Re-Assessment Survey 2024

Client Address:

City of Toronto Water
2701 Queen Street East
Toronto, Ontario

Project Location:
3rd & 4th Floors
Admin Building
R.C. Harris Treatment Plant
2701 Queen Street East
Toronto, ON

Project No: 30308

N

Date: Dec. 2024

Scale: NTS

Drawn By: AF

Approved By: FA

Drawing No:

1.21

MB CONSULTANTS
Occupational Hygiene & Environment

Background Information on Hazardous Materials

ASBESTOS

Asbestos is a term applied to a family of fibrous minerals divided into two geological groups, serpentine and amphibole. These minerals are naturally occurring and are found in every mountain formation throughout the world. Only six forms of asbestos were used commercially. These are chrysotile, the only serpentine asbestos type, and amosite, crocidolite, anthophyllite, tremolite and actinolite which are the amphibole asbestos type.

There are over 3,000 separate uses of asbestos identified in existing literature. Each use is dependent upon the physical and chemical properties of a particular asbestos type. The desirable properties of asbestos fibres differ with each type of asbestos and include:

Fire retardance	Resistance to acids and alkalies	High tensile strength
Filter action	Thermal insulating qualities	Friction and wear resistance
Cohesion	Reinforcement	Filler

Asbestos is rarely found in pure form in a product and all products are divided into two broad categories: ; "friable materials" and "non-friable materials or manufactured products". "Friable materials" are defined as materials that, when dry, can be crumbled, pulverized or powdered by hand pressure. This classification includes materials such as sprayed fireproofing, thermal insulation applications, acoustical texturized material and refractory or non-friable materials that have been made to become friable through degradation.

"Non-friable materials" are generally hard and do not readily release fibres. Most asbestos-containing materials (ACMs) are found in this category and are typically included in materials such as cement products, felts, cloths, floor and roof coverings, friction products and ceiling tiles.

Asbestos fibres, when inhaled, may cause various respiratory diseases primarily including Asbestosis, Mesothelioma and Lung Cancer which all can cause an early death. Based on the health effects of exposure to asbestos fibres, the use of asbestos has become regulated across Canada and some products are now prohibited. Essentially, the location of ACMs must be identified and a written report kept and maintained of the ACMs locations so that work undertaken on these materials is conducted in a safe manner and any damaged ACMs or debris is repaired or removed.

ACRYLONITRILE

Acrylonitrile is explosive, flammable and toxic, found as a colorless or yellow clear liquid. It is used to produce a variety of products including plastics, adhesives, gaskets, seals and hoses. Health effects resulting in acute exposure to acrylonitrile vary from minor symptoms such as eye irritation, itching skin, blisters,

headaches, sneezing and vomiting with chronic exposures potentially causing cancers of the stomach, lymph system and brain.

ARSENIC

The common form of arsenic is grey in color with a metallic appearance. Arsenic has been used in the manufacturing of glass to eliminate the green color resulting from the impurities of iron compounds. It was also used in the productions of poisons. Arsenic is poisonous in doses significantly larger than 65 mg (1 grain), and poisoning can arise from a single large dose or from repeated small doses.

BENZENE

Benzene is an aromatic organic hydrocarbon existing either as a clear liquid or a vapour. Benzene is a highly flammable and volatile material and was primarily a by-product in petroleum refineries. However, it has also been commonly used to produce styrene, synthetic rubbers, plastics, resins and solvents.

Serious health effects can occur from exposure to benzene, mainly as a result of inhalation of vapours and mists. Ingestion by swallowing and absorption through the skin are also possible routes of exposure. Health effects can result from ingesting food or drink contaminated with benzene. Symptoms can range from irritated eyes, red blistering skin, headaches, nausea and drowsiness. Benzene exposure can also induce blood and bone marrow toxicity.

COKE OVEN EMISSIONS

Coke oven emissions can be either in a condensed form as a brownish thick liquid, or uncondensed form as a vapour. Coke oven emissions are a mixture of coal tar, coal tar pitch, and creosote and contain chemicals such as benzo(a)pyrene, benzanthracene, chrysene, and phenanthrene.

Chronic (long-term) exposure to coke oven emissions in humans results in conjunctivitis, severe dermatitis, and lesions of the respiratory and digestive systems. Epidemiologic studies of coke oven workers have reported an increase in cancer of the lung, trachea, bronchus, kidney, prostate, and other sites.

ETHYLENE OXIDE

Sources of ethylene oxide emissions into the air include uncontrolled emissions or venting with other gases in industrial settings. Other sources of ethylene oxide air emissions include automobile exhaust and its release from commodity-fumigated materials. Individuals may be exposed to ethylene oxide through breathing contaminated air, from smoking tobacco or being in the proximity to someone who is smoking.

Ethylene Oxide has been linked to reproductive and tissue damage and to have teratogenic effects, cytogenetic damage and neurological effects.

ISOCYANATES

Isocyanates are compounds that contain a group of atoms consisting of Nitrogen (N), Carbon (C), and Oxygen (O), which make isocyanates very useful in the manufacturing industry. Isocyanates are commonly used in the production of plastics, foams, and coatings.

Exposure to isocyanates can be through inhalation of vapour, mist or dust, or by direct contact.
Health effects associated with exposure to isocyanates include: decreased lung function, cold and flu-like symptoms, fever and shortness of breath.

LEAD

For thousands of years lead has been used industrially because of its poor conductive property. Lead has been commonly used for electric storage batteries, pigments, paints, and rubber compounds.

Health effects associated with lead exposure can result in damage to the kidneys, gastrointestinal system, nervous system and reproductive system. Symptoms range from vomiting, and abdominal cramps to pains in joints and muscles.

OZONE DEPLETING SUBSTANCES

The main source of ozone depleting substances is in the form of man-made halocarbon refrigerants (chlorofluorocarbon (CFCs), freons and halons). CFCs and other contributory substances are referred to as ozone-depleting substances (ODS). Since the ozone layer of the earth prevents most harmful ultraviolet light from passing through the Earth's atmosphere, these ozone depleting substances require proper disposal and limit its release into the atmosphere. The main health concern regarding ODS are the effects of increased surface UV radiation on human health.

MERCURY

At room temperature mercury is in the form of a silver colored liquid. Mercury can exist in three forms: elemental (the pure form) organic or inorganic.

Mercury can be absorbed into the body by inhalation, ingestion or absorption through the skin. As a health hazard mercury can affect the respiratory system resulting in coughing and chest pains. Mercury poisoning can also cause kidney damage, skin irritation and may even harm the nervous system.

MOULD AND ANIMAL DROPPINGS

Mould is a colloquial term used to define large and taxonomically diverse number of fungal species where their growth results in a “mouldy” appearance on porous building materials (i.e. gypsum wallboard, wood, suspended ceiling tiles, etc.). Essentially, the building materials become discoloured by a layer of fungal growth.

Mould is a fungus that grows in the form of multicellular filaments called hyphae. A connected network of hyphae, called a mycelium, is considered a single organism. Mould reproduces via spores and the formation and shape of these spores is traditionally used to classify the mould into its respective genus. In order for mould to grow it requires two things: a food source (i.e. gypsum wallboard, ceiling tiles, etc.) and water.

Mould is ubiquitous in nature and is required to breakdown detritus in nature; hence, mould spores are a common component of outdoor and indoor air. Although mould spores can be found in both indoor and outdoor air, mould growth on buildings materials is a concern. First, it can degrade the building materials and second, it can lead to a variety of health problems. General symptoms caused by mould are allergenic reactions such as watery, itchy eyes, cough, headaches or migraines, difficulty breathing, rashes, tiredness, sinus problems, nasal blockage and frequent sneezing. Various practices can be followed to mitigate mould issues in buildings, the most important of which is to remedy any water intrusion issues in a building as it facilitates the growth of mould. Removal of the affected building materials and repair of the source of water intrusion is required in buildings. Once the affected buildings have been removed the source of the allergenic reactions are reduced and/or eliminated.

Animal droppings within a building are a sign of an infestation problem that needs to be addressed. Workers removing accumulations of animal droppings are at risk of exposure to airborne mould spores and other microbial hazards, if the material is disturbed. Many of these microorganisms are known to cause respiratory infections in workers exposed during construction or maintenance disturbance. Therefore, appropriate measures should be taken when cleaning animal droppings.

PCBs

PCBs were widely used as dielectric and coolant fluids, for example in transformers, capacitors, and electric motors. Due to PCBs environmental toxicity and classification as a persistent organic pollutant, PCB production has been banned. According to the U.S. Environmental Protection Agency (EPA), PCBs have been shown to cause cancer in animals, and there is also evidence that they can cause cancer in humans. Concerns about the toxicity of PCBs are largely based on compounds within this group that share a structural similarity and toxic mode of action with dioxin. Toxic effects such as endocrine disruption and neurotoxicity are also associated with other compounds within the group.

SILICA

Silica can be found naturally in two forms, crystalline or amorphous material. Crystalline silica is regulated due to its significant toxicity over the amorphous silica. The three most common forms of crystalline silica in the workplace are: quartz, cristobalite and tridymite. The physical properties of silica make it a valuable substance for use in a variety of different industries and processes such as an abrasive and scouring compound, fillers for paint and mastic and optical equipment. Health effects resulting from exposure to crystalline silica range from eye and skin irritation, coughing and sneezing to silicosis, a progressive lung disease.

VINYL CHLORIDE

Vinyl chloride is required in the manufacture of polyvinyl chloride (PVC) and at room temperature is present as a colorless, flammable gas. Vinyl chloride is also known as chloroethene, chloroethylene, and ethylene monochloride, and can result from the breakdown of other substances such as trichloroethane, trichloroethylene, and tetrachloroethylene.

Common exposure is a result of inhaling vinyl chloride from industrial leaks, hazardous waste sites and landfills. Symptoms of breathing vinyl chloride are sleepiness, dizziness or labored breathing. Chronic exposure can cause liver and nerve damage or cancer.

Summary of the Applicable Regulations and/or Guidelines

DESIGNATED SUBSTANCES REGULATIONS

In accordance with Section 30 of the Occupational Health and Safety Act (OHSA), Designated Substances and other potentially hazardous building materials must be identified prior to construction or demolition that may disturb such materials. Designated Substances include:

Asbestos	Benzene
Lead	Acrylonitrile
Mercury	Coke Oven Emissions
Silica	Arsenic
Isocyanates	Ethylene Oxide
Vinyl Chloride	

A Designated Substances report is completed to fulfil the Owner's requirements under Section 30 of the OHSA. A copy of the report must be provided to the general contractor who in turn must submit the report to all subcontractors prior to the commencement of any demolition, construction or renovation work.

Ontario Regulation 490/09 "Designated Substances" (O. Reg. 490/09) provides guidance on exposure monitoring, permissible exposure levels, medical monitoring, etc. for all Designated Substances in an industrial setting. There are no specific Ministry of Labour (MOL) regulations for control of the Designated Substances, with the exception of asbestos, on construction projects; however, the MOL actively enforces the general duty clause of the OHSA to take all reasonable precautions in the circumstances of protection of a worker. It is important to note that Ontario Regulation 213/91 "Construction Projects" (O. Reg. 213/91) applies to construction projects and provides instruction on general requirements, safe work practices, reporting, etc.

ASBESTOS

Three regulations govern the control, handling, transport and disposal of asbestos in Ontario:

- Ontario Regulation 278/05 "Asbestos on Construction Projects and in Buildings and Repair Operations" made under OHSA (O. Reg. 278/05);
- Ontario Regulation 347/90 "General – Waste Management" (as amended) made under the Environmental Protection Act (O. Reg. 347/90); and,
- The regulations respecting "The Handling and Offering for Transport and Transporting of Dangerous Goods".

O. Reg. 278/05

O. Reg. 278/05 applies to buildings with regards to maintenance, renovations or demolition work where Asbestos-Containing Materials (ACMs) are or may be disturbed.

Under O. Reg. 278/05 a building owner must instate an Asbestos Management Program (AMP) for the building. The major requirements for the AMP including the following:

- Preparation and maintenance of a record of the location of ACMs in the building;
- Notification of the building's tenants of the location of such material;
- Establishment of a training program for those employees of the owner who may work in close proximity to and disturb the material;
- Periodic inspection (once in a 12 month period) of the material to determine its condition;
- Remedial action on material that has deteriorated following the precautions and procedures prescribed by the regulation as Type 1, Type 2 and Type 3; and,
- Removal of ACMs to the extent practicable prior to demolition of a building or part thereof.

The regulation prescribes work to be conducted according to three procedure types. The procedure to be followed depends on the type of material and the regulation provides instruction on how the work must be performed.

O. Reg. 347/90

O. Reg. 347/90 applies to the disposal of all hazardous materials, including asbestos waste, from the location of generation to a landfill site. The regulation also prescribes procedures on how the asbestos waste is to be buried at the landfill site.

The major requirements to the building owner are to ensure that:

- The waste is appropriately packaged and labelled;
- The transport vehicle has an appropriate placard;
- The asbestos waste is transported on the same day as received by the landfill site; and,
- The route of travel is the most direct.

The building owners are held responsible for their asbestos waste as prescribed in the regulation until it is accepted by the waste disposal site.

DESIGNATED SUBSTANCES GUIDELINES

LEAD

As stated previously there are no specific regulations regarding lead on construction projects; however, the MOL published a guideline entitled “Lead on Construction Projects” to raise the awareness of employers and workers to the hazards posed by lead in construction and the measures and procedures that should be taken to control those hazards.

The document provides information on the following:

- Health effects associated with lead exposure;
- Methods for controlling the lead hazard;
- Classification of work; and,
- Measure and procedures for working with lead.

The guideline classifies operations involving lead-containing materials into three groups, Type 1, Type 2 and Type 3 operations. The procedure to be followed depends on the anticipated airborne concentration of lead generated during the operation, which is dependent on the type of work performed. The guideline also provides instruction on how the work must be performed.

SILICA

Again, there are no specific regulations regarding silica on construction projects; however, the MOL published a guideline entitled “Silica on Construction Projects” to raise the awareness of employers and workers to the hazards posed by silica in construction and the measures and procedures that should be taken to control those hazards.

The document provides information on the following:

- Health effects associated with silica exposure;
- Methods for controlling the silica hazard;
- Classification of work; and,
- Measure and procedures for working with silica.

The guideline classifies operations involving silica-containing materials into three groups, Type 1, Type 2 and Type 3 operations. The procedure to be followed depends on the anticipated airborne concentration of silica generated during the operation, which is dependent on the type of work performed. The guideline also provides instruction on how the work must be performed.

Remaining Designated Substances

There are no specific Ministry of Labour guidelines or regulations for control of the other eight (8) designated substances on construction projects (recall that asbestos is not included in this survey). However, the Ministry of Labour actively enforces the general duty clause of the Health and Safety Act which protects workers and provides guidance on exposure monitoring, permissible exposure levels, medical monitoring, etc. for all Designated Substances in an industrial setting.

POLYCHLORINATED BIPHENYLS (PCBS)

The federal PCB Regulations, SOR/2008-273, regulates the use, handling, storage, management and release of PCBs and any product containing PCBs. The purpose of the regulation is to also accelerate the elimination of these substances by setting deadlines to end the use of PCBs and products containing PCBs and sending them for destruction.

Ontario Regulation 362/90 "Waste Management-PCBs" made under the Environmental Protection Act (O. Reg. 362/90) controls the waste management and transfer of PCBs. Under O. Reg. 362/90 a PCB material is defined as a material containing a PCB concentration of 50 parts per million (ppm) by weight.

OZONE DEPLETING SUBSTANCES

The federal Ozone Depleting Substances Regulations SOR/99-7 (as amended), regulates the import, export, manufacture, use and sale of ozone depleting substances (e.g. chlorofluorocarbons, halons, etc.) in Canada.

In addition, the federal Halocarbon Regulations SOR/2003-289 (as amended), governs the release, recovery and recycling of ozone depleting substances and their halocarbon alternatives in refrigeration and air conditioning equipment in Canada.

Lastly, Ontario Regulation 463/10 made under the Environmental Protection Act regulates the disposal, transport and transfer of ozone depleting substances and halocarbons and refrigerants in Ontario.

MOULD AND WATER DAMAGED BUILDING MATERIALS

Currently, there are no Canadian regulations that govern the presence of mould and water damaged materials in the workplace environment. However, the Health Canada document "Fungal Contamination in Public Buildings: Health Effects and Investigation Methodology" (2004) concludes that current knowledge supports the need to prevent damp conditions and mould growth and to remediate mould growth and clean mould contamination in buildings. Therefore, the presence of mould growth, mould contaminated materials and/or water damaged materials in the occupied environment is interpreted as a failure of Health Canada guidelines and as such requires remedial action.

In addition, the MOL has issued a document titled "Alert: Mould in Workplace Buildings". This document explains the MOL's position with respect to the presence of mould growth in workplace buildings. Essentially, there is a responsibility to ensure the health and safety of workers. This includes protecting

workers from biological hazards in workplace buildings. Various sections of the Industrial, Construction, Mining or Health Care regulations may also apply to maintenance and remediation activities.

The Canadian Construction Association (CCA) document CCA 82 - 2004 “Mould Guidelines for the Canadian Construction Industry” (CCA 82/04) provides guidelines for the assessment and remediation of mould in indoor environments.

Survey Methodology

GENERAL SURVEY METHODOLOGY

The survey focused on the previously identified hazardous building materials in all accessible areas of the building Materials suspected to contain hazardous materials were assessed based on the surveyor's knowledge regarding the historical use of hazardous building materials in buildings, through published data and through previous experiences.

Accessible is defined as an area above a suspended ceiling tile, within an access hatch or behind a closed door, not impeded by any structure, article or thing. An area enclosed by cement block, plaster, solid lumber, etc., where minor demolition is required to gain entry is considered non-accessible. The walkthrough survey was augmented with layout drawings where available.

OHE's approach to the work followed accepted industry procedures as well as our own in-house protocols. The examination of materials was largely performed visually with some occasion where physical contact was necessary to assess the condition or examine for underlying layers.

ASBESTOS SURVEY METHODOLOGY

No bulk samples were collected during the current re-assessment.

This following information summarizes the bulk sample analysis methodology and the methodology for the assessment of the condition of Asbestos-Containing Materials (ACMs).

Bulk samples were not required to be collected for subsequent analysis during the building re-assessment. To collect previous bulk samples for asbestos analysis, a small volume of material (approximately one teaspoon full) was removed either from a damaged section of suspect material or cut out of intact material and then repaired by sealing with an appropriate surfacing compound, tape, paint, or plaster to prevent fibre release. Tools used in sample collection were washed after each use to prevent cross-contamination. Collected samples were placed in sealed plastic bags and shipped to an independent laboratory for analysis.

Bulk Sample Analysis Methodology

Bulk samples of suspect ACMs were analyzed in accordance with a US EPA method for the determination of asbestos content in bulk materials, EPA Method 600/R-93/116 as per requirements of O. Reg. 278 which specifies this method be used to establish whether a material is considered to be an ACM (i.e., contains $\geq$0.5% asbestos by dry weight) and for establishing its asbestos content and the type of asbestos.

The EPA Method requires that the samples be analyzed using the Polarized Light Microscopy (PLM) technique. The percentage of asbestos in the sample is measured as perceived by the analyst in comparison to standard area projections and is greatly influenced by the analyst's experience. The method is useful for the qualitative identification of asbestos (type) and the semi-quantitative (% estimates) determination of asbestos content in bulk samples.

The asbestos bulk samples were analyzed by EMSL Canada Incorporated, an independent and NVLAP accredited laboratory. To ensure quality results, the independent laboratory chosen must successfully participate in an "Asbestos Proficiency Analytical Testing Program" and as such, this laboratory is responsible for their findings.

Assessment of ACMs Methodology

The assessment of ACMs involves the evaluation of a number of factors by the surveyor including:

- Asbestos content
- Condition of the material
- Accessibility
- Water damage
- Activity and vibration
- Presence in air plenum/direct air stream

Where ACMs are found to be in good condition, firmly bound and not likely to deteriorate or fall, the recommended procedure is to evaluate the condition of the material on a periodic basis (which should be at least once every twelve-month period as required by O. Reg. 278/05 unless specified more frequently) in order to detect gradual deterioration. This process is referred to as an "Operation and Maintenance Program".

Damaged material is identified by surface crumbling, blistering, water stains, gouges, marring or being otherwise abraded. The accumulation of powder dust or debris similar in appearance to the suspect material can be used as confirmatory evidence.

In situations where the ACMs are found to have deteriorated or likely to fall, the following are the four abatement options that may be specified in this report:

1. **Cleaning**. The cleaning of asbestos-containing debris may be performed using a High Efficiency Particulate Air (HEPA) filter vacuum cleaner or by damp wiping techniques. All fallen asbestos material must be cleaned upon discovery. In situations where the material will continue to fall due to deterioration, damage or abrasion, additional corrective work is required, i.e., the material must be repaired, permanently enclosed or removed.

2. **Repairs**. This option is usually selected in situations where damage to the ACMs are of a minor nature and is not likely to reoccur due to accessibility or activity. This method of repair is chosen in situations where performing the repair activities will not cause significant disturbance to the underlying material. Typical repairs include the repair of thermal insulation by the application of mastic (paint adhesive) to lagging (canvas cloth). The repair of sprayed fireproofing or acoustical texturized material can involve the application of an encapsulant to limited areas of abraded or damaged material. If this option is followed, the sprayed material must be capable of supporting the additional weight of the encapsulant.

3. **Enclosure**. An enclosure consists of the construction of a physical barrier, typically constructed from drywall or metal sheeting. This option is applicable in situations where the removal of materials with asbestos is not practicable, is of a high financial cost, or where damage is likely to occur without a protective

barrier. Where the installation of the barrier is likely to disturb the ACMs, the work must be performed in isolation from the building's normal environment.

4. **Removal**. This option is recommended in situations where the ACMs are damaged beyond repair and the material is highly likely to be damaged due to nearby activities, by renovation or during demolition. The precautions employed may vary depending on the volume of the material to be removed and whether the material is friable or not. Typical programs can include the use of glove bags for limited amounts of thermal pipe insulation or minor amounts of fireproofing may be removed within a small polyethylene lined enclosure. For larger amounts of asbestos, more stringent protocols are used and consist of attached shower facilities, the establishment of a negative pressure differential, a filtration system for the air and monitoring for exposure to asbestos fibres.

METHODOLOGY FOR LEAD IN PAINT BULK SAMPLING AND ANALYSIS

No bulk samples were collected during the current re-assessment.

Bulk samples, where required were collected for subsequent analysis during the building survey. A small volume of material (approximately one teaspoon full) was removed either from a damaged section of suspect material or removed from an inconspicuous area using clean hand tools. Collected samples were placed in sealed plastic bags and and shipped to an independent laboratory for analysis.

Bulk Sample Analysis Methodology

Bulk samples of suspect lead-containing materials were analyzed in accordance with a US EPA method for the determination of lead content in bulk materials, EPA Method (SW 846 3050B/7000B). The EPA Method requires that the samples be analyzed using the Flame Atomic Absorption Spectrometry (SW 846 3050B/7000B) technique. This method may be used determine trace elements in solution.

The lead bulk samples were analyzed by EMSL Analytical, Incorporated, an independent and ELLAP accredited laboratory.

METHODOLOGY FOR THE INVESTIGATION OF PCB-CONTAINING EQUIPMENT

No direct visual assessment were completed during the current re-assessment.

The investigation typically includes equipment such as fluorescent light ballasts and transformers. Information collected from the labels of light ballasts is cross referenced with the Environment Canada publication entitled "Identification of Lamp Ballasts Containing PCBs" (Revised August 1991). The investigation is restricted to the equipment observed and excludes PCB-containing components that may be concealed. Due to safety precautions, only the exterior of electrical equipment is inspected. If the equipment labels do not provide enough information on the contents with respect to the subject substances, the findings are noted and recommendations regarding the next course of action are provided.

METHODOLOGY FOR THE INVESTIGATION OF OZONE DEPLETING SUBSTANCES

No direct visual assessment were completed during the current re-assessment.

The investigation for ODSs included equipment and building systems that are suspected to contain ODSs, including but not limited to, chillers, coolers, refrigerators and HVAC systems. The investigation was restricted to the equipment observed and excludes components that may be concealed. Due to safety precautions, only the exterior of devices, equipment and building systems were inspected. If the equipment labels did not provide enough information on the contents with respect to the subject substances, the findings were noted and recommendations regarding the next course of action were provided.

METHODOLOGY FOR THE INVESTIGATION OF MOULD AND WATER DAMAGED BUILDING MATERIALS

The investigation for mould and water damaged building materials included a visual inspection along accessible building finishes (eg. walls, floors, ceilings, etc.).

Project Limitations

The survey was non-destructive in nature and the areas surveyed were based on the previously surveyed areas where hazardous materials were identified by "2017 Hazardous Materials Re-Assessment" report, Project number 17069, dated December 11, 2017 by T. Harris Environmental Management (THEM); a one-page laboratory analysis report issued by EMC Scientific Inc., dated March 1, 2018, provided by the client; "Hazardous Material Reassessment Survey 2018" report, Project number 23650, issued by OHE Consultants dated November 2018; "Hazardous Material Reassessment Survey 2019" report, Project number 24827, issued by OHE Consultants dated November 2019; "Bulk Sampling for the Presence of Asbestos in Suspect Materials and for Lead in Paint – Summary Report", Project number 24964, issued by OHE Consultants dated October 2019; "Bulk Sampling for the Presence of Asbestos in Suspect Materials – Summary Report", Project number 25042, issued by OHE Consultants dated November 2019; "Hazardous Building Materials Re-Assessment 2020", Project number 26090 issued by OHE Consultants dated November 2020; "Hazardous Building Materials Survey", Project number 26723-006 issued by OHE Consultants dated September 2021;"Hazardous Building Materials Re-Assessment 2021", Project number 27219, issued by OHE Consultants dated December 2021; "Designated Substances and Hazardous Building Materials Assessment Report", Project number 1-3210982, issued by Safetech Environmental Ltd. dated December 28, 2021 and "Hazardous Building Materials Re-Assessment 2022", Project number 28271, issued by OHE Consultants dated December 2022; "Hazardous Building Materials Re-Assessment 2023", Project number 29388, issued by OHE Consultants dated December 2023; "Bulk Sampling Report 2024" Project number 1-3240629, issued by Safetech Environmental Ltd. dated August 20, 2024; and a visual re-inspection of previously identified hazardous building materials.

Hazardous building materials may be present in areas not accessible for view and identification. In situations where hazardous building materials extend into a non-accessible area, the materials were assumed to also be present in those areas and have been reported as such. Contractors and maintenance personnel must be warned of the possibility of undisclosed hazardous building materials in enclosed areas. All hazardous building materials discovered in these areas must be treated as a hazardous building material until proven otherwise as per all applicable regulations and guidelines.

Asbestos is also assumed to be present in various building materials which were not sampled as part of the survey since they were excluded from the scope of work. These materials include, but are not limited to, vermiculite in solid block walls, above solid ceilings and in manufactured wall panels; elevator and lift brakes; high voltage wiring; mechanical packing, ropes and gaskets; fire-rate doors; bell and spigot joints; exterior cladding, soffit and fascia boards on building; roofing materials, roofing felt/tar; caulking and mastic material; and building paper and refractory materials within boilers. In cases of demolition and/or renovation, all excluded materials shall be assumed asbestos-containing until proven otherwise by bulk sampling and analysis.

In cases where asbestos was identified in some but not all samples of similar materials, the conservative approach was applied and all such material was assumed and reported to contain asbestos. When a renovation is planned, we recommend a detailed sampling of suspected asbestos-

containing material to confirm the presence of asbestos. Materials that are removed through renovations should be replaced with non-asbestos-containing materials only. This must be documented. Confirmatory sampling will not be required on any new products if the manufacturer supplies written confirmation that these materials are asbestos-free.

Water damaged building materials were observed in various locations throughout the Subject Location. The locations detailed in this report are based on the observations noted at the time of the site visit and can change if site conditions change. For removal and/or repair operations, these areas should be confirmed on-site.

Appendix D
Division 2 – B – Power Tunnel – DSHM Survey

Final Report

Project Specific Designated Substances and Hazardous Materials Survey Report

RC Harris Water Treatment Plant, Power Tunnel Area
2701 Queen Street East, Scarborough, ON

Submitted to City of Toronto
by Arcadis
130892
April 2024

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25 April 2024
Arcadis Project No.: 130892

City of Toronto – Metro Hall
55 John Street, 7th Floor
Toronto, ON M5V 3C6

ATTENTION: Punyama Jayasinghe, M.Eng., P.Eng.

Re: Project Specific Designated Substances and Hazardous Materials Survey Report RC Harris Water Treatment Plant, 2701 Queen Street East, Scarborough, ON

Arcadis is pleased to submit the enclosed Project Specific Designated Substances and Hazardous Materials Survey Report to City of Toronto (herein referred to as "the Client"). This report summarizes a visual inspection and testing for the presence of Designated Substances (asbestos, lead, mercury, etc.) and other hazardous materials (such as mould, UFFI, PCBs, etc.) within R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Scarborough, Ontario, for the upcoming cable tray replacement and rehabilitation project.

We thank you for the opportunity to undertake this work. If you have any questions, please do not hesitate to call our office.

Yours sincerely,

Arcadis

Hassan Ktaech, H.B.A., MCIWM
Associate - Manager, Environmental Services

HK/as

Document Control Page

CLIENT:	City of Toronto
PROJECT NAME:	R.C. Harris Water Treatment Plant, 2701 Queen Street East, Scarborough, Ontario
REPORT TITLE:	Project Specific Designated Substances and Hazardous Materials Survey Report
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ORIGINATOR:	Ankit Sajwan, H.B.Sc. Project Manager, Environmental Services
REVIEWER:	Hassan Ktaech, HBA, MCIWM Associate – Manager, Environmental Services
AUTHORIZATION:	Hassan Ktaech, HBA, MCIWM Associate – Manager, Environmental Services
SUBMITTED:	V1 - Final Report – April 25, 2024

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Executive Summary

Arcadis was retained by City of Toronto (herein referred to as "the Client") and is pleased to provide the following observations and recommendations regarding the Project Specific Designated Substances and Hazardous Materials Survey (PS-DSHMS) in support of the upcoming repair project within the Power Tunnel Area (herein referred to as the "Project Area") of R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Scarborough, Ontario (herein referred to as the "Site"). Mr. Ankit Sajwan completed an assessment of the Project Area on April 3, 2024. The assessment included a visual inspection and testing for the presence of Designated Substances (asbestos, lead, mercury, etc.) and other hazardous materials (such as mould, UFFI, PCBs, etc.) as required.

This survey report fulfils requirements set forth within the Ministry of Labour codes and the Ontario Occupational Health and Safety Act to inform workers of the presence of Designated Substances and other hazardous materials prior to renovation or demolition.

Key Findings

Table E1 presents a brief outline of Arcadis's findings within the Project Area. Refer to **Appendix A** for the analytical results of sampling. Refer to the main body of the report for complete details and locations of Designated Substances and Hazardous Materials in the Project Area.

Recommendations documented in this report meet the requirements of the *Occupational Health and Safety Act*. Asbestos recommendations meet the requirements of the Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, Ontario Regulation 278/05.

This executive summary provides a brief overview of the study findings. It is not intended to substitute for reading the complete report, nor does it discuss specific issues documented in the report.

Table E1 Summary of Findings

MATERIAL	FINDINGS
Asbestos	No asbestos-containing material was observed to be present within the Project Area. If any materials within the Project Area, previously inaccessible during the assessment, are encountered during project work, they should be presumed to contain asbestos unless laboratory analysis proves otherwise.
Lead	One of the two paint samples collected within the Project Area, specifically a reddish-brown paint, was determined to be lead-based upon analysis, with a concentration of 8700 ppm.
Mercury	Mercury-containing equipment such as fluorescent light bulbs were observed throughout the Project Area at the time of the survey. However, it is understood that the project will not involve removal of such equipment.
Mould	Mould-impacted and water-damaged wooden boards and concrete walls were observed within the Project Area. Clean-up is required for approximately fifteen (15) m^2 of concrete wall and remediation of two (2) m^2 of wooden boards.
Ozone Depleting Substances (ODS)	Ozone depleting substances were no observed within the Project Area.

Table E1 Summary of Findings

MATERIAL	FINDINGS
Polychlorinated Biphenyls (PCBs)	Fluorescent light ballasts were present throughout the Project Area. However, it is understood that the project will not involve removal of such equipment.
Silica	Building components containing silica such as concrete walls and concrete floor slabs were observed in the Project Area.
UFFI	UFFI insulation was not observed during the investigation.
Other Designated Substances and Hazardous Materials	Other designated substances and hazardous materials that were part of the survey and are regulated by the following Ontario or Canadian regulations, including acrylonitrile, arsenic, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride were not observed in the Project Area at the time of the survey.

1 Introduction and Regulatory Requirements

1.1 Introduction and Scope

Arcadis was retained by City of Toronto (herein referred to as “the Client”) and is pleased to provide the following observations and recommendations regarding the Project Specific Designated Substances and Hazardous Materials Survey (PS-DSHMS) in support of the upcoming repair project within the Tunnel Service Area (herein referred to as the “Project Area”) of R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Scarborough, Ontario (herein referred to as the “Site”). Mr. Ankit Sajwan completed an assessment of the Project Area on April 3, 2024. The assessment included a visual inspection and testing for the presence of Designated Substances (asbestos, lead, mercury, etc.) and other hazardous materials (such as mould, UFFI, PCBs, etc.) as required.

This survey report fulfils requirements set forth within the Ministry of Labour codes and the Ontario Occupational Health and Safety Act to inform workers of the presence of Designated Substances and other hazardous materials prior to renovation or demolition.

The survey included an investigation for the presence of designated substances, namely:

Asbestos	Acrylonitrile	Benzene
Lead	Arsenic	Coke Oven Emissions
Mercury	Vinyl Chloride Monomer	Ethylene Oxide
Silica	Isocyanates	

And, in addition, investigation for:

Mould	Ozone Depleting Substances (ODS)
Urea Formaldehyde Foam Insulation (UFFI)	Polychlorinated Biphenyls (PCB)s

The following report details the project scope of work, regulatory requirements, survey and analytical methodologies, survey statement of limitations, and findings and recommendations.

1.2 Regulatory Requirements

A Designated Substances and Hazardous Materials Report was completed to fulfil the Owner's requirements under Section 30 of the *Ontario Occupational Health and Safety Act*. Prior to tendering project work in a building, the building owner must provide this report to contractors tendering the work.

Ontario Regulation 278/05 – Designated Substances – Asbestos on Construction Projects and in Buildings and Repair Operations, controls the disturbance of asbestos materials on construction projects. Ministry of Environment Regulation, R.R.O. 347, controls the disposal of asbestos waste. The Ministry of Labour has also issued guidelines for the control of Lead and Silica on construction projects titled Guideline - Lead on Construction Projects and Guideline - Silica on Construction Projects, respectively.

There are no specific Ministry of Labour regulations for control of the remaining Designated Substances on construction projects. However, the Ministry of Labour actively enforces the general duty clause of the *Occupational Health and Safety Act* which protects workers and provides guidance on exposure monitoring, permissible exposure levels, medical monitoring, etc., for all Designated Substances in an occupational setting.

2 Survey Methodology

2.1 General Approach

During the survey, the surveyor looked for the most common applications of building materials made with Designated Substances based on historical applications. The investigation performed was generally non-intrusive in nature (i.e., did not include demolition of building systems to verify concealed conditions); however, asbestos and paint chip bulk samples were collected from discrete locations for the investigation of hazards for accessible suspected materials.

Observations of accessible areas in the Project Area were made to identify the presence of materials suspected of containing asbestos or to be contaminated by asbestos (e.g., vermiculite).

2.2 Asbestos Survey Methodology

2.2.1 Asbestos Sampling Strategy and Analytical Methods

Where sampling was deemed to be required, bulk samples of potential asbestos containing materials (ACMs) were collected for analysis in accordance with the requirements of Ontario Regulation 278/05; multiple samples (ranging from 1 to 7, depending on quantity and type of material) are required to confirm the absence of asbestos. Arcadis's sampling strategy involves the collection of sufficient numbers of samples to meet regulatory requirements.

The sampling procedure required a small volume of material to be removed either from a damaged section of suspect material or cut from intact material and then repaired by sealing with tape to prevent fibre release. The collected samples were placed in plastic bags and sealed during shipment to an independent laboratory. A formal chain of custody procedure was maintained between Arcadis and the contracted laboratory during sample transport. Samples were then analyzed following the analytical procedure prescribed the Regulation 278/05 U.S. Environmental Protection Agency Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials. June 1993. Although not required by provincial regulation, all laboratories used by Arcadis are accredited under the U.S. National Voluntary Laboratory Accreditation Program (NVLAP) to ensure consistent, accurate and defendable results.

The Chain of Custody and the Certificate of Analysis, which details analytical results referenced in the findings section, for all asbestos bulk sampling is presented in **Appendix A**.

2.2.2 Asbestos Survey Omissions from Scope

When conducting an asbestos survey, it is standard practice to assume that certain building materials potentially contain asbestos. Depending on the material, this assumption is undertaken for one or more of the following reasons:

- The material is inaccessible (i.e., underground piping or at great heights);
- There is an inherent danger in sampling the material (i.e., high voltage wires); and
- Sampling will compromise the integrity of the building structure or envelope (i.e., fire-rated doors, etc.).

In addition, no identification was made of asbestos products used in manufacturing processes or operations (i.e., manufacturing equipment, laboratories, etc.).

2.3 Lead Survey Methodology

In April 2005, the *Federal Surface Coating Materials Regulation* (SOR/2005-109) limited the allowable concentration of total lead present in a surface coating material (with some exceptions) to 600mg/kg (600ppm).

In December 2010, the Federal Government lowered the total lead limit in surface coating materials from 600mg/kg to 90mg/kg under subsections 4(1) and 5(1) and Section 8 of the *Surface Coatings Materials Regulations* (SOR/2005-109). The lowering of this limit aligns Canada with the United States in respect of total lead levels in surface coating materials and certain products with surface coating materials applied to them.

Therefore, using this revised threshold limit, surface coating materials with lead concentrations that exceed 90ppm (0.009% by weight) are considered to be lead-containing according to the Surface Coatings Materials Regulations.

In the absence of specific regulatory limits or guidance for total lead concentrations allowable in existing paint applications in buildings, and for the purposes of worker protection, Arcadis considers paints with lead concentrations that are equal to, or exceed, 90ppm as “lead-containing”. Arcadis further recommends that appropriate lead exposure precautions, in accordance with the Ministry of Labour guidelines, be implemented prior to the disturbance of these materials.

The presence of lead in paint was assessed by the collection and submission of bulk material samples to a professional laboratory for analysis by flame atomic absorption spectroscopy. The Chain of Custody and the Certificate of Analysis for all lead bulk sampling is presented in **Appendix A**.

2.4 Mould Assessment

A visual mould assessment of the Project Area was conducted in accordance with industry-accepted protocols, specifically:

- Canadian Construction Association, Standard Construction Document CCA 82-2004; *“Mould Guidelines for the Canadian Construction Industry”*, 2004.
- New York City Department of Health and Mental Hygiene: Bureau of Environmental & Occupational Disease Epidemiology; *“Guidelines on Assessment and Remediation of Fungi in Indoor Environments”*, 2008.
- Institute of Inspection Cleaning and Restoration (IICRC): S520, *“Standard and Reference Guide for Professional Mold Remediation”*, December 2003.

Please note that a non-intrusive mould assessment of the Project Area was carried out during this survey assessment which included sampling (i.e., tape-lift or bulk sample). The assessment did not require any intrusive investigations (i.e., test-cuts).

2.5 Survey of Other Hazardous Materials

Materials or equipment suspected of containing ODS, UFFI and other Designated Substances are identified by appearance, age, and knowledge of historic applications.

3 Observation and Results

The following outlines the materials identified within the Project Area. Additional materials may be present in the Project Area concealed behind fixed building components, which were not visually identified during this survey. Site photographs are provided in **Appendix B**.

In support of scheduled and future operational redesign works, sampling of the suspect building materials was conducted in order to determine asbestos content and satisfy the requirements of Ontario Regulation 278/05 (O. Reg. 278/05). In Ontario, asbestos-containing material (ACM) is defined as any material that has an asbestos concentration of 0.5% or greater, by dry weight. All samples collected were submitted to an independent laboratory (EMSL Analytical of Mississauga, ON) for analysis of asbestos content. Samples were analyzed using Polarized Light Microscopy (PLM) following the EPA600/R-93/116 method in accordance with O. Reg. 278/05.

Recommended actions for management, repair, or removal of confirmed ACM, are based on the requirements and procedures specified by O. Reg. 278/05 and have been suggested based on the type of disturbance which is anticipated or likely. Alternate handling, repair and removal procedures must comply with the requirements of O. Reg. 278/05 (as amended), and O. Reg. 490/09.

The accessibility of building materials known or suspected of being ACM was rated according to the following criteria:

Table 3.1 Evaluation of Accessibility

ACCESSIBILITY CODE	DESCRIPTION
Access A	Areas of the building within reach (from floor level) of all building users. Includes areas such as gymnasiums, workshops, and storage areas where activities of the building users may result in disturbance of ACM not normally within reach from floor level.
Access B	Frequently entered maintenance areas within reach of maintenance staff, without the need for a ladder. Includes: frequently entered pipe chases, tunnels and service areas or areas within reach from a fixed ladder or catwalk, i.e., tops of equipment, mezzanines.
Access C (exposed)	Areas of the building above 8'0" where the use of a ladder is required to reach the ACM. Only refers to ACM materials that are exposed to view, from the floor or ladder, without removing or opening other building components such as ceiling tiles, or service access doors or hatches. Does not include infrequently accessed service areas of the building.
Access C (concealed)	Areas of the building which require the removal of a building component, including lay-in ceilings and access panels into solid ceiling systems. Includes rarely entered crawl spaces, attic spaces, etc. Observations are limited to the extent visible from the access points.
Access D	Areas of the building behind inaccessible solid ceiling systems, walls, or mechanical equipment, etc., where demolition of the ceiling, wall or equipment, etc., is required to reach the ACM. Evaluation of the condition and extent of ACM is limited or impossible, depending on the surveyor's ability to visually examine the materials in Access D.

3.1 Project Area

The Project Area consists of a Power Tunnel which connects the existing pumping stations to the service building. The non-asbestos building materials within the Project Area consisted of poured concrete floor slab, concrete walls and deck, plaster patching on concrete walls, insulation on pipes, etc.

If any materials within the Project Area, previously inaccessible during the assessment, are encountered during project work, they should be presumed to contain asbestos unless laboratory analysis proves otherwise.

3.1.1 Findings

A total of three (3) samples were collected from the Project Area as part of the current investigation. None of the samples collected were determined to be asbestos-containing.

Table 3.2 below summarizes the results of bulk material samples collected from suspect materials as part of the current investigation which had no detectable concentrations of asbestos

or had asbestos concentrations less than the regulated threshold limit of 0.5% (by weight), and therefore can be considered as “non-asbestos” in accordance with O.Reg. 278/05.

Table 3.2 Summary of Bulk Samples Identified As ‘Non-Asbestos’

MATERIAL DESCRIPTION	SAMPLE ID[1]
Peeling plaster patching on concrete wall observed in Power Tunnel	130892-ASB-01A-C

1 For laboratory results, site photographs and sample locations refer to Appendix A, Appendix B & Appendix C, respectively.

3.2 Lead-Containing Materials

In April 2005, the Federal Surface Coating Materials Regulation (SOR/2005-109) limited the allowable concentration of total lead present in a surface coating material (with some exceptions) to 600mg/kg (600ppm).

In December 2010, the Federal Government lowered the total lead limit in surface coating materials from 600mg/kg to 90mg/kg under subsections 4(1) and 5(1) and Section 8 of the *Surface Coatings Materials Regulations* (SOR/2005-109). The lowering of this limit aligns Canada with the United States in respect of total lead levels in surface coating materials and certain products with surface coating materials applied to them.

Therefore, using this revised threshold limit, surface coating materials with lead concentrations that exceed 90ppm (0.009% by weight) are considered to be lead-containing according to the *Surface Coatings Materials Regulations*.

In the absence of specific regulatory limits or guidance for total lead concentrations allowable in existing paint applications in buildings, and for the purposes of worker protection, Arcadis considers paints with lead concentrations that are equal to, or exceed, 90ppm as “lead-containing”. Arcadis further recommends that appropriate lead exposure precautions, in accordance with the Ministry of Labour guidelines, be implemented prior to the disturbance of these materials.

The presence of lead in paint was assessed by the collection and submission of bulk material samples to a professional laboratory for analysis. A total of two (2) paint samples were collected and submitted to an independent laboratory (EMSL Analytical of Mississauga, ON) for analysis of lead content. See **Table 3.3** for the sample results. Samples were analyzed using Lead in Paint Chips by flame atomic absorption spectroscopy (AAS) in accordance with SOR/2005-109.

One of the two paint samples collected within the Project Area, specifically a reddish-brown paint, was determined to be lead-based upon analysis, with a concentration of 8700 ppm.

Other lead-containing building materials observed throughout the Project Area include solder on copper pipes and bell and spigot joints on cast iron pipes.

Table 3.3 Lead Sampling Results for Project Area

MATERIAL DESCRIPTION	SAMPLE ID[1]	CONDITION	LEAD CONCENTRATION
Black paint on cable trays observed in Power Tunnel	130892-PB-01	**Fair**	<81 ppm
Reddish brown paint on cable trays observed in Power Tunnel	130892-PB-02	**Fair**	8700 ppm

1 For laboratory results, site photographs and sample locations refer to Appendix A, Appendix B & Appendix C, respectively.

3.3 Mould

Mould growth was visually identified in the Power Tunnel, emanating from the point of water infiltration on the concrete wall down to the concrete floor. The growth exhibited typical green,

woolly, and slimy characteristics. Active water infiltration was observed from pipe penetrations on the wall, with water dripping down to the floor during the assessment. Corroded cable trays adjacent to the wall were also noted, where water dripped down. Additionally, wooden boards were utilized to divert water flow away from the service building, but these boards were found to be impacted by mould and water damage.

The presence of mould was assessed by collecting and submitting tape-lift and bulk material samples to an accredited laboratory for analysis. A single tape-lift sample was collected and submitted to an independent laboratory (EMSL Analytical of Mississauga, ON) for analysis using Direct Microscopic Exam (DME) techniques. This analytical method can identify the presence of mould growth and provide subjective quantification of its relative extent. Typically, mould types are identified at the genus level using this analytical method. The analytical results of the mould samples collected for analysis are provided below in Table 3.4.

Table 3.4 Mould Sampling Analytical Results

SAMPLE ID[1]	MATERIAL DESCRIPTION	SAMPLE TYPE	FUNGAL IDENTIFICATION[2]
130892-M-01	Wooden Board, Power Tunnel	Tape-lift	Low

1 For laboratory results, site photographs and sample locations refer to Appendix A, Appendix B & Appendix C, respectively.

2 Mould presence was categorized based on count/area, with distinctions made between rare, low, medium, and high occurrences. Instances of 1 to 10 mould counts were classified as rare, while counts ranging from 11 to 100 fell into the low category. Medium presence encompassed counts between 101 and 1000, and high mould concentrations were identified in cases exceeding 1000.

Laboratory analysis revealed the presence of low levels of mould spores in the surface sample collected from the wooden board. Despite the low spore count, the visible mould growth on the wooden board indicates that it should be categorized as mould-impacted. Approximately fifteen (15) m^2 of concrete wall and two (2) m^2 of wooden boards were observed to be mould-impacted.

During the Indoor Air Quality (IAQ) Assessment, airborne mould presence was evaluated by collecting and submitting spore-trap air samples for analysis. As outlined in the IAQ report, the airborne mould testing indicated that there is significant evidence of mould amplification impacting the air at the time of sampling in the Power Tunnel work area.

3.4 Other Designated Substances and Hazardous Materials

Table 3.5 summarizes other Designated Substances and hazardous materials, which were also included in the survey. Identification of these materials and substances were based on visual observations only, and where appropriate, recommendations and necessary actions have been provided.

Table 3.5 Summary of Other Designated Substances and Hazardous Materials for Project Area

MATERIAL	DESCRIPTION	ACTION
Benzene	Benzene is a component of diesel fuel.	N/A
Mercury	Mercury-containing equipment such as fluorescent light bulbs were observed throughout the Project Area at the time of the survey. However, it is understood that the project will not involve removal of such equipment.	N/A
ODS	Ozone depleting substances were no observed within the Project Area.	N/A
PCBs	Fluorescent light ballasts were present throughout the Project Area. However, it is understood that the project will not involve removal of such equipment.	N/A

Table 3.5 Summary of Other Designated Substances and Hazardous Materials for Project Area

MATERIAL	DESCRIPTION	ACTION
Silica	Building components containing silica such as concrete walls and concrete floor slabs were observed in the Project Area.	Work that may disturb silica-containing materials should follow all applicable provincial and federal regulations and guidelines pertaining to Silica including the requirements of O. Reg. 490/09.
UFFI	UFFI is a type of insulation made from a foaming agent and compressed air used to insulate hard to reach areas, such as within pre-existing hollow walls. UFFI insulation was not observed during the investigation.	N/A
Other DSHM	The other designated substances and hazardous materials that were part of the survey and are regulated by the following Ontario or Canadian regulations, include acrylonitrile, arsenic, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride.	These designated substances are typically found in industrial settings and are unlikely to be located within the subject building and/or disturbed by the project work.

4 Recommendations

The following recommendations meet the requirements of *the Occupational Health and Safety Act*. Asbestos recommendations meet the requirements of the Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, Ontario Regulation 278/05. Based upon review of historical reports, as well as analytical results and observations of this assessment, Arcadis offers the following for your consideration:

4.1 Asbestos

Based on survey results, the following conclusions are made with regards to ACMs within the Project Area:

- As ACMs were not identified within the Project Area during this assessment, no further action is required.
- Demolition, renovation, or maintenance activities involving materials found NOT to contain asbestos, or not suspected of containing asbestos, should implement general health and safety precautions and best practices including, in part, the use of dust suppression techniques and appropriate respiratory protection.
- During the project, if additional materials are found beyond those which are described in this report or described in the existing inventory of asbestos-containing materials (i.e., materials not previously identified, or materials that are not homogenous to those previously identified, or materials that become revealed during the work), additional testing for asbestos-content should be completed immediately, and prior to disturbance of the material. Alternatively, these materials can be assumed to contain asbestos, and the appropriate level of asbestos safety precautions must be implemented.

4.2 Lead

Renovation, demolition or general construction work involving the removal of non-lead containing paints (i.e., trace concentrations of lead below 0.009%, or 90ppm, by dry weight) can be completed without lead specific safety precautions provided that:

- Work does not include 'fume generating activities' (heat producing) such as welding, torching, burning, high temperature cutting, etc.

- Dust levels are maintained below 3mg/m^3.
- General health and safety construction procedures are implemented, which would include dust suppression methods, proper respiratory protection (minimum of a ½-face respirator) and protective clothing, as is appropriate for the work being completed.
- Materials containing even trace amounts of lead should be removed without grinding, cutting, torching, or chemical stripping. Additionally, workers should employ general safety precautions such as appropriate dust suppression methods and proper personal protective equipment.

In general, the following procedures are recommended if/when removing lead-containing (i.e., concentrations of lead above 0.009%, or 90 ppm, by dry weight) materials, coatings, and paint applications can be completed with the following lead specific safety precautions:

- Follow Class 1 – if the coating is to be removed with a chemical gel or paste;
- Follow Class 2a – if the coating is to be removed by scraping or sanding using non-powered hand tools, or manual demolition of lead-painted building components by striking with sledgehammer or similar tool;
- Follow Class 3a – if the coating is to be removed using power tools; or
- Follow Class 3b – if the coating is to be removed by abrasive blasting.

If lead-containing paint applications and surface coatings are not removed prior to the handling, disturbance, or removal of the substrate materials, ensure that waste complies with the requirements of *General – Waste Management Regulation*, R.R.O. 1990, Regulation 347.

4.3 Mercury

The presence of mercury within assembled units (e.g., fluorescent light bulbs) should not be considered a hazard provided that the assembled units remain sealed and intact. Avoid direct skin contact with mercury and avoid inhalation of mercury vapour. Dispose of mercury following applicable legislative requirements.

Prior to any demolition or renovations to the building, the fluorescent lights that may be disturbed must be handled and if necessary, disposed of in accordance with O. Reg. 490/09 (as amended). Avoid inhalation of mercury vapour.

4.4 Ozone Depleting Substances (ODS)

Removal or disposal of any refrigeration equipment and/or refrigerant containers is regulated under the Federal Halocarbons Regulation, 2003 and should only be undertaken by qualified licensed individuals.

4.5 Polychlorinated biphenyls (PCBs)

Florescent light ballasts should be disassembled to observe serial codes and compared to standard PCB Identifier Code literature. Ballasts with unidentifiable serial codes, from manufactures who are not included in the standard PCB Identifier Code literature, are not clearly labeled as “PCB Free”, or no date is clearly visible (ballasts dated 1981 or later do not contain PCBs), must be assumed to contain PCBs. Ballasts and transformers confirmed or assumed to contain PCBs must be disposed of following Ontario Regulation 362 of the *Environmental Protection Act*, O. Reg 347/90 and *Transportation of Dangerous Goods Act* (TDGA) requirements.

4.6 Silica

Any work involving the disturbance of materials that may contain silica should be conducted following recommendations detailed in the Ministry of Labour document "*Guideline - Silica on Construction Projects*", dated April 2011.

4.7 Mould

Level 2 mould safety precautions must be adhered to, in accordance with the procedures outlined in the Environmental Abatement Council of Canada (EACC), Mould Abatement Guidelines, Edition 3 (2015). These precautions are necessary when addressing:

- Mould clean-up procedures for an estimated fifteen (15) square meters of mold-impacted concrete wall.
- Mould abatement of two (2) square meters of wooden board within the Power Tunnel work area.

4.8 Additional Materials

During work, if materials are revealed beyond what are described in this report (i.e., materials that are not identified, or that are not homogenous to those identified, or that become revealed during the work), additional testing and investigations should be completed immediately, and prior to disturbance of the material.

5 Statement of Limitations

This report describes the Designated Substances and Hazardous Materials observed by the surveyor(s) in the Project Area. The surveyor(s) assessed only those structures, finishes and permanent equipment identified in this report. The assessment does not consider or define contaminants that may or may not be present in the soil or air around the site.

This report is prepared for the sole use of City of Toronto who are responsible for its distribution to any third parties. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third party. The conclusions and recommendations contained in this report are based on professional opinions with regard to the subject matter. These opinions are in accordance with currently accepted industry practices for designated substances surveys and regulatory requirements for sampling and identifying designated substances and are subject to the following inherent limitations:

1. The data and findings presented in this report are valid as of the date(s) of the investigation only. The passage of time, a manifestation of latent conditions or the occurrence of future events may warrant further exploration of the Site, analysis of the data, and re-evaluation of the findings, observations, and conclusions expressed in this report.
2. The findings, observations, conclusions, and recommendations expressed by Arcadis in this report do not represent an opinion concerning the compliance of any past or present owner or operator of the Site with any federal, provincial, or local laws or regulations.
3. Arcadis's assessment presents professional opinions and findings of a scientific and technical nature. While attempts were made to relate the data and findings to applicable environmental and occupational health & safety laws and regulations, the report shall not be construed to offer legal opinion or representations as to the requirements of, nor compliance with, environmental and occupational health and safety laws, rules, regulations, or policies of federal, provincial, or local governmental agencies. Arcadis's liability extends only to its client as set forth and strictly in accordance with the terms of

contract entered by the parties and not to any other parties who may obtain this assessment report. Issues raised by the report should be reviewed by appropriate legal counsel.

Appendix A

Laboratory Certificate of Analysis

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order 552405047
Customer ID: 55AIBI75
Customer PO: 130892
Project ID:

Attn: Ankit Sajwan
Arcadis IBI Group
2620 Bristol Circle
Suite 300
Oakville, ON L6H 6Z7

Phone: (289) 81-2975
Fax:
Collected: 4/ 3/2024
Received: 4/03/2024
Analyzed: 4/10/2024

Proj: 130892, RC Harris WTP

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 130892-ASB-01A ***Lab Sample ID:*** **552405047-0001**

Sample Description: Peeling plaster, Tunnel Area

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	4/10/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 130892-ASB-01B ***Lab Sample ID:*** **552405047-0002**

Sample Description: Peeling plaster, Tunnel Area

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	4/10/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 130892-ASB-01C ***Lab Sample ID:*** **552405047-0003**

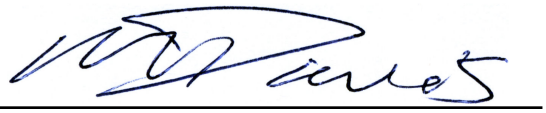
Sample Description: Peeling plaster, Tunnel Area

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	4/10/2024	Gray	0.0%	100.0%	None Detected	

Analyst(s):

Ashley Brito PLM (1)
Nickesh Mistry PLM (2)

Reviewed and approved by:



Matthew Davis or other approved signatory
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This is a summary report; official reports are available on LabConnect or upon request and relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 04/10/202415:23:45

OrderID: 552405047

EMSL CANADA, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Chain of Custody (Air, Bulk, Soil, Water)

EMSL Order Number / Lab Use Only: 552405047

EMSL Canada, Inc.
2756 Slough St
Mississauga, ON L4T 1G3
PHONE: 289-997-4602
EMAIL: TorontoLab@EMSL.com

If Bill-To is the same as Report-To leave this section blank. Third-party billing requires written authorization.

Customer Information		Billing Information	
Customer ID:	55CLEG25	Billing ID:	
Company Name:	Arcadis (formerly IBI Group)	Company Name:	
Contact Name:	Ankit Sajwan; Hassan Ktaech	Billing Contact:	
Street Address:	2620 Bristol Cir #300	Street Address:	
City, Province, Postal Code:	Oakville, ON L6H 6Z7	Country: Canada	City, Province, Postal Code: / Country:
Phone:	647-617-3873	Phone:	
Email(s) for Report:	ankit.sajwan@arcadis.com; hassan.ktaech@arcadis.com	Email(s) for Invoice:	accountspayable@ibigroup.com

Project Information

Project Name/No:	130892, RC Harris WTP	Purchase Order:	130892
EMSL LIMS Project ID. (If applicable, EMSL will provide)		US State where samples collected:	
Sampled By Name:	Ankit Sajwan	Sampled By Signature:	
		No. of Samples in Shipment	3

Turn-Around-Time (TAT)

☐ 3 Hour[1] ☐ 4-4.5 Hour[1] AHERA Only ☐ 6 Hour[1] ☐ 24 Hour ☐ 32 Hour[2] ☐ 48 Hour ☐ 72 Hour ☐ 96 Hour ☑ 1 Week ☐ 2 Week

[1]Premium Service Charge applies for 3 Hour TEM AHERA or EPA Level II TAT. TEM Air 3-6 Hour, please call ahead to schedule [2]32 Hour TAT available for select tests only; samples must be submitted by 11 30am

Test Selection

PCM Air
- ☐ NIOSH 7400
- ☐ IRSST PCM

PLM - Bulk (reporting limit)
- ☑ PLM EPA 600/R-93/116 (<1%)
  - ☐ 400 PTCT (<0.25%)
  - ☐ Conditional 400 PTCT (<0.25%)
  - ☐ 1000 PTCT (<0.1%)
- ☐ PLM EPA NOB(<1%)
  - ☐ 400 PTCT (<0.25%) ☐ 1000 PTCT (<0.1%)
- ☐ IRSST PLM
- ☐ NIOSH 9002 (<1%)
- ☐ Other

TEM - Air
- ☐ AHERA 40 CFR, Part 763
- ☐ NIOSH 7402
- ☐ EPA Level II

TEM - Bulk
- ☐ TEM EPA NOB
- ☐ IRSST TEM (NYS 198.4)

TEM - Settled Dust
- ☐ Microvac - ASTM D 5755
- ☐ Wipe - ASTM D6480

TEM - Water
- ☐ EPA 100.2 (All fibre sizes)
- ☐ EPA 100.2 (Fibres >10µm)

Soil - Rock - Vermiculite (reporting limit)*
- ☐ PLM EPA 600/R-93/116 with milling prep (<0.25%)
- ☐ PLM EPA 600/R-93/116 with milling prep (<0.1%)
- ☐ TEM EPA 600/R-93/116 with milling prep (<0.1%)
- ☐ TEM EPA 600/R-93/116 with milling prep (<0.01%)
- ☐ ASTM D7521 Sieve Method
- ☐ TEM Qualitative via Filtration Prep
- ☐ TEM Qualitative via Drop Mount Prep
- ☐ Cincinnati Method EPA 600/R-04/004 - PLM/TEM* *(required for vermiculite in BC and NS)

Asphalt
- ☐ PLM EPA Gravimetric with milling prep (<0.25%)

Stop At First Positive *(clearly identify homogenous areas below)*

*Please call with your project-specific requirements.

☑ Positive Stop - Clearly Identified Homogeneous Areas (HA) | Filter Pore Size (Air Samples) ☐ 0.8um ☐ 0.45um

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
130892-ASB-01A	Peeling plaster, Tunnel Area	Bulk	03/04/2024
130892-ASB-01B	Peeling plaster, Tunnel Area	Bulk	03/04/2024
130892-ASB-01C	Peeling plaster, Tunnel Area	Bulk	03/04/2024

RECEIVED EMSL CANADA, INC. TORONTO 2024 APR -3 P 4:55

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by: Ankit Sajwan	Date/Time: 03/04/2024;	Received by:	Date/Time 4/3/2024
Relinquished by:	Date/Time:	Received by:	Date/Time 4:55 PM

Controlled Document - COC-05-CAN Asbestos R11 04/15/21

☑ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.) AB

EMSL Canada, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

EMSL Canada Inc.
2756 Slough Street, Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

EMSL Canada Or	552405046
CustomerID:	55CLEG25
CustomerPO:	130892
ProjectID:	

Attn: **Ankit Sajwan**
Arcadis IBI Group
8133 Warden Ave, Unit 300
Markham, ON L6G 1B3

Phone: (905) 940-6161
Fax:
Received: 4/3/2024 04:55 PM
Collected: 4/3/2024

Project: **130892, RC Harris WTP**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client SampleDescription	*Collected*	*Analyzed*	*Weight*	*RDL*	*Lead Concentration*
130892-Pb-01	4/3/2024	4/5/2024	0.2475 g	81 ppm	<81 ppm
552405046-0001	Site: Black paint on cable trays				
130892-Pb-02	4/3/2024	4/5/2024	0.2444 g	410 ppm	8700 ppm
552405046-0002	Site: Reddish brown paint on cable trays				

Rowena Fanto, Lead Supervisor
or other approved signatory

* Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
Samples analyzed by EMSL Canada Inc. Mississauga, ON AIHA LAP, LLC-ELLAP Accredited #196142

Report Amended: 04/10/2024 10:53:35 Replaces the Inital Report 04/10/2024 09:21:22. Reason Code: Data Entry-Change to Appearance

OrderID: 552405046

EMSL CANADA, INC.
LABORATORY • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

552405046

EMSL Canada, Inc.
2756 Slough St
Mississauga, ON L4T 1G3

PHONE: 289-997-4602
EMAIL: TorontoLab@EMSL.com

If Bill-To is the same as Report-To leave this section blank. Third-party billing requires written authorization.

Customer Information		Billing Information	
Customer ID:	55CLEG25	Billing ID:	
Company Name:	Arcadis (formerly IBI Group)	Company Name:	
Contact Name:	Ankit Sajwan; Hassan Ktaech	Billing Contact:	
Street Address:	2620 Bristol Cir #300	Street Address:	
City, Province, Postal Code:	Oakville, ON L6H 6Z7	City, Province, Postal Code:	
Country:	Canada	Country:	
Phone:	647-617-3873	Phone:	
Email(s) for Report:	ankit.sajwan@arcadis.com; hassan.ktaech@arcadis.com	Email(s) for Invoice:	accountspayable@ibigroup.com

Project Information

Project Name/No:	130892, RC Harris WTP	Purchase Order:	130892
EMSL LIMS Project ID: (If applicable, EMSL will provide)		US State where samples collected:	ON
State of Connecticut (CT) must select project location:	☐ Commercial (Taxable) ☐ Residential (Non-Taxable)		
Sampled By Name:	Ankit Sajwan	Sampled By Signature:	
No. of Samples in Shipment	2		

Turn-Around-Time (TAT)

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32 Hour ☐ 48 Hour ☐ 72 Hour ☐ 96 Hour ☑ 1 Week ☐ 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only; samples must be submitted by 11:30am.

MATRIX	METHOD	INSTRUMENT	REPORTING LIMIT	SELECTION
CHIPS ☑ % by wt. ☑ ppm (mg/kg) ☐ mg/cm² *Reporting Limit based on a minimum 0.25g sample weight. **Not appropriate for Ceramic Tiles - XRF is recommended	SW 846-7000B	Flame Atomic Absorption	0.008% (80ppm)	☑
	SW 846-6010D*	ICP-OES	0.0004% (4ppm)	☐
AIR	NIOSH 7082	Flame Atomic Absorption	4µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-OES	0.5µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-MS	0.05µg/filter	☐
WIPE ☐ ASTM ☐ NON-ASTM *If no box is checked, non-ASTM Wipe is assumed	SW 846-7000B	Flame Atomic Absorption	10µg/wipe	☐
	SW 846-6010D*	ICP-OES	1.0µg/wipe	☐
TCLP	SW 846-1311 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1311 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
SPLP	SW 846-1312 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1312 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
TTLC	22 CCR App. II, 7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
STLC	22 CCR App. II, 7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
Soil	SW 846-7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
Wastewater	SM 3111B / SW 846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
Unpreserved ☐ / Preserved with HNO3 ☐ PH<2	EPA 200.7	ICP-OES	0.020 mg/L (ppm)	☐
Drinking Water	EPA 200.5	ICP-OES	0.003 mg/L (ppm)	☐
Unpreserved ☐ / Preserved with HNO3 ☐ PH<2	EPA 200.8	ICP-MS	0.001 mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50	ICP-OES	12 µg/filter	☐
Other:				☐

Sample Number	Sample Location	Volume / Area	Date / Time Sampled
130892-Pb-01	Black paint on cable trays	N/A	03/04/2024
130892-Pb-02	Reddish brown paint on cable trays	N/A	03/04/2024

2024 APR -3 P 4:55
RECEIVED
EMSL CANADA, INC.
TORONTO

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by: Ankit Sajwan	Date/Time: 03/04/2024: 2:	Received by:	Date/Time 4/3/2024
Relinquished by:	Date/Time:	Received by:	Date/Time 4:55 PM

Controlled Document - COC-25-CAN Lead Canada R14 05/09/2022

*6010C Available Upon Request

☑ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature)

Prices quoted do not include tax, which is payable at the time services are billed.

EMSL Canada, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Canada, Inc. constitutes acceptance an Page 1 Of 1 ns by Customer.

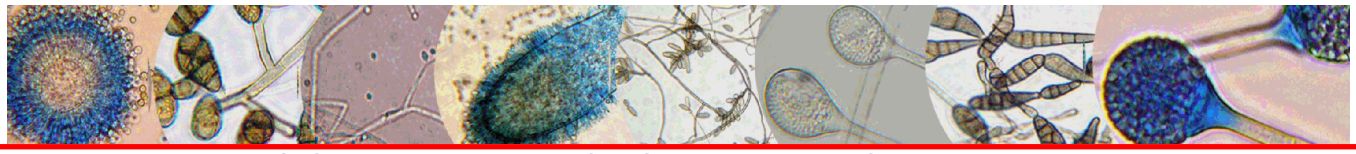
EXPANDED FUNGAL REPORT™

Prepared Exclusively For

Arcadis IBI Group

8133 Warden Ave, Unit 300
Markham, ON L6G 1B3
Phone:905-940-6161

Report Date:	**4/10/2024**
Project:	**130892, RC Harris WTP**
P.O:	**130892**
EMSL Canada Orde	**552405045**



EMSL Canada Inc.
2756 Slough Street Mississauga, ON L4T 1G3
Phone: (289) 997-4602 Fax: (289) 997-4607 Web: http://www.EMSL.com Email:torontolab@emsl.com

Attn: Ankit Sajwan
Arcadis IBI Group
8133 Warden Ave, Unit 300
Markham, ON L6G 1B3

EMSL Order: 552405045
Customer ID: 55CLEG25
Collected: 4/03/2024
Received: 4/03/2024
Analyzed: 4/10/2024

Proj: 130892, RC Harris WTP

1. Description of Analysis

Analytical Laboratory

EMSL Canada Inc. (EMSL Canada) is a nationwide, full service, analytical testing laboratory network providing Asbestos, Mold, Indoor Air Quality, Microbiological, Environmental, Chemical, Forensic, Materials, Industrial Hygiene and Mechanical Testing services. Ranked as the premier independently owned environmental testing laboratory in the nation, EMSL Canada puts analytical quality as its top priority. This is assured by our high quality personnel, including experienced microbiologists with graduate degrees. Our quality is recognized by many well-respected federal, provincial and private accrediting agencies, such as the American Association for Laboratory Accreditation (A2LA). A2LA is a nonprofit, non-governmental, public service, membership society providing laboratory accreditation based on internationally accepted criteria for competence (ISO/IEC 17025). A2LA accreditation is also recognized internationally through its membership with the International Laboratory Accreditation Cooperation (ILAC).

EMSL Canada is an independent laboratory that performed the analysis of these samples. EMSL Canada did not conduct the sampling or site investigation for this report. The samples referenced herein were analyzed under strict quality control procedures using state-of-the-art microbiological methods. The analytical methods used and the data presented are scientifically and legally defensible

The laboratory data is provided in compliance with A2LA accreditation and the ISO 17025 standard for the particular test(s) requested, including any associated limitations for the methods employed. These data are intended for use by professionals having knowledge of the testing methods necessary to interpret them accurately.

2. Analytical Results

See attached data reports and charts.

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Test Report: Microscopic Examination of Fungal Spores, Fungal Structures, Hyphae, and Other Particulates from Tape Samples (EMSL Method MICRO-SOP-200)

Lab Sample Number	Client Sample ID	Location	Fungal Identification	Category
552405045-0001	130892-M-01	Wooden board, Tunnel Area	Cladosporium	*Low*

No discernable field blank was submitted with this group of samples.

++ = Includes other spores with similar morphology; see EMSL's fungal glossary for each specific category.
* = Sample contains fruiting structures and/or hyphae associated with the spores.
- Denotes Not Detected.

Category	Count/area Analyzed
Rare	1 to 10
Low	11 to 100
Medium	101 to 1000
High	> 1000

Sneha Panchal, M.Sc.,RMCCM Laboratory Manager

Initial report from: 04/10/2024 16:49:48

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Proj: 130892, RC Harris WTP

3. Understanding the Results

EMSL Canada Inc. is an independent laboratory, providing unbiased and scientifically valid results. These data represent only a portion of an overall IAQ investigation. Visual information and environmental conditions measured during the site assessment (humidity, moisture readings, etc.) are crucial to any final interpretation of the results. Many factors impact the final results; therefore, result interpretation should only be conducted by qualified individuals. The American Conference of Governmental Industrial Hygienists (ACGIH) has published a good reference book covering sampling and data interpretation. It is entitled, Bioaerosols: Assessment and Control, 1999.

Fungal spores are found everywhere. Whether or not symptoms develop in people exposed to fungi depends on the nature of the fungal material (e.g., allergenic, toxic, or infectious), the exposure level, and the susceptibility of exposed persons. Susceptibility varies with the genetic predisposition (e.g., allergic reactions do not always occur in all individuals), age, pre-existing medical conditions (e.g., diabetes, cancer, or chronic lung conditions), use of immunosuppressive drugs, and concurrent exposures. These reasons make it difficult to identify dose/response relationships that are required to establish “safe” or “unsafe” levels (i.e., permissible exposure limits).

It is generally accepted in the industry that indoor fungal growth is undesirable and inappropriate, necessitating removal or other appropriate remedial actions. The New York City guidelines and EPA guidelines for mold remediation in schools and commercial buildings define the conditions warranting mold remediation. Always remember that water is the key. Preventing water damage or water condensation will prevent mold growth.

This report is not intended to provide medical advice or advice concerning the relative safety of an occupied space. Always consult an occupational or environmental health physician who has experience addressing indoor air contaminants if you have any questions.

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Markham, ON L6G 1B3

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Analyzed: 4/10/2024

Proj: 130892, RC Harris WTP

4. Glossary of Fungi

CLADOSPORIUM	
Natural Habitat	Dead plant matter. Straw. Soil. Woody plants
Suitable Substrates in the Indoor Environment	Fiberglass duct liner. Paint. Textiles. Found in high concentration in water-damaged building materials.
Water Activity	Aw 0.84-0.88
Mode of Dissemination	Air
Allergic Potential	Type I (asthma and hay fever).
Potential or Opportunistic Pathogens	Edema. keratitis. onychomycosis. pulmonary infections. Sinusitis.
Industrial Uses	Produces 10 antigens.
Potential Toxins Produced	Cladosporin and Emodin.

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Markham, ON L6G 1B3

EMSL Order: 552405045
Customer ID: 55CLEG25
Collected: 4/03/2024
Received: 4/03/2024
Analyzed: 4/10/2024

Proj: 130892, RC Harris WTP

5. References and Informational Links

Books

- Bioaerosols: Assessment and Control. Janet Macher, Ed., American Conference of Governmental Industrial Hygienists, Cincinnati, OH 1999.
- Exposure Guidelines for Residential Indoor Air Quality. Environmental Health Directorate, Health Protection Branch, Health Canada, Ottawa, Ontario, 1989.
- Fungal Contamination in Public Buildings: Health Effects and Investigation Methods. Health Canada, Ottawa, Ontario, 2004.
- IICRC: S500 Standard and Reference Guide for Professional Water Damage Restoration. 3rd Edition, Institute of Inspection, Cleaning, and Restoration Certification, Vancouver, WA, 2006

  IICRC: S520 Standard and Reference Guide for Professional Mold Remediation. 1st Edition, Institute of Inspection, Cleaning, and Restoration Certification, Vancouver, WA, 2004
- Field Guide for the Determination of Biological Contaminants in Environmental Samples. 2nd Edition, American Industrial Hygiene Association, 2005.

Consumer Links

Read the full text of AIHA's "The Facts About Mold" consumer brochure.
<http://www.aiha.org/get-involved/VolunteerGroups/Documents/BiosafetyVG-FactsAbout%20MoldDecember2011.pdf>

The Occupational Safety and Health Administration (OSHA)
http://www.osha.gov/SLTC/molds/index.html

CDC Mold Facts
http://www.cdc.gov/mold/faqs.htm

CDC Stachybotrys - Questions and answers on Stachybotrys chartarum and other molds
http://www.cdc.gov/mold/stachy.htm

IOM, NAS: Clearing the Air: Asthma and Indoor Air Exposures
https://www.epa.gov/indoor-air-quality-iaq/should-you-have-air-ducts-your-home-cleaned

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Proj: 130892, RC Harris WTP

National Library of Medicine-Mold website
http://www.nlm.nih.gov/medlineplus/molds.html

California Department of Health Services (CADOHS)
https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Mold.aspx

Minnesota Department of Health
http://www.health.state.mn.us/divs/eh/indoorair/mold/index.html

New York City Department of Health and Mental Hygiene
https://www1.nyc.gov/site/doh/health/health-topics/mold.page

H.R.: The United States Toxic Mold Safety and Protection Act

EPA

"Should You Have the Air Ducts in Your Home Cleaned?"
<http://www.epa.gov/iaq/pubs/airduct.html>

General information about molds and actions that can be taken to clean up or prevent a mold problem.
<http://www.epa.gov/asthma/molds.html>

“A Brief Guide to Mold, Moisture, and Your Home” - Includes basic information on mold, cleanup guidelines, and moisture and mold prevention
http://www.epa.gov/mold/moldguide.html

“Mold Remediation in Schools and Commercial Buildings” - Information on remediation in schools and commercial property, references for potential mold and moisture remediators.
https://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide

FEMA

“Homes That Were Flooded May Harbor Mold Problems” - Information and tips for cleaning mold.
http://www.fema.gov/news-release/homes-were-flooded-may-harbor-mold-problems

“Dealing With Mold & Mildew in Your Flood Damaged Home.
http://www.fema.gov/pdf/rebuild/recover/fema_mold_brochure_english.pdf

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EMSL Order: 552405045
Customer ID: 55CLEG25
Collected: 4/03/2024
Received: 4/03/2024
Analyzed: 4/10/2024

Proj: 130892, RC Harris WTP

6. Important Terms, Conditions, and Limitations

A. Sample Retention

Samples analyzed by EMSL Canada will be retained for 60 days after analysis date Storage beyond this period is available for a fee with written request prior to the initial 30 day period. Samples containing hazardous/toxic substances which require special handling will be returned to the client immediately. EMSL Canadareserves the right to charge a sample disposal fee or return samples to the client.

B. Change Orders and Cancellation

All changes in the scope of work or turnaround time requested by the client after sample acceptance must be made in writing and confirmed in writing by EMSL Canada. If requested changes result in a change in cost the client must accept payment responsibility. In the event work is cancelled by a client, EMSL Canada will complete work in progress and invoice for work completed to the point of cancellation notice. EMSL Canada is not responsible for. holding times that are exceeded due to such changes.

C. Warranty

EMSL Canada warrants to its clients that all services provided hereunder shall be performed in accordance with established and recognized analytical testing procedures and with reasonable care in accordance with applicable federal, state and local laws. The foregoing express warranty is exclusive and is given in lieu of all other warranties, expressed or implied. EMSL Canada disclaims any other warranties, express or implied, including a warranty of fitness for particular purpose and warranty of merchantability.

D. Limits of Liability

In no event shall EMSL Canada be liable for indirect, special, consequential, or incidental damages, including, but not limited to, damages for loss of profit or goodwill regardless of the negligence (either sole or concurrent) of EMSL Canada and whether EMSL Canada has been informed of the possibility of such damages, arising out of or in connection with EMSL Canada's services thereunder or the delivery, use, reliance upon or interpretation of test results by client or any third party. We accept no legal responsibility for the purposes for which the client uses the test results. EMSL Canada will not be held responsible for the improper selection of sampling devices even if we supply the device to the user. The user of the sampling device has the sole responsibility to select the proper sampler and sampling conditions to insure that a valid sample is taken for analysis. Any resampling performed will be at the sole discretion of EMSL Canada, the cost of which shall be limited to the reasonable value of the original sample delivery group (SDG) samples. In no event shall

Attn: Ankit Sajwan
Arcadis IBI Group
8133 Warden Ave, Unit 300
Markham, ON L6G 1B3

EMSL Order: 552405045
Customer ID: 55CLEG25
Collected: 4/03/2024
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Analyzed: 4/10/2024

Proj: 130892, RC Harris WTP

EMSL Canada be liable to a client or any third party, whether based upon theories of tort, contract or any other legal or equitable theory, in excess of the amount paid to EMSL Canada by client thereunder.

E. Indemnification

Client shall indemnify EMSL Canada and its officers, directors and employees and hold each of them harmless for any liability, expense or cost, including reasonable attorney's fees, incurred by reason of any third party claim in connection with EMSL Canada services, the test result data or its use by client

OrderID: 552405045

Microbiology Chain of Custody Form

EMSL Order Number / Lab Use Only: 552405045

EMSL CANADA, INC.
LABORATORY • PRODUCTS • TRAINING

EMSL Canada, Inc.
2756 Slough Street
Mississauga, ON L4T 1G3

PHONE: (289) 997-4602
EMAIL: TorontoLab@EMSL.com

If Bill-To is the same as Report-To leave this section blank. Third-party billing requires written authorization.

Customer Information		Billing Information	
Customer ID:	55CLEG25	Billing ID:	
Company Name:	Arcadis (formerly IBI Group)	Company Name:	
Contact Name:	Ankit Sajwan; Hassan Ktaech	Billing Contact:	
Street Address:	2620 Bristol Cir #300	Street Address:	
City, State/Province, Zip/Postal Code:	Oakville, ON L6H 6Z7	City, State/Province, Zip/Postal Code:	
Country:	Canada	Country:	
Phone:	647-617-3873	Phone:	
Email(s) for Report:	ankit.sajwan@arcadis.com; hassan.ktaech@arcadis.com	Email(s) for Invoice:	accountspayable@ibigroup.com

Project Information

Project Name/No:	130892, RC Harris WTP	Purchase Order:	130892
EMSL LIMS Project ID: (If applicable, EMSL will provide)		State Samples Collected: Ontario	Zip Code Samples Collected::
Sampled By Name:	Ankit Sajwan	Sampled By Signature:	No. of Samples in Shipment: 1

Sterile, Sodium Thiosulfate Preserved Bottle Used: ☐ Biocide Used in Source (specify)

Public Water Supply Samples: ☐ Note: All results may automatically be reported to DOH if required by State.

Turn-Around-Time (TAT) Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only; samples must be submitted by 11:30am.

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32* Hour ☐ 48 Hour ☐ 72 Hour ☐ 96 Hour ☑ 1 Week ☐ 2 Week

MICROBIOLOGY TEST CODES

M001 Air-O-Cell	**M012** *Pseudomonas aeruginosa (P/A***)*	**M115** Sewage Screen - Water (P/A***)
M030 Micro 5	**M024** *Pseudomonas aeruginosa* (MFT*)	**M116** Sewage Screen - Water (MPN**)
M041 Fungal Direct Examination	**M015** Heterotrophic Plate Count	**M117** Sewage Screen - Swab (P/A***)
M169 Pollen ID & Enumeration	**M017** Total Coliform & *E. Coli* (Colilert P/A***)	**M013** Sewage Screen - Swab (MFT*)
M280 Dust Characterization Level-1	**M018** Total Coliform & *E. Coli* (MFT*)	**M133** *Methicillin-resistant Staph. aureus* (MRSA)
M281 Dust Characterization Level-2	**M114** Total Coliform & *E. Coli Enumeration* (Colilert MPN**)	**M031** Rapid-growing non-TB Mycobacteria Detection & Enumeration
M005 Viable Fungi-Air Samples (Genus ID & Count)	**M019** Fecal Coliform (MFT*)	**M014** Endotoxin Analysis
M006 Viable Fungi-Air Samples (Includes *Penicillum, Aspergillus, Cladosporium, Stachybotrys* Species ID & Count)	**M020** Fecal *Streptococcus* (MFT*)	**M044** Group Allergen (Cat, Dog, Cockroach, Dust Mite)
M007 Culturable Fungi-Surface Samples (Genus ID & Count)	**M029** *Enterococci* (MFT*)	**Other** - See Analytical Price Guide for Test Code
M008 Culturable Fungi-Surface Samples (Includes *Penicillum, Aspergillus, Cladosponum, Stachybotrys* Species ID & Count)	**M129** *Enterococci* (Enterolert P/A***)	***Legionella* Analysis** Please use EMSL *Legionella* COC
M009 Bacteria Culture Gram Stain & Count	**M180** Real Time qPCR-ERMI 36 Panel	
M010 Bacteria Count & ID - 3 Most Prominent	**M025** Sewage Screen - Water (MFT*)	
M011 Bacteria Count & ID - 5 Most Prominent		

*MFT= Membrane Filtration Technique
**MPN = Most Probable Number
***P/A = Presence/Absence

Sample #	Sample Location/Description	Sample Type (Matrix)	Potable / Non-Potable (Only for Water)	Test Code	Volume/Area	Date / Time Collected	Temperature (Lab Use Only)
Example: Sample 1	Kitchen	Water	Potable	M017	1,000 ml	1/1/2021 3:30pm	
130892-M-01	Wooden board, Tunnel Area	N/A	N/A	M041	N/A	03/04/2024; 11:00am	

RECEIVED
EMSL CANADA, INC.
TORONTO
2024 APR -3 PM 4:55

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by: Ankit Sajwan	Date/Time: 03/04/2024;	Received by:	Date/Time: 4/3/24 4:55
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document - COC-34 CAN Micro R6 04/15/2021

☑ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Canada's Laboratory Terms and Conditions are incorporated into this chain of custody by reference in their entirety. Submission of samples to EMSL constitutes acceptance and acknowledgment of all terms and conditions by Customer.

Appendix B

Site Photographs

ARCADIS

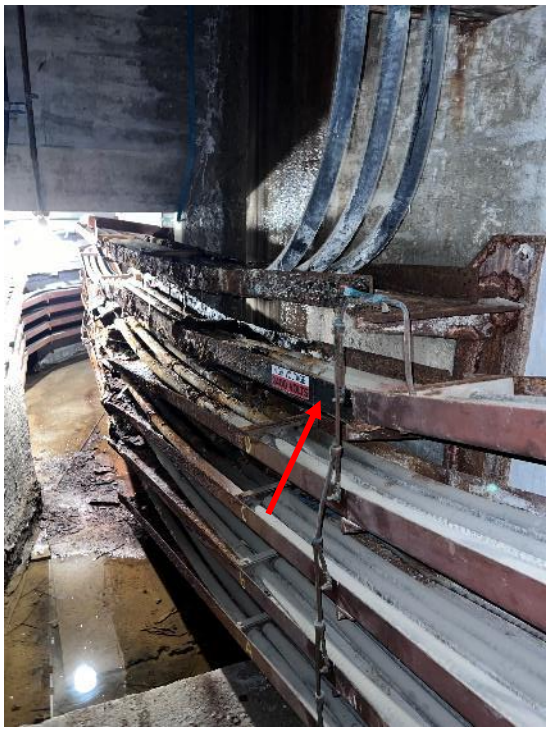
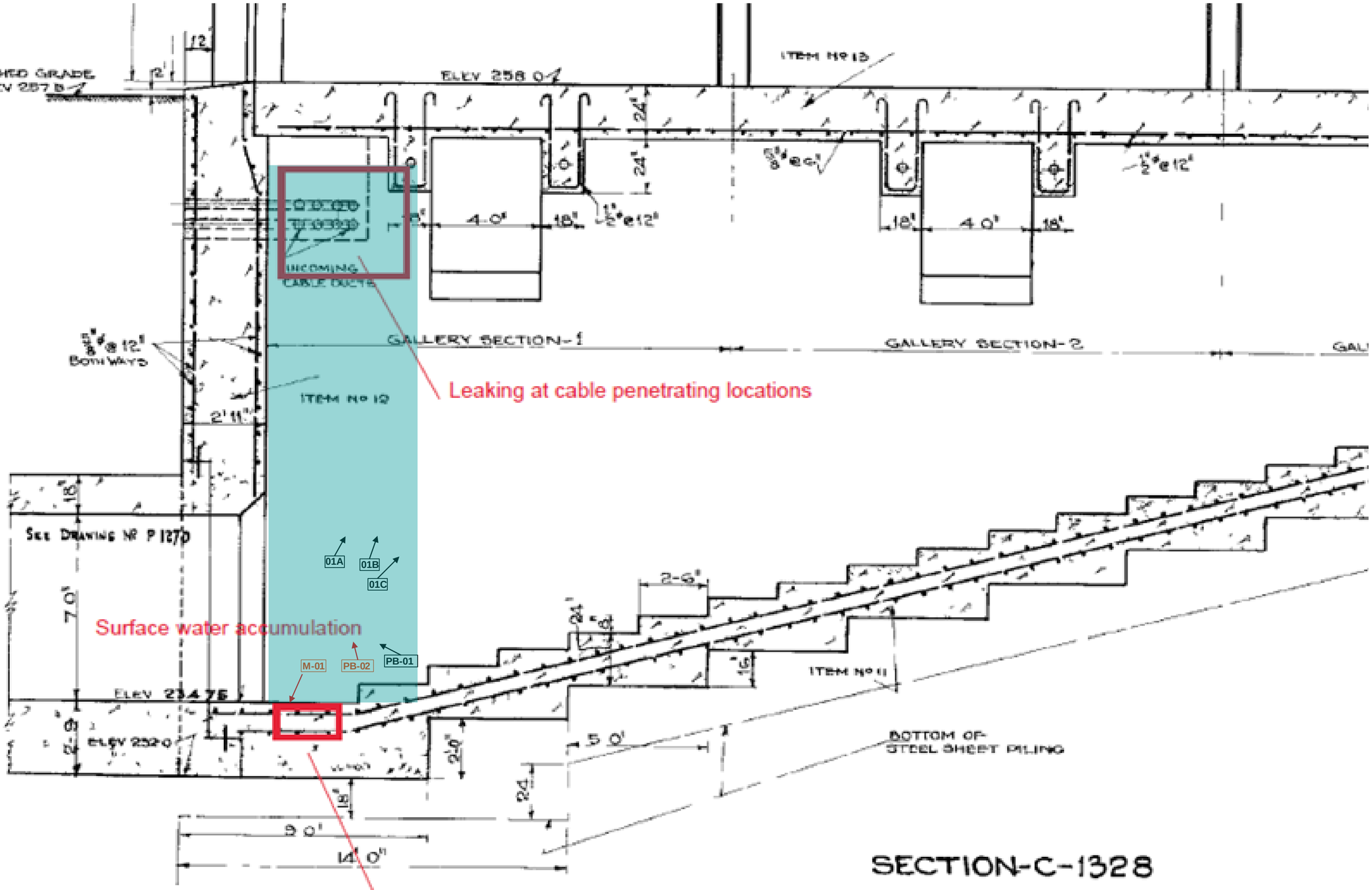
	
Photo 1: Representative photograph of non-asbestos plaster patching on concrete wall.	**Photo 2:** Representative photograph of trace lead-containing black paint on cable trays.
	
Photo 3: Representative photograph of **lead-based** reddish brown paint on cable trays.	**Photo 4:** Representative photograph of mould-impacted and water-damaged wooden boards used to restrain water movement in the Tunnel Area.

	
Photo 5: Representative photograph of mould-impacted concrete wall in the Tunnel Area.	**Photo 6:** Representative photograph of water-damaged cable trays and mould-impacted concrete wall in the Tunnel Area.

Appendix C

Drawings



CLIENT

City of Toronto
R.C. Harris WTP
2701 Queen Street East,
Scarborough, ON

ISSUES

No.	DESCRIPTION	DATE
1	Project Specific Designated Substances Survey	April 19, 2024

NOT FOR CONSTRUCTION

CONSULTANTS

LEGEND:

01A	ASBESTOS BULK SAMPLE COLLECTED
01A	ASBESTOS BULK SAMPLE COLLECTED WITH CONTAMINATION EXCEEDANCE
PB-01	LEAD BULK SAMPLE COLLECTED
PB-01	LEAD BULK SAMPLE COLLECTED WITH CONTAMINATION EXCEEDANCE
M-01	MOULD TAPE-LIFT SAMPLE COLLECTED
M-01	MOULD TAPE-LIFT SAMPLE COLLECTED WITH CONTAMINATION EXCEEDANCE

MOULD-IMPACTED BUILDING MATERIAL

SEAL

PROJECT

Project-Specific Designated Substances and Hazardous Materials Survey – Power Tunnel, R.C. Harris WTP

PROJECT NO: 130892

DRAWN BY: NL | CHECKED BY: AS

PROJECT MGR: HK | APPROVED BY: HK

ARCADIS

SHEET TITLE

Hazardous Materials Sampling Plan and Identification Drawings

SHEET NUMBER 1 | ISSUE 1

Appendix E
Division 2 – Appendix C – Power Tunnel IAQ Report 2024

Final Report

Indoor Air Quality Assessment Report

RC Harris Water Treatment Plant, Power Tunnel Area
2701 Queen Street East, Scarborough, ON

Submitted to City of Toronto
by Arcadis
130892
April 2024

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25 April 2024
Arcadis Project No.: 130892

City of Toronto – Metro Hall
55 John Street, 7th Floor
Toronto, ON M5V 3C6

ATTENTION: Punyama Jayasinghe, M.Eng., P.Eng.

Re: Indoor Air Quality Assessment Report
RC Harris Water Treatment Plant, 2701 Queen Street East, Scarborough, ON

Arcadis is pleased to submit the enclosed Indoor Air Quality Assessment Report to City of Toronto (herein referred to as "the Client"). This report summarizes a visual inspection and testing for indoor air quality within Power Tunnel Area of R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Scarborough, Ontario.

We thank you for the opportunity to undertake this work. If you have any questions, please do not hesitate to call our office.

Yours sincerely,

Arcadis

Hassan Ktaech, H.B.A., MCIWM
Associate - Manager, Environmental Services

HK/as

Document Control Page

CLIENT:	City of Toronto
PROJECT NAME:	R.C. Harris Water Treatment Plant, 2701 Queen Street East, Scarborough, Ontario
REPORT TITLE:	Indoor Air Quality Assessment Report
ARCADIS REFERENCE:	130892
VERSION:	V1
DIGITAL MASTER:	J:\IM16-0273 TOR_HarrisWTP-StandbyGenerator\400_Tchncl\DSS & IAQ Investigation\IAQ Report\130892_RCHarris_PowerTunnel_IAQReport_April2024.docx
ORIGINATOR:	Ankit Sajwan, H.B.Sc. Project Manager, Environmental Services
REVIEWER:	Hassan Ktaech, HBA, MCIWM Associate – Manager, Environmental Services
AUTHORIZATION:	Hassan Ktaech, HBA, MCIWM Associate – Manager, Environmental Services
SUBMITTED:	V1 - Final Report – April 25, 2024

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Executive Summary

Arcadis was retained by City of Toronto (herein referred to as "the Client") and is pleased to provide the following observations and recommendations regarding the Indoor Air Quality (IAQ) Assessment within the Power Tunnel Area (herein referred to as the "Project Area") of R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Scarborough, Ontario (herein referred to as the "Site"). Mr. Ankit Sajwan completed an assessment of the Project Area on April 3, 2024.

The project consisted of the following scope of work:

1. Gathering spot measurements of IAQ parameters in locations representing different spaces and uses in the facility, including the Power Tunnel Work Area, Tunnel Pathway, and Ground Floor Lobby Area. Measurements were taken, and outdoor air was measured for control purposes to aid in evaluating indoor readings. The parameters measured using direct reading instruments included:
    a. Temperature
    b. Relative Humidity (RH%)
    c. Carbon Dioxide (CO_2)
    d. Carbon Monoxide (CO)
    e. Particulate Matter (PM_{10}, $PM_{2.5}$, and TPM)
    f. Total Volatile Organic Compounds (TVOC)
2. Collecting three (3) mould air samples in representative areas, along with one outdoor reference sample.

Key Findings

All spot measurements of carbon dioxide, carbon monoxide, temperature, relative humidity, particulate matter and total volatile organic compounds (TVOCs) were found to be within recommended criteria.

However, airborne mould testing indicated evidence of mould amplification impacting the air at the time of sampling, particularly in the Power Tunnel work area sample (ST-02). Mould growth was visually identified in the Power Tunnel, emanating from the point of water infiltration on the concrete wall and extending down to the concrete floor. Level 2 mould safety precautions should be utilized to clean-up mould-impacted concrete wall and removal of wooden boards in the Power Tunnel work area.

This executive summary provides a brief overview of the study findings. It is not intended to substitute for reading the complete report, nor does it discuss specific issues documented in the report.

1 Introduction and Regulatory Requirements

1.1 Introduction

Arcadis was retained by City of Toronto (herein referred to as "the Client") and is pleased to provide the following observations and recommendations regarding the Indoor Air Quality Assessment within the Power Tunnel Area (herein referred to as the "Project Area") of R.C. Harris Water Treatment Plant located at 2701 Queen Street East, Scarborough, Ontario (herein referred to as the "Site"). Mr. Ankit Sajwan completed an assessment of the Project Area on April 3, 2024.

The following report details the project scope of work, regulatory requirements, survey and analytical methodologies, survey statement of limitations, and findings and recommendations.

1.2 Scope of Work

The scope of work for the project, as referenced in the Arcadis Proposal dated February 29, 2024, identifies the requirement to conduct the assessment. Specifically, the scope of work include:

1. Gathering spot measurements of IAQ parameters in locations representing different spaces and uses in the facility, including the Power Tunnel Work Area, Tunnel Pathway, and Ground Floor Lobby Area. Measurements were taken, and outdoor air was measured for control purposes to aid in evaluating indoor readings. The parameters measured using direct reading instruments included:
    a. Temperature
    b. Relative Humidity (%RH)
    c. Carbon Dioxide (CO_2)
    d. Carbon Monoxide (CO)
    e. Particulate Matter (PM_{10}, $PM_{2.5}$, and TPM)
    f. Total Volatile Organic Compounds (TVOC)
2. Collecting three (3) mould air samples in representative areas, along with one outdoor reference sample.

2 Survey Methodology

Outlined below is the methodology employed for this assessment, encompassing interviews, inspections, test methods and criteria.

2.1 Interviews and Inspections

Arcadis conducted an interview with the representative from the R.C. Harris Water Treatment Plant to discuss Project Area issues and upcoming repair project work.

Additionally, Arcadis conducted a walk-through inspection of the Power Tunnel, noting the number of occupants worked in the space, observing any signs of moisture ingress or damage, and assessing the condition of the area.

2.2 Test Methods and Criteria

Test methods used for this assessment included direct reading instruments and mould air sample collection. All instruments were calibrated by the equipment supplier, Pine Environmental Services LLC, prior to their use.

The following table includes the parameters measured in this investigation, the instruments and sampling/analytical methods used, the applicable units of measurement, and the criteria selected by Arcadis for the evaluation of the results. The recommended limits and guideline values referenced in the table below are in accordance with the scope of work.

Table 2.1 Parameters Tested, Recommended Limits and Instruments or Methods Used

Parameter	Unit of Measurement	Recommended Limit or Guide to Interpretation	Instrumentation or Test Method
Temperature, T	°C	Summer: 23 – 26 C (at 50% RH); Winter: 20 – 23.5 C (at 50% RH). Reference: CSA Standard Z412- Office Ergonomics.	TSI® Quest EVM-7 Environmental Monitor
Relative Humidity, RH	RH%	>25%. Reference: Indoor Air Quality in Office Buildings: A Technical Guide, Health Canada. <60%. Reference: ASHRAE Standard 55- 1992.	
Carbon dioxide, CO_2	Parts per million in air (ppm)	1,000 ppm (Long-term exposure limit – 24 hours). Reference: *Health Canada Residential indoor air quality guidelines*.	
Carbon monoxide, CO	ppm	10 ppm (Long-term exposure limit – 24 hours). 25 ppm (Short-term exposure limit – 1 hour). Reference: Health Canada *Residential indoor air quality guidelines*.	
Particulate Matter PM_{10}, $PM_{2.5}$ and TPM	Micrograms per cubic meter of air, ($\mu g/m^3$)	Respirable (PM_{10}) – 50 ug/m^3. Reference: ASHRAE Standard 62.1 – 2016. Note: Health Canada recommends keeping indoor levels of $PM_{2.5}$ as low as possible. No guideline value is provided by Health Canada for $PM_{2.5}$.	
Total Volatile Organic Compounds, (TVOC)	Parts per billion in air (ppb) or $\mu g/m^3$	1 mg/m^3 (~ 440 ppb) – Target level. 5 mg/m^3 (~ 2,200 ppb) – Action Level. Reference: Health Canada *Indoor Air Quality in Office Buildings: A Technical Guide.*	
Airborne mould (spore trap method)	Spores per cubic meter of air	Compare test area to reference areas and outdoors.	SKC Quick Take 30 pump and Air-O-Cell Cassettes, laboratory analysis by Direct Microscope Examination

Mould air samples were submitted to the Paracel Laboratories Ltd., Missisauga, Ontario for microscopic analysis. Paracel is accredited by the ISO/IEC 17025:2017 standard by the Canadian Association for Laboratory Accreditation Inc.

2.3 Mould Assessment

A visual mould assessment of the Project Area was conducted in accordance with industry-accepted protocols, specifically:

- Canadian Construction Association, Standard Construction Document CCA 82-2004; *"Mould Guidelines for the Canadian Construction Industry"*, 2004.

- New York City Department of Health and Mental Hygiene: Bureau of Environmental & Occupational Disease Epidemiology; *"Guidelines on Assessment and Remediation of Fungi in Indoor Environments"*, 2008.
- Institute of Inspection Cleaning and Restoration (IICRC): S520, *"Standard and Reference Guide for Professional Mold Remediation"*, December 2003.

During this assessment, it's important to note that a visual assessment for mould in the Project Area was carried out, which involved sampling, specifically air samples, and not intrusive bulk sampling.

3 Observation and Results

The detailed results of this assessment are outlined below, with accompanying site photographs available in Appendix A. Additionally, the analytical laboratory results can be found in Appendix B.

3.1 Interviews and Inspections

Following the interview and site walk-through, it was revealed that the Project Area consists of a Power Tunnel linking the existing pumping stations to the service building. Water infiltration into the Power Tunnel is facilitated through incoming cable ducts, which allow water to enter the tunnel during or after precipitation events.

3.2 Indoor Air Quality

A summary of the spot indoor air quality measurements collected throughout the assessment are detailed below in Table 3.1

Table 3.1 Spot Measurements for Indoor Air Quality Parameters

Location	Temperature (°C)	Relative Humidity (%RH)	CO_2 (ppm)	CO (ppm)	Particulate Matter PM_{10}, $PM_{2.5}$, and TPM ($\mu g/m^3$)	TVOCs (ppb)
Outdoor	10.9	66.8	416	0	4, 2, and 12	0
Power Tunnel Work Area	18.8	57.6	633	0	31, 10 and 35	319
Power Tunnel Pathway	19.0	52.4	572	0	37, 4 and 63	24
Ground Floor Lobby	21.9	43.6	671	0	18, 5 and 44	0
Outdoor	9.3	72.6	394	0	4, 1, and 10	0

3.2.1 Temperature

The indoor spot measurements of temperature ranged from 18.8 to 21.9 °C, while the outdoor temperature ranged from 9.3 to 10.9 °C.

Temperature measurements for the ground floor lobby area fell within the recommended comfort ranges for office environments outlined in the CSA Standard Z412, typically ranging from 20 to

24 °C. However, it's important to note that the Power Tunnel, being a non-occupied area, does not undergo active heating or cooling for occupancy. As a result, the temperature levels in the Power Tunnel do not conform to the standard comfort ranges.

3.2.2 Relative Humidity (RH%)

The indoor spot measurements of relative humidity ranged from 43.6. to 57.6% RH, while outdoor measurements ranged from 66.8 to 72.6% RH. All relative humidity measurements fell within the recommended comfort ranges for office environments, which typically range from greater than 25% to less than <60%. The higher outdoor humidity levels were attributed to rainy weather conditions.

3.2.3 Carbon Dioxide (CO_2)

The indoor spot measurements of carbon dioxide ranged from 572 to 671 ppm, with an outdoor average of 405 ppm. These concentrations were below the ASHRAE limit of 1,105 ppm (calculated as 405 ppm outdoors plus 700 ppm).

Carbon dioxide (CO_2) levels serve as an indicator of the adequacy of fresh air supply and are primarily influenced by the density of occupants in a given area and the volume of air supplied by the mechanical ventilation system or natural ventilation.

Typical indoor CO_2 levels range between 500 and 800 ppm, while outdoor levels typically range from 300 and 500 ppm. Consistently elevated carbon dioxide concentrations above 800-1,000 ppm can lead to symptoms such as itchy or sore eyes, drowsiness, and/or mild headaches (according to the EACC IAQ Guideline).

ASHRAE establishes minimum ventilation rates based on factors such as space type/application, occupancy level, floor area and other measures aimed at ensuring indoor air quality that is acceptable for occupants while minimizing adverse health effects. The ASHRAE Standard states that if ventilation rates are set to maintain carbon dioxide concentrations no greater than approximately 700 ppm above outdoor levels, a significant majority of individuals entering a space will be satisfied regarding human bio effluents (body odours).

3.2.4 Carbon Monoxide (CO)

The indoor spot measurements of carbon monoxide registered 0.0 ppm across all indoor areas surveyed. Outdoors, the recorded CO level also stood at 0.0 ppm. These measurements fell well below Health Canada's long-term exposure limit of 10 ppm and the short-term exposure limit of 25 ppm for carbon monoxide.

3.2.5 Particulate Matter ($PM_{2.5}$, PM_{10}, and TPM)

The indoor spot measurements of particulate matter ($PM_{2.5}$, PM_{10}, and TPM) are as follows:

- $PM_{2.5}$: Ranged from 4 to 10 micrograms per cubic metre (µg/m^3), with an outdoor average of 2 µg/m^3.
- PM_{10}: Ranged from 18 to 37 micrograms per cubic metre (µg/m^3), with an outdoor average of 4 µg/m^3.f
- TPM: Ranged from 35 to 63 micrograms per cubic metre (µg/m^3), with an outdoor average of 11 µg/m^3.

The PM_{10} levels were below ASHRAE Standard 62.1 – 2016 guideline value of 50 µg/m^3. Health Canada recommends maintaining indoor $PM_{2.5}$ levels as low as possible, although no specific guideline value is provided.

3.2.6 Total Volatile Organic Compounds (TVOCs)

The indoor spot measurements of TVOCs ranged from 0 to 319 ppb across all areas tested. The outdoor average TVOC level was 0 ppb. All indoor TVOC measurements remained below the 440 ppb target level outlined in the Health Canada *Indoor Air Quality in Office Buildings: A Technical Guide.*

3.2.7 Mould

The results of air sampling can be interpreted by comparing the types and concentrations of fungal elements (i.e., mould) detected in samples collected indoors to the findings in the outdoor sample. Moulds, forms of fungi, are ubiquitous, existing both indoors and outdoors throughout the year. Outdoors, moulds thrive in soil, on plants, and on dead and decaying matter. Indoors, over 1000 different types of moulds have been identified in buildings. Moulds propagate by producing spores, which are small, lightweight, and capable of travelling through the air, enduring dry, adverse environmental conditions, and surviving for extended periods. Mould growth requires moisture and nutrients, with warm, damp, and humid conditions serving as optimal stimulants for their proliferation.

To assess mould presences, four (4) air samples were collected on April 3, 2024, and analyzed by an accredited laboratory using Direct Microscopic Exam (DME) techniques. The analytical results of the mould samples are provided in Table 3.2 below. The laboratory report is detailed in Appendix B. The results of airborne mould testing indicated significant evidence of mould amplification impacting the air at the time of sampling, particularly in the Power Tunnel work area sample (ST-02).

Table 3.2 Mould Sampling Analytical Results

Sample ID[1]	Area Description	Spore Identification	Counts	Counts/m³	Total Count/m³
130892-ST-01	Outdoor	basidiospores ascospores *Aspergillus/Penicillium-like spores* *Cladosporium spores* unidentified spore	29 10 5 4 1	1547 533 267 213 53	2613
130892-ST-02	Power Tunnel Work Area	*Cladosporium spores* *Aspergillus/Penicillium-like spores* ascospores basidiospores smuts, myxomycetes, Periconia spores unidentified spore	292 21 1 1 1 1	31147 2240 107 107 107 107	33815
130892-ST-03	Power Tunnel Pathway	*Cladosporium spores* *Aspergillus/Penicillium-like spores* basidiospores *Mycelial fragments, pigmented*	15 6 4 1	800 320 213 53	1386
130892-ST-04	Ground Floor, Lobby	Ascospores *Aspergillus/Penicillium-like spores* basidiospores *Cladosporium spores* *Mycelial fragments, pigmented*	1 1 1 1 1	53 53 53 53 53	265

1 For laboratory results and locations refer to **Appendix B**: Laboratory Certificates of Analysis

Mould growth was visually identified in the Power Tunnel, emanating from the point of water infiltration on the concrete wall and extending down to the concrete floor. The growth exhibited typical characteristics of green, woolly, and slimy mould. Active water infiltration was observed

from pipe penetrations on the wall, with water dripping down to the floor during the assessment. Additionally, corroded cable trays adjacent to the wall exhibited water drips. Wooden boards were utilized to divert water flow away from the service building; however, these boards were found to be impacted by mould and water damage.

During the Project Specific Designated Substances and Hazardous Materials Survey (PS-DSHMS), mould presence was evaluated by collecting and submitting tape-lift and bulk material samples for analysis. As outlined in the PS-DSHMS report, laboratory analysis detected low levels of mould spores in the surface sample extracted from the wooden board. Nevertheless, considering the visible mould growth on the wooden board, it should be classified as mould-impacted.

4 Conclusions and Recommendations

All spot measurements of carbon dioxide, carbon monoxide, temperature, relative humidity, particulate matter and total volatile organic compounds (TVOCs) were found to be within recommended criteria.

Upon analysis, the outdoor sample revealed a lower-than-expected spore count due to prevailing rainy weather conditions during collection. However, the findings suggest significant mould amplification in the Power Tunnel work area.

Furthermore, based on the identification of suspect mould on the concrete wall and wooden board within the Power Tunnel, remediation should be carried out in compliance with CCA Mould Guidelines, EACC Mould Abatement Guidelines Edition 3 (2015) and Infrastructure Health & Safety Association (IHSA) Construction Health and Safety Manual, Chapter 9 - Moulds.

The following actions are recommended and should be addressed:

1. Level 2 mould safety precautions should be utilized to clean-up mould-impacted concrete wall and removal of wooden boards in the Power Tunnel work area.
2. To maintain comfortable carbon dioxide levels within the Power Tunnel work area, it is essential to conduct real-time monitoring of CO_2 levels during repair works. Since CO_2 levels can fluctuate with occupancy, this monitoring will provide valuable insights into maximum occupancy thresholds, helping to ensure that CO_2 levels remain within comfortable and safe limits throughout the duration of the repair project.
3. To ensure a safe working environment during the remediation and repair project in the Power Tunnel, active air exchange should be facilitated using negative air units. These units will help to provide fresh air intake and maintain appropriate air circulation within the work area.

5 Statement of Limitations

The opinions, conclusions and recommendations presented in this report are limited to the information obtained during the performance of the specific scope of service identified in the report. To the extent that Arcadis relied upon any information prepared by other parties not under direct contract to Arcadis, no representation as to the accuracy or completeness of such information is made. This report is an instrument of professional service and the services described in the report were performed in accordance with generally accepted standards and level of skill and care ordinarily exercised by members of the profession working under similar conditions including comparable budgetary and schedule constraints. No warranty, guarantee or certification express or implied, is intended or given with respect to Arcadis' services, opinions, conclusions or recommendations.

Arcadis' observations, the results of any testing and Arcadis' opinions, conclusions and recommendations apply solely to conditions existing at the specific times when and specific

locations where Arcadis' investigative work was performed. Arcadis affirms that data gathered and presented in this report was collected in an appropriate manner in accordance with generally accepted methods and practices. Arcadis cannot be responsible for decisions made by our client solely on the basis of economic factors. Observation and testing activities such as those conducted by Arcadis are inherently limited and do not represent a conclusive or complete characterization. Arcadis analyzed only the substances, conditions and locations described in the report at the time indicated. Conditions in other parts of the project site, building or area may vary from conditions at the specific locations where observations were made and where testing was performed by Arcadis. Additionally, other building material hazards which were not identified by Arcadis, may also be present un-accessed areas and in walls, ceilings, cavities, and floors.

This report is expressly for the sole and exclusive use of the Client for whom this report was originally prepared and for the particular purpose outlined in the report. Reuse of this report or any portion thereof for other than its intended purpose, or if modified, or if used by third parties, shall be at the user's sole risk. This report must be presented in its entirety.

Appendix A

Site Photographs

ARCADIS

Photo 1: Representative photograph of outdoor spot measurement for air quality parameters.

Photo 2: Representative photograph of indoor spot measurement for air quality parameters.

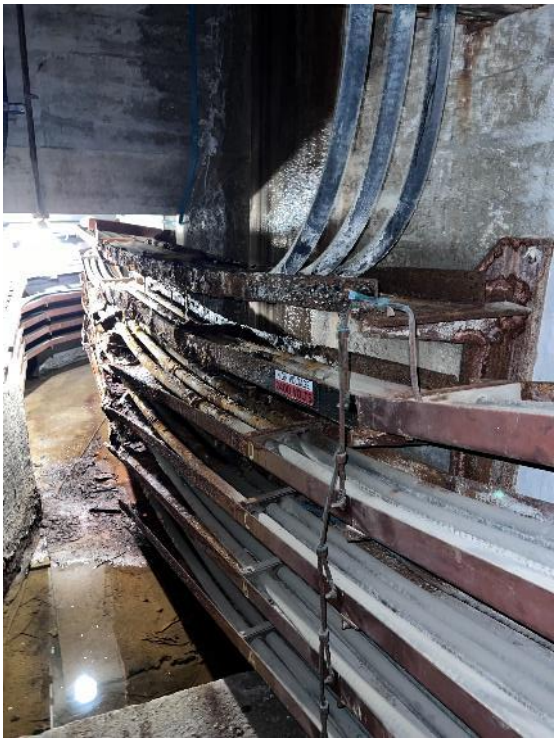

Photo 3: Representative photograph of corroded cable trays.

Photo 4: Representative photograph of mould-impacted and water-damaged wooden boards used to restrain water movement in the Tunnel Area.

	
Photo 5: Representative photograph of mould-impacted concrete wall in the Tunnel Area.	**Photo 6:** Representative photograph of water-damaged cable trays and mould-impacted concrete wall in the Tunnel Area.

Appendix B

Laboratory Certificate of Analysis

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

15 - 6800 Kitimat Rd
Mississauga, ON, L5N 5M1
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

Arcadis (Oakville)

2620 Bristol Circle, Suite 300
Oakville, ON L6H 6Z7
Attn: Ankit Sajwan

Client PO: 130892
Project: 130892
Custody:

Report Date: 8-Apr-2024
Order Date: 3-Apr-2024

Order #: 2414232

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2414232-01	130892 - ST-01 (Outdoor)
2414232-02	130892 - ST-02 (Tunnel Work Area)
2414232-03	130892 - ST-03 (Tunnel Pathway)
2414232-04	130892 - ST-04 (Ground Floor, Lobby)

Approved By:

Emma Diaz
Senior Analyst

PARACEL LABORATORIES LTD.

Order #: 2414232

Certificate of Analysis
Client: Arcadis (Oakville)
Client PO: 130892

Report Date: 08-Apr-2024
Order Date: 3-Apr-2024
Project Description: 130892

Microscopic - Air-O-Cell

Paracel I.D.	*Sample Date*	*Media Expiry Date*	*Background Debris***	*% of Trace*	*LOD (Cts/m³)*	*Sample Volume(L)*	*Total Cts/m³*	*Propagule Identification*	*Cts/m³*	*% of Total*	*Counts**
2414232-01	03-Apr-24	2024-11	Low	25	53	75	**2613**	**Client ID: 130892 - ST-01 (Outdoor)**			
								basidiospores	1547	59	29
							[M-CL, Z-01]	ascospores	533	20	10
								Aspergillus/Penicillium-like spores	267	10	5
								Cladosporium spores	213	8	4
								unidentified spore	53	2	1
2414232-02	03-Apr-24	2024-11	Moderate	13	107	75	**33815**	**Client ID: 130892 - ST-02 (Tunnel Work Area)**			
								Cladosporium spores	31147	92	292
								Aspergillus/Penicillium-like spores	2240	7	21
								ascospores	107	<1	1
								basidiospores	107	<1	1
								smuts, myxomycetes, *Periconia* spores	107	<1	1
								unidentified spore	107	<1	1
2414232-03	03-Apr-24	2024-11	High	25	53	75	**1386**	**Client ID: 130892 - ST-03 (Tunnel Pathway)**			
								Cladosporium spores	800	58	15
								Aspergillus/Penicillium-like spores	320	23	6
								basidiospores	213	15	4
								Mycelial fragments, pigmented	53	4	1
2414232-04	03-Apr-24	2024-11	Moderate	25	53	75	**265**	**Client ID: 130892 - ST-04 (Ground Floor, Lobby)**			
								ascospores	53	20	1
								Aspergillus/Penicillium-like spores	53	20	1
								basidiospores	53	20	1
								Cladosporium spores	53	20	1
								Mycelial fragments, pigmented	53	20	1

**Counts - Definitions:*
Trace = 2 propagules or less noted per trace
Low = occupying < 10% of microscopic field
Moderate = 11-30% of microscopic field
High = > 31% of microscopic field

***Background Debris - Definitions:*
Low = occupying < 10% of microscopic field
Moderate = 11-30% of microscopic field
High = > 31% of microscopic field

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	Analysis Date
Microscopic Fungal - Air-O-Cell	ASTM D7391-09	Mississauga	3-Apr-24

Mississauga Lab: 15 - 6800 Kitimat Rd Mississauga, Ontario, L5N 5M1

Certificate of Analysis

Client: Arcadis (Oakville)

Client PO: 130892

Report Date: 08-Apr-2024

Order Date: 3-Apr-2024

Project Description: 130892

Qualifier Notes

Sample Qualifiers :

M-CL: Spore clusters were reported that were not consistent with the deposition over the rest of the trace. This may result in artificially high counts for a particular propagule.

Z-01: 1 spore cluster (8) was reported.

Work Order Revisions / Comments

Information on common indoor/outdoor fungi may be found on our website at the link below; however, interpretation of the results is the responsibility of the client.

Paracel Species Ecology List

Report Notes:

ND - No fungal propagules detected, below limit of detection (LOD).

NA - Not applicable; calculations cannot be performed on non-numerical data.

NOTE: Sample volume was provided by the client and has been used in the calculations. This can affect the validity of the final result.

PARACEL LABORATORIES LTD.

2414232

ad Office
-2319 St. Laurent Blvd.
awa, Ontario K1G 4J8
-800-749-1947
aracel@paracellabs.com

Chain of Custody
(Lab Use Only)
№ 73703

Page 1 of 1

Client Name: Arcadis (Formerly TBT Group)	Project Reference: 130892
Contact Name: Aulcit Sojoam	Quote #:
Address: 2020 Bristol circle, Suite 300 Oakville, ON L6H 6Z7	PO #: 130892
Telephone: 647-617-3873	Email Address: aulcit.sojoam@arcadis.com hassan.ktaech@arcadis.com

Turnaround Time:
- ☐ Immediate
- ☐ 4 Hour
- ☐ 8 Hour
- ☐ 1 Day
- ☐ 2 Day
- ☐ 3 Day
- ☑ Regular

Date Required: _____

ASBESTOS & MOLD ANALYSIS

Matrix: ☐ Air ☐ Bulk ☐ Tape Lift ☐ Swab ☐ Other **Regulatory Guideline:** ☑ ON ☐ QC ☐ AB ☐ SK ☐ Other:

Analyses: ☑ Microscopic Mold ☐ Culturable Mold ☐ Bacteria GRAM ☐ PCM Asbestos ☐ PLM Asbestos ☐ Chatfield Asbestos ☐ TEM Asbestos

	Paracel Order Number: 2414232 / Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Asbestos - Bulk: Identify Distinct Building Materials to Be Analyzed (if not specified, all materials identified will be analyzed) *	Positive Stop?
1	130892-ST-01 (out door)	Apr 3, 24	75L	Mould ID		☐
2	130892-ST-02 (tunnel work area)	↓	↓	↓		☐
3	130892-ST-03 (tunnel pathway)					☐
4	130892-ST-04 (ground floor, lobby)	↓	↓	↓		☐
5						☐
6						☐
7						☐
8						☐
9						☐
10						☐
11						☐
12						☐

* If left blank, all distinct materials identified in the samples will be analyzed and reported separately as per EPA 600/R-93/116. Additional charges will apply.

Comments:

Method of Delivery: Drop off

Relinquished By (Sign):	Received at Depot:	Received at Lab:	Verified By:
Relinquished By (Print): Aulcit Sojoam			
Date/Time: 03/07/2024, 2:30pm	Date/Time:	Date/Time: Apr 3/24 14:30	Date/Time: Apr 3/24 15:25

Appendix F
Division 2 – Appendix D – EACC Mould Abatement Guidelines

EACC Mould Abatement Guidelines
Edition 3 (2015)

Environmental Abatement Council of Canada

Canadian Chapter of the EIA

Foreword

This guideline has been prepared to assist building owners, constructors, contractors, subcontractors and workers who have duties under the Occupational Health and Safety Act and its Regulations to safely perform work activities involving Mould (Microbial) Abatement and remediation. The guideline is intended to promote safe work practices, the use of personal protective equipment, worker awareness and training and is based in a thorough review of the available guidance materials available to December 2014 and professional experience of the abatement industry in Canada.

We believe that this guideline will not only help employers fulfill their responsibilities and due diligence under the Occupational Health and Safety Act but will also assist them to better address the challenges involved with proper assessment and remediation of Mould (Microbial) contamination in buildings.

Disclaimer

EACC disclaims any liability or risk resulting from the use of the work practices and recommendations discussed in the guideline. It is the user's responsibility to ensure that work practices and recommendations discussed in the guideline apply to specific workplaces and projects and to ensure compliance with all other applicable federal, provincial and local acts, codes and regulations.

EACC Mould Abatement Guidelines
Edition 3 (2015)

Table of Contents

SECTION A: GENERAL POINTS AND LIMITATIONS

1. Three levels of work practice are given for removal of Small, Medium and Large-scale Mould growth, depending on the extent of material supporting Mould growth present. The thresholds between Small and Medium project areas (10 ft^2) and between Medium and Large project areas (100 ft^2) are a guideline only and are subject to professional judgment. EACC recommends that the enumeration of Mould growth be based on an approximation of the extent of visible growth (total affected area of building material), including the estimated extent of any hidden Mould.

2. These procedures do not address the identification or control of the cause(s) of the Mould growth being abated by these procedures. This would include such factors as past flooding, moisture intrusion and elevated levels of relative humidity. The project authority is cautioned to ensure that the underlying cause(s) of the Mould growth is investigated and remedied prior to completing the Abatement process to reduce the potential for Mould re-growth.

3. These procedures do not address the potential for fungal infections that may be acquired by Susceptible Occupants in hospitals or other health care settings if Mouldy materials are disturbed without appropriate precautions. Refer to "Construction-related Nosocomial Infections in Patients in Health Care Facilities – Decreasing the Risk of Aspergillus, Legionella and Other Infections", July 2001, Canada Communicable Disease Report, Health Canada and CSA Standard Z317.13-12, Infection Control During Construction or Renovation of Health Care Facilities.

4. These procedures do not address the potential presence of Designated Substances (asbestos, lead, etc.) or other hazardous materials in a mould remediation work area. The project authority is cautioned that designated substances are regulated in Ontario under the Occupational Health & Safety Act. In addition, Ontario Regulation 278/05, *Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations* (O. Reg. 278/05) outlines specific procedures for the handling and disturbance of asbestos-containing materials (ACM). Typical ACMs that may be disturbed as part of a mould remediation project include drywall joint filling compound, ceiling tiles, pipe and duct insulation and vinyl flooring.

5. These procedures are not directly intended to address Biohazards, other than Mould, potentially present in a project area as a result of contamination with sewage waste, river floods or other water with high levels of Microbial contamination. Appendix D does provide additional procedures for unsanitary remediation. The reader is referred to the guidance of the Institute of Inspection, Cleaning and Restoration Certification S500 Standard, "Standard and Reference Guide for Professional Water Damage Restoration." Additional precautions might apply.

6. These guidelines are not meant to respond to the development of minor areas of superficial mould growth in households due to water absorption or condensation on the occupied side of finishes, often referred to as lifestyle mould growth. Examples include spotty mould growth on grout in bathrooms or on cold window frames under winter conditions. Such areas of minor surface mould growth are generally limited in area and can usually be addressed with improved ventilation and/or moisture control, and standard house cleaning methods. However, if there are large areas of surface condensation or indications of sub-surface moisture sources, the area should be inspected for the possibility of hidden water damage or mould growth.

SECTION B: GENERAL PRECAUTIONS APPLICABLE TO ALL LEVELS OF MOULD ABATEMENT WORK

1. Protection of Occupants

1.1 The project authority should consider whether occupants should be removed from areas adjacent to the work area. The removal of occupants from spaces adjacent to the work area is not necessary in all cases but should be considered in the presence of Susceptible Occupants including but not limited to infants less than 12 months old, persons having undergone recent surgery, the elderly, immune suppressed people, or people with chronic inflammatory lung diseases.

2. Worker Training and Medical Pre-screening

2.1 Mould abatement workers shall be trained in the hazards of Mould Abatement and in the procedures to be followed. Training at a minimum shall include classroom and site instruction. Minimum training topics shall include: hazards of mould abatement; use and limitations of personal protective equipment such as respirators and gloves; proper abatement practices including site isolation, removal techniques, proper clean-up and decontamination procedures. General health and safety training should also be provided to workers, as required by the Occupational Health & Safety Act and regulations for construction sites, and waste handling and disposal regulations.

2.2 Workers must be fit to work with potential Mould or microbial exposure. Workers with a history of significant allergic disease (asthma, hay fever, hives, etc.) or with a potential immuno-compromised status (persons with an immune system disease, taking immune system suppression medication, etc.) should consult with an experienced physician to determine whether Mould removal activities, and the associated potential for exposure to pathogenic materials, would present an unacceptable health risk.

2.3 Mould Abatement workers who may encounter a risk of infectious disease from unsanitary water sources (sewage, river floods, etc.) should consult with an experienced physician regarding vaccinations to reduce the risk of infectious disease through available immunizations, particularly Hepatitis A and B, tetanus and polio.

3. Respiratory Protection

3.1 The respiratory protection in these procedures has been established for protection against fungal particulate material, for which a Respirator with a NIOSH-approved particulate filter will be adequate. Another type of Respirator may be required if the Mould Abatement will employ a Disinfectant with a volatile hazardous ingredient (e.g., household chlorine bleach). Consult MSDS data for specific respiratory protection in relation to specific cleaning products.

3.2 Respirators shall be NIOSH approved.

3.3 Workers should complete Respirator pre-screening as detailed in CSA Standard Z94.4-11, Selection, Care and Use of Respirators (Appendix E Figure E1) and, if required, consult with an experienced physician to determine if a Respirator can be used without serious difficulty.

3.4 Respirator wearers shall be Fit-tested for each type of Respirator, prior to use, following CSA Standard Z94.4-11, Selection, Care and Use of Respirators.

3.5 Follow CSA Standard Z180.1-13 as amended, for testing of breathing air quality for supplied air respiratory protection required for dry ice abrasive blasting (see Appendix C).

3.6 Clean and maintain the Respirator and battery pack (where applicable) in accordance with manufacturer's recommendations.

3.7 No facial hair or spectacle side arms, which affect the seal of the Respirator to the skin, are allowed.

3.8 Dispose of filters daily due to the potential growth of Mould spores on damp filter media.

3.9 Due to the nature and working conditions of Mould Abatement, Filtering Facepiece Respirators shall not be utilized for Level 2 or Level 3 Abatement projects.

4. Personal Protection and Hygiene

4.1 Refer to the EACC Guideline Construction Worker Hygiene Practices 2014. Workers shall wear appropriate eye protection including safety glasses or goggles that provide protection from external debris (not required with full face negative pressure respirator), chemical splashes, impact or dusty environments, dust-impermeable gloves appropriate for the work underway and water-impermeable gloves for application of detergent and/or Disinfectant. Refer to the MSDS for the detergent and/or Disinfectant for glove selection.

4.2 Wash face and hands after work at the Abatement project each time after exiting the Abatement work area.

4.3 For all levels of work, eating, drinking or smoking is prohibited in the work area.

5. Cleaning

5.1 Pre-clean any items that will be retained, whether removed from the work area or covered and left in the work area. Use appropriate and effective cleaning methods.

5.2 After bulk removal, clean the surrounding areas with a HEPA vacuum. No other type of vacuum can be used. If a HEPA vacuum is not available, wet wiping may be adequate for Level 1 work.

5.3 Do not dry sweep or dry whisk. Use power tools only if fitted with effective HEPA-filtered dust collection.

5.4 Wipe all non-Porous surfaces within the removal area with a detergent solution. Rinse with clear water as required.

5.5 As an option, a Disinfectant solution can be used in place of, or in addition to a detergent. Apply the Disinfectant as specified by the manufacturer, maintaining the surfaces wet for the prescribed period. Generally, surfaces to be disinfected must be cleaned of all dust and loose organic material prior to application of the Disinfectant. A Disinfectant is required where the work area has been contaminated with a significant pathogenic hazard (i.e., sewage floods).

5.6 The project authority should consider the use of a Disinfectant in hospital or health care settings, or in other settings where the project authority believes occupants to be significantly immuno-compromised. Refer to the Health Canada and CSA guidelines for prevention of fungal infections in health care settings, given above.

5.7 Use only disinfectants with current Health Canada DIN registration. Apply the disinfectant according to the DIN label, observing requirements for mixing, storage time, worker safety, pre-cleaning, contact time, and any requirements for rinsing.

5.8 These cleaning requirements apply to all exposed surfaces within the work area. The project authority will determine if soft goods and Porous materials can be adequately cleaned or must be disposed of.

5.9 Clean all equipment used in the Abatement work area by HEPA vacuuming or wet wiping. Equipment that cannot be readily cleaned shall be HEPA vacuumed and sealed in 6 mil polyethylene bags before removal from the work area.

6. Post Abatement Cleanup

6.1 Remove Polyethylene sheeting used during abatement by carefully rolling towards the centre of the work area. Clean any visible dust and debris using a HEPA vacuum.

6.2 Clean all tools, supplies and equipment in the work area using a HEPA vacuum and by wet wiping. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be HEPA vacuumed and sealed in 6 mil polyethylene bags or suitable sealed containers before removal from the work area.

6.3 Seal the intake and exhaust of HEPA Filtered Exhaust Fans (negative air machines) and clean the cabinet by wet wiping, before removal from the work area.

6.4 Leave the work area and surrounding areas dry and visibly free of dust and debris.

7. Waste Disposal

7.1 Remove all waste as contaminated material, including but not limited to building debris, disposable coveralls, Respirator filters and/or cartridges, and plastic sheeting. All waste should be immediately double-bagged into two 6-mil polyethylene bags, each individually sealed. If the material cannot be bagged, wrap in 2 layers of 6 mil Polyethylene Sheeting and seal with tape.

7.2 Transport and dispose of the waste material in compliance with local, provincial and federal regulations, including the Ontario Environmental Protection Act and any other regulations, which may apply to the Mould or the substrate on which the Mould was located.

8. Post-Abatement Drying

8.1 By the completion of the mould abatement, ensure the cause of the mould growth has been identified and an action plan initiated to prevent further mould growth. This action would include mitigation of the original cause of the mould contamination. This would include such factors as past flooding, moisture intrusion or elevated levels of relative humidity. Also, at completion of mould abatement check that the remaining finishes (e.g., concrete, wood framing, sub-floors) have been adequately dried so that mould growth will not re-occur when new finishes are installed. The work area may require further drying efforts before re-construction can commence.

SECTION C: PRECAUTIONS FOR LEVELS 1, 2 AND 3 MOULD ABATEMENT

9. Level 1: Small Isolated Areas, Less than 10 ft^2 (1 m^2) of Building Materials or Clean-up of Less than 10 ft^2 (1 m^2) of Mould Growth in HVAC Systems in Non-occupied Areas.

9.1 This section gives instructions for performing Mould Abatement specifically for small-scale projects. This work practice is suitable for the abatement of under about 10 square feet of mould growth on building materials or finishes or the abatement of the same extent of mould growth within HVAC equipment in non-occupied areas such as mechanical rooms. Abatement of HVAC equipment in occupied locations shall be performed following a minimum of Level 2 procedures (contained mould abatement). Comply with all of the items of Section B, General Precautions (protection of occupants, worker training and medical pre-screening, respiratory protection, personal protection and hygiene, cleaning, and waste disposal) while performing this work.

9.2 The worker shall wear a half face piece air-purifying Respirator fitted with replaceable filters (N95 minimum) or a Filtering Facepiece Respirator (N95 minimum) plus appropriate gloves.

9.3 Workers shall wear full-body dust-impervious coveralls with attached hoods. Secure the coveralls tight at the ankles and wrists.

9.4 Turn off HVAC systems where possible and seal over any diffusers immediately adjacent to the work area.

9.5 Where possible, place a drop sheet below the Mouldy materials.

9.6 Dust Suppression methods should be used where possible, prior to disturbance of the Mouldy materials. Tape a section of plastic sheeting or duct tape over the Mouldy material, or if this is not feasible, lightly mist the Mouldy material with water.

9.7 Remove any Porous substrate materials (ceiling tiles, drywall, etc.) to a point beyond the immediate areas of visible contamination, for a minimum distance of 30 cm in all directions.

9.8 Clean the work area and dispose of the waste.

10. Level 2: Medium areas, 10-100 ft^2 (1-10 m^2) or less than 10 ft^2 (1 m^2) in HVAC Systems in Occupied Areas

10.1 This section gives instructions for performing Mould Abatement specifically for medium scale projects, or the abatement of less than 10 square feet of mould growth in HVAC equipment in occupied areas. Comply with all of the items of Section B, General Precautions (protection of occupants, worker training and medical pre-screening, Respiratory protection, personal protection and hygiene, cleaning, and waste disposal) while performing this work.

10.2 Consult with a qualified Health and Safety Professional prior to remediation work to provide Quality Assurance for the project and monitoring of compliance with these guidelines.

10.3 A competent supervisor must be present during all Contaminated Work.

10.4 The worker shall wear gloves appropriate for the work being done and full-body dust-impervious coveralls with attached hood. Secure the coveralls tight at the ankles and wrists.

10.5 The worker shall wear an elastomeric half face piece air-purifying Respirator fitted with 100 Series Filter cartridges.

10.6 Workers shall wear disposable boot covers or separate work boots that can be effectively HEPA vacuumed or wiped clean prior to removal from the work area.

10.7 Turn-off HVAC systems where possible and seal over any supply and return openings immediately adjacent to the work area. Objective of this engineering control is to maintain negative pressure and prevent the distribution of mould spores and dust from the work area.

10.8 The Abatement area must be secured and access restricted. Isolate the work area with an enclosure constructed of fibre-reinforced Polyethylene Sheeting or 6 mil Polyethylene Sheeting, taped and supported as required. Provide a temporary roof where an existing ceiling does not complete the temporary enclosure. The Project authority may require a single chamber decontamination/change room.

10.9 A Competent Supervisor or project authority must inspect the work area for defects in the enclosure, barriers and change room, at the beginning of every shift and at the end of every shift. Records of the inspections should be generated and maintained.

10.10 Install signs warning of the exposure hazard. Suggested wording: CAUTION, MOULD EXPOSURE, WEAR ASSIGNED PROTECTIVE EQUIPMENT, AUTHORIZED PERSONNEL ONLY.

10.11 Provide continuous Negative Pressure within the enclosure by drawing air from the work area and exhausting it out of the enclosure, either by use of a HEPA vacuum or a portable HEPA-filtered exhaust fan. Provide a minimum Negative Pressure of 5 Pascals (0.02 inches of water column) and at least 4 air changes per hour. Discharge the filtered air outside the building and away from persons wherever possible, and if this is not possible, consider on-site leak testing of the HEPA filtered equipment. Refer to the EACC DOP/PAO Testing Procedure Guideline 2013. Negative Pressure must be maintained until the completion of all Contaminated Work.

10.12 Remove any Porous substrate materials (ceiling tiles, drywall, etc.) to a point beyond the immediate areas of visible contamination, for a minimum distance of 30 cm in all directions.

10.13 Clean the work area and dispose of the waste.

10.14 Before exiting the work area, workers shall fully wipe or vacuum clean all footwear, coveralls and other personal protective equipment and remove and dispose of protective equipment not for re-use. Workers shall then complete personal cleaning as in Section B, General Precautions.

11. Level 3: Large Areas, More than 100 ft^2 (10 m^2), or more than 10 ft^2 (1 m^2) in HVAC Systems

11.1 The following work procedures describe the general set-up, conduct and safety measures for Level 3 Mould Abatement. Each project should be conducted following a site-specific work plan or specification developed by a Health and Safety Professional.

11.2 This section gives instructions for performing Mould Abatement specifically for large-scale projects. Comply with all of the items of Section B, General Precautions (protection of occupants, worker training and medical pre-screening, Respiratory protection, personal protection and hygiene, cleaning, and waste disposal) while performing this work.

Quality Assurance

11.3 Consult with a qualified Health and Safety Professional (qualified by knowledge, training and experience) with experience performing Microbial investigations and remediation, prior to remediation work, to develop a site specific work plan or specification and Quality Assurance services for the project and monitoring of compliance with these guidelines.

Quality assurance will include a combination of site inspections prior to abatement, during abatement, after abatement and clearance sampling including air sampling prior to dismantling of the abatement work area. Clearance sampling requirements to be defined by the appointed Health and Safety Professional. Refer to Section 11.22

Worker Protection

11.4 The worker shall wear a tight-fitting full face piece Powered Air Purifying Respirator with high efficiency particulate filters or a non-powered full face piece air purifying Respirator fitted with 100 Series Filters. Refer to Appendix C for respiratory protection for dry ice abrasive blasting.

11.5 The worker shall wear gloves appropriate for the work being done and full-body dust-impervious coveralls with attached hood. Secure the coveralls tight at the ankles and wrists.

11.6 Workers shall wear disposable boot covers or separate work boots that can be effectively HEPA vacuumed or wiped clean prior to removal from the work area.

11.7 A Competent Supervisor must be present during all Contaminated Work.

Site Isolation

11.8 Turn-off HVAC systems where possible and seal over any supply and return openings immediately adjacent to the work area.

11.9 Isolate the work area from adjacent spaces using temporary hoarding, tape and Polyethylene Sheeting, etc.

11.10 Install signs warning of the exposure hazard. Suggested wording: CAUTION, MOULD EXPOSURE, WEAR ASSIGNED PROTECTIVE EQUIPMENT, AUTHORIZED PERSONNEL ONLY.

11.11 Provide continuous Negative Pressure within the enclosure, through use of portable HEPA-Filtered Exhaust Fans. Provide a minimum Negative Pressure of 5 Pascals (0.02 inches of water column) and at least 4 air changes per hour. Note that higher levels of negative air pressure may be required to maintain site isolation. Discharge the filtered air outside the building and away from persons wherever possible, and if this is not possible, perform on-site leak testing of the HEPA filtered fan. Negative Pressure must be maintained until the completion of all Contaminated Work.

11.12 Negative Pressure within the enclosure shall be continuously measured and recorded with a portable monitor located at the entrance to the work area.

11.13 A Competent Supervisor and/or the Health and Safety Professional must inspect the work area for defects in the enclosure, barriers and change room, at the beginning of every shift, at the end of every shift where there is no shift beginning immediately following the shift that is ending, and at least once per day on days where there are no shifts. Records of the inspections should be generated and maintained.

Worker and Waste Decontamination Facilities

11.14 Provide a Worker Decontamination Facility, to include a clean change room and a dirty change room. Install flap doors at each opening into and within the decontamination facility. Provide a wash station consisting of at least a basin, fresh water, soap and toweling, in the clean change room. A shower for worker comfort may be provided, but is optional. Refer to Appendix A for a diagram of a typical Decontamination Facility.

11.15 When going into the Contaminated Work area the worker will don clean coveralls and a Respirator in the clean change room.

11.16 Prior to exiting the Contaminated Work Area, the worker will use a HEPA vacuum in the work area to remove gross contamination from coveralls and boot covers (or separate dirty work boots).

11.17 The worker will then enter the dirty change room where the dirty coveralls and boot covers are removed (to be used only once). Work boots used without boot covers will also be removed and stored in the dirty change room.

11.18 The worker then proceeds to the clean change room to complete clean up. The wash station is to be used by each worker on leaving the work area to clean face and hands.

11.19 A separate Waste Decontamination Facility, consisting of a double bagging room and a waste transfer room should be provided where large volumes of waste will be removed. Seal the waste into bags (or Polyethylene Sheeting sealed with tape) in the Contaminated Work area, and wipe the exterior of the bags or other containers. Transfer the waste to the double bagging room and place a second bag around bagged waste. Seal the second bag. Transfer the double-bagged waste into the waste transfer room for removal by workers entering from the outside of the decontamination facilities.

Removal, Salvage and Cleaning

11.20 Remove any Porous substrate materials (ceiling tiles, drywall, etc.) to a point beyond the immediate areas of visible contamination, for a minimum distance of 30 cm in all directions.

11.21 Clean the work area and dispose of the waste. Clean tools and equipment such as vacuums, negative air units or any other items that were exposed during abatement.

Clearance Inspection and Monitoring

11.22 The Health and Safety Professional or representative should inspect the Level 3 work area for acceptable completion, by a combination of careful inspection and testing. A site will be considered acceptable and clean when a thorough inspection shows an acceptable state of cleanliness. In addition, Clearance air samples to be taken to indicate the work area is no longer impacted by the Mould contamination abatement process.

Generally, clearance air samples collected within the work area will be compared to samples taken in adjacent areas from where the work area make-up air is being drawn, another suitable location, or to outdoor air samples. An acceptable condition is indicated when:

1. Concentrations of airborne fungal particles in the work area are not significantly elevated when compared to concentrations in the reference area; and
2. The types of fungal particulate present in the work area do not significantly differ from those present in the reference area.

Surface samples should show minimal or no Mould growth remaining at completion. Interpretations of sample results are subject to the professional judgment of the Health and Safety professional with experience performing microbial investigation and remediation.

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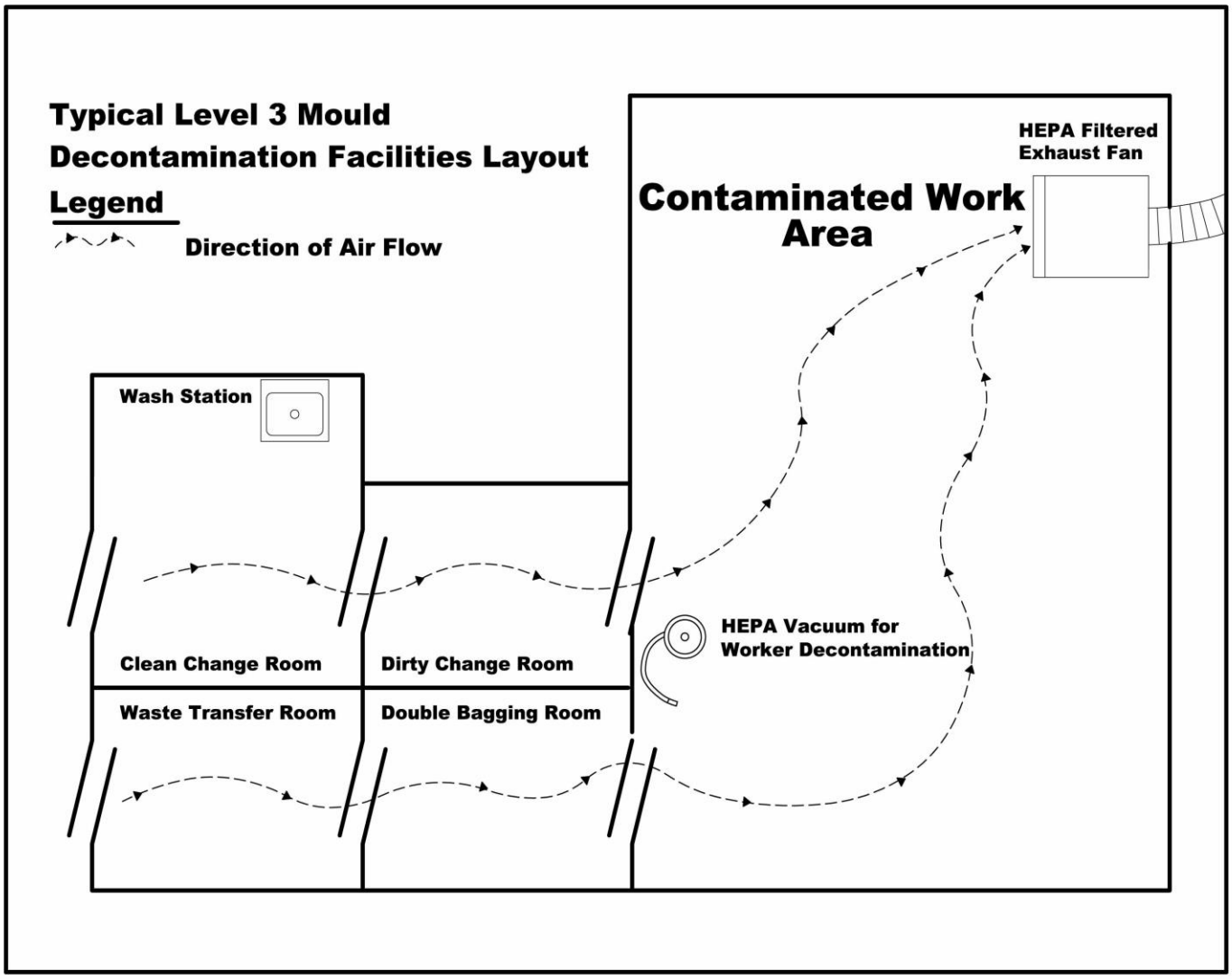
Appendix A: Typical Level 3 Mould Decontamination Facility Lay-Out



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Appendix B: Procedures for Clean-up of Bird and Bat Droppings

Workers removing accumulations of bird or bat droppings are at risk of exposure to airborne fungal spores (and other microbial hazards) likely to be released when this material is disturbed. Bird and bat droppings should be presumed to be contaminated with the fungi Histoplasma capsulatum, Cryptococcus neoformans, and other infectious hazards. The spores of some of these organisms can remain infectious for decades after their growth in the guano has ceased. Many of these microorganisms are known to cause respiratory infections in workers exposed during construction or maintenance disturbance.

NOTE: Although a disinfectant will be applied during this work, the treated excrement may still contain viable organisms and use of personal protective equipment should continue until the site is cleaned.

General Precautions during Abatement Work

1. Health and safety measures and procedures required during the abatement of bird or bat droppings shall be based on the findings of a project-specific risk assessment completed by a health and safety professional.
2. The project-specific risk assessment must consider conservation and/or habitat preservation.
3. The project-specific risk assessment should consider post abatement corrective measures that may be necessary to prevent the return of birds or bats (e.g. block openings into buildings or structure ledges, screen off ventilation intakes or other void openings, install netting/mesh or anti-roosting control systems, etc.).
4. Requirements of Section B (of this document) shall also apply, as applicable, for the clean-up of bird or bat droppings. Section B provides general guidance related to; protection of occupants, worker training and medical pre-screening, respiratory protection, personal protection and hygiene practices.

Personal Protection

All work will require the following personal protective equipment, as a minimum:

- Rubber boots (CSA approved for construction work).
- Either disposable gloves taped to coveralls and worn under work gloves, or heavy rubber or nitrile work gloves, taped to coveralls.
- Water-resistant disposable coveralls, complete with elasticized hood, taped to gloves and boots.
- Minimum of a full-face piece respirator fitted with appropriate cartridge filters. As a minimum, P100 filters are required for protection against airborne particles. Depending on the disinfectant used, the cartridge may require protection against vapours or gases. A powered air purifying respirator (PAPR) fitted with an appropriate cartridge filter may also be used, and will provide more comfort for the worker.

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Edition 3 (2015)

Appendix B: Procedures for Clean-up of Bird and Bat Droppings

Disinfectant

Use only disinfectants with current Health Canada drug identification number (DIN) registration. Apply the disinfectant according to the DIN label, observing requirements for mixing, storage time, worker safety, pre-cleaning, contact time, and any requirements for rinsing.

Hazard Sign

Install signs warning of exposure hazard during all abatement operations.

Site Isolation Considerations

The site isolation procedures implemented shall be based on the findings of a project-specific risk assessment. The following site isolation procedures, as a minimum, should be considered for all bird or bat dropping abatement operations.

1. Turn-off HVAC systems where possible and seal over any openings immediately adjacent to the work area.
2. Isolate the work area from adjacent spaces using temporary hoarding, tape and polyethylene sheeting, etc.
3. If the work area is enclosed, establish continuous negative pressure using portable HEPA-filtered exhaust fans. Provide a minimum negative pressure of 5 Pascals (0.02 inches of water column) and at least 4 air changes per hour. Refer to EACC document "*DOP / PAO Testing Guideline*, 2013", for guidance on negative air system testing and reporting requirements.
    a. Negative pressure within the enclosure shall be continuously measured and recorded with a portable monitor.
4. Provide a worker decontamination facility, to include a clean change room and a dirty change room. Install flap doors at each opening into and within the decontamination facility. Provide a wash station consisting of at least a basin, fresh water, soap and toweling, in the clean change room. Refer to Appendix A for a diagram of a typical decontamination facility.
    a. For large work areas, long term projects or areas with excessive amounts of bird or bat droppings, including a shower in the worker decontamination facility should be considered.
5. Additional considerations for outdoor operations:
    a. Install signs warning of exposure hazard, and ropes or barriers, around the perimeter of the work area, to the extent that is practicable, to prevent unauthorized personnel from entering the work area. All workers and personnel within the perimeter of the work zone must be adequately protected.
    b. Provide a worker decontamination facility as close to the work area as practical.
    c. Assess the prevailing wind patterns affecting the work area. Arrange the location of the worker decontamination facility, and sequencing of abatement operations, in a manner to minimize exposure to workers and surrounding areas.
    d. Complete an assessment to identify the location of fresh air intakes for building heating, ventilation and air conditioning (HVAC) systems. Fresh air intakes and/or HVAC

systems located within the perimeter of the work area shall be turned-off where possible and openings shall be sealed.

i. Clean HVAC system sheet metal that may have been contaminated.

ii. Replace HVAC air filters that may have been contaminated.

e. Isolate other routes of potential air transfer (into a building) located within the perimeter of the work area, such as windows, doors, void spaces, vents, etc.

f. If soil removal is required, soil pretreatment or decontamination may be required.

Work Practices

1. Dampen dry and dusty droppings with water to reduce the amount of airborne dust that may be created during abatement activities. Adding a surfactant to water (i.e. a wetting agent) may further reduce the amount of dust that becomes airborne.
    a. Wetting should be completed only by a low-pressure system or hose.
        i. Never wet bird or bat droppings using a high pressure power-washer system or using a high pressure garden hose setting (e.g. do not use direct or jet spray settings).
    b. Where bird or bat droppings are excessive, a prolonged wetting period and/or, repeated wetting during abatement work may be required.
        i. Never dry shovel or dry sweep bird or bat droppings.
    c. Avoid walking over areas with bird or bat droppings unnecessarily.
2. Perform an initial shoveling and HEPA vacuum removal of as much of the residue as possible.
3. Following a HEPA vacuuming, apply a disinfectant solution to all areas with visible residue. Apply with a garden sprayer set for droplet as opposed to mist spraying. Lightly brush to ensure uniform wetting and contact through to the underlying surface. Apply additional disinfectant as necessary to maintain the area wet for the contact time specified by the disinfectant manufacturer. Leave the material wet overnight where practical to do so.
4. Clean the area of residue with suitable tools and HEPA vacuuming. Lightly mist with water to reduce dust formation.
5. After surfaces have been cleaned of residue to the extent possible, apply a second application of the disinfectant and maintain wet contact time for the period recommended by the manufacturer. If the surface cannot be left with a residue, rinse and wipe with clear water.

Waste Collection and Disposal

Collect all waste into 6 mil disposal bags and immediately seal. Wipe the bag with the disinfectant solution and place into a second bag. Ensure proper notification and compliance with all applicable local, provincial and federal regulations including the Ontario Environmental Protection Act.

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Appendix B: Procedures for Clean-up of Bird and Bat Droppings

Clearance Inspection

The project authority or representative should complete a detailed visual inspection of the work area to confirm that an acceptable level of cleanliness has been achieved.

NOTE: Currently there are no accredited analytical procedures able to measure the presence of viable organisms of *Histoplasma capsulatum*.

Post Abatement Corrective Measures

1. Review the findings and recommendations of the project-specific risk assessment. The project-specific risk assessment must consider conservation and/or habitat preservation.
2. The project-specific risk assessment should consider post abatement corrective measures that may be necessary to prevent the return of birds or bats (e.g. block openings into buildings or structure ledges, screen off ventilation intakes or other void openings, install netting/mesh or anti-roosting control systems, etc.).

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Appendix C: Additional Hazards with Abrasive Blasting in Mould Abatement

General guidance related to; protection of occupants, worker training and medical pre-screening respiratory protection, personal protection and hygiene procedures are found in Section of B of this document and shall apply, as applicable, for mould abatement using abrasive blasting,

Abrasive blasting techniques, using media such as soda, dry-ice or sand, are effective methods for the removal of mould growth from contaminated building materials. However, it must be recognized that additional hazards to workers and building occupants might exist when utilizing such methods. The primary hazards and additional precautions recommended for abrasive blasting of mould growth are summarized below:

- The aggressive disturbance of mould growth through blasting will result in much higher airborne mould concentrations than manual removal methods.

- Dry-ice blasting will release significant amounts of carbon dioxide (CO_2) into the work area which may result in an overexposure to carbon dioxide in enclosed work areas.

- The compressed air used to deliver the blasting media will reduce the negative pressure in the containment. Even smaller blasting equipment delivers 2000 cfm or more of additional air into the containment. This air supply will offset the negative pressure created by ventilation equipment.

- The pressure applied by the blasting equipment can transport or drive mould debris through various substrates, building elements, and assemblies (such as floor board seams, roof and wall sheathing seams, service penetrations, expansion joints) to an uncontained or occupied area where it may impact air quality or expose other workers, building occupants or the public.

Based on these hazards, the following precautions, in addition to the measures prescribed in Section B (of this document), should be followed when conducting abrasive blasting operations.

Containment

1. Level 3 precautions should be used for all blasting activities.

2. Ensure the substrate being blasted will not permit the penetration of blast media, dust or mould. If the substrate is likely to permit the transport of blast media, dust or mould then erect appropriate containment.

3. Provide adequate negative pressure ventilation during abrasive blasting. The ventilation must take into consideration the supply of air into the work area by the compressed air delivery of the abrasive media.

4. Continually monitor the workplace atmosphere for oxygen content and carbon dioxide when using dry-ice blasting methods.

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Appendix C: Additional Hazards with Abrasive Blasting in Mould Abatement

Blast Media and Substrate Dust

5. Silica containing blast media should not be used wherever possible due to the high toxicity of fine silica dust. This is of particular importance in occupied buildings.

6. Ensure that adequate precautions are taken to control the hazards of the dust generated from the surfaces being impacted, which may include lead based and lead containing paints, silica containing substrate or asbestos containing materials.

Personal Protection

7. The minimum respiratory protection for all abrasive blasting activities shall be a full face piece air purifying respirator with P100 filters.

8. Wear supplied air respiratory protection for abrasive blasting with dry ice. Monitor carbon dioxide concentrations on an ongoing basis to determine the requirement for and adequacy of supplied air respiratory protection.

9. The addition of a worker decontamination shower should be considered, but is optional.

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Appendix D: Additional Procedures for Unsanitary Remediation

1. *Introduction and Scope*

   - Buildings can be flooded with Unsanitary Water sources that contain micro-organisms that pose a risk of infection to occupants and abatement workers. Examples of Unsanitary Water include water originating from a sanitary sewer system, and flooding from over-land water or waterways. This appendix presents the precautions necessary for the cleaning of Unsanitary Water contamination.

   - Further precautions will be required where there other hazards in addition to Unsanitary Water, such as mould growth, chemicals or asbestos.

   - For further information on water damage restoration, refer to Standard and Reference Guide for Professional Water Damage Restoration, IICRC S500, Institute of Inspection Cleaning and Restoration Certification, 3rd Edition, 2006.

   - Requirements of Section B (of this document) shall also apply, as applicable, for the remediation of unsanitary water. Section B provides general guidance related to protection of occupants, worker training and medical pre-screening, respiratory protection, personal protection and hygiene practices.

2. *Personal Protection*

   All work with Unsanitary Water restoration requires the following personal protective equipment:

   - CSA-approved construction-rated rubber boots.

   - Water-resistant disposable coveralls, complete with elasticized hood, taped to gloves and boots.

   - Rubber or nitrile work gloves, tape-sealed to the coveralls at the wrists and cuffs. Inspect before re-use. Wear puncture-resistant work gloves on top of the liquid-resistant gloves, where there is a risk of cuts or tears.

   - Minimum of a half-face piece Respirator, fitted with a P100 cartridge filter. Odour protection can be provided with combination organic vapour and P100 cartridges.

   - Chemical splash goggles, or a full-facepiece respirator fitted with P100 filters, or a Powered Air Purifying Respirator (PAPR) fitted with Type H filters.

3. *Isolation*

   - Turn off HVAC systems where possible and seal over any openings immediately adjacent to the work area.

   - Seal off the contaminated areas to prevent access by unauthorized persons. Consider polyethylene sheeting isolation to ceiling height if there a strong odour present or there will be significant demolition work. Negative pressure ventilation as specified for Level 2 Mould Abatement elsewhere in this guideline may be a useful additional precaution.

- Install signs warning of a Biological Hazard and restricting access to personnel with suitable protection.

4. Cleaning and Disinfection

- Generally, all porous materials impacted by Unsanitary Water cannot be de-contaminated and must be discarded. Dispose of all drywall, carpets, carpet tiles, soft furniture, etc.

- It might be possible to restore some porous contents impacted by Unsanitary Water (e.g., high-value carpets, clothing, documents) using specialized restoration services. Any decision to restore contaminated porous articles should be approved by the Competent Person. Post-disinfection testing with bacteria swab testing is recommended for these items.

- Package all waste contaminated with Unsanitary Water into sealed water-tight containers, typically a 6 mil polyethylene bag. Wipe the containers with the disinfectant solution. Alternately, wrap items with 6 mil polyethylene sheeting, seal with tape and wipe the exterior of the packaged waste with disinfectant.

- After removal of items and finishes to be discarded, clean all surfaces with a general-purpose cleanser prior to application of a disinfectant. All soiling must be removed before disinfection.

- Apply a Health Canada approved disinfectant to all surfaces impacted with Unsanitary Water. If the product is sold as a concentrate, mix according to the manufacturer's recommendations and use within the time given by the manufacturer. Observe the wet contact time specified in the Health Canada approval (typically 5 – 10 minutes), re-applying as necessary.

- If indicated by the manufacturer, rinse the disinfected surfaces with clean potable water.

- Ensure all mould-susceptible surfaces are dry within 24 hours. Ensure all other surfaces are adequately dry before the installation of mould-susceptible surfaces that could be impacted by excess trapped moisture.

5. Post-Disinfection Testing

- Collect surface samples to test for residual viable bacteria, by swabbing 100 square centimetre areas of typical disinfected surfaces or articles.

- Analyse the swab samples for *E. coli* and possibly other Unsanitary Water indicator bacteria.

- The standard of acceptance for *E. coli* on disinfected surfaces, is no detectable Colony Forming Units per 100 square centimetre area.

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Appendix E: Definitions

Term	Definition
Abatement	The process of returning a building or part thereof, from a condition of Biohazard, to background concentrations of biological agents and products, typical of buildings not affected by Mould contamination.
Biohazard	The presence of (a) biologically derived aerosols, gases, or vapours of a kind and concentration likely to cause disease or predispose persons to adverse health effects, or (b) indoor biological growth and remnants of growth that may become airborne and to which people may be exposed.
Canister or Cartridge	A container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.
Clearance Tests	Environmental tests (e.g., air samples, tape lifts, swabs) taken after Mould Abatement has been completed as a Quality Assurance measure.
Competent Person or Supervisor	A person who is qualified because of knowledge, training and experience to organize the performance of Mould Abatement, is familiar with Mould Abatement procedures, and has knowledge of the hazards of Mould and other dangers in the Abatement work area.
Contaminated Work	The portion of the Abatement project during which active disturbance, handling or cleanup of contaminated materials is occurring.
Cryptococcus neoformans	A pathogenic yeast growing in accumulated bird (usually pigeon) or bat Guano and posing a risk of cryptococcosis infections in heavily exposed or immuno-compromised individuals.
Disinfectant	Substance used to reduce the number of micro-organisms such as Moulds, bacteria or viruses to below the level necessary to cause infection. Some common Disinfectants, include sodium hypochlorite, quaternary ammonium compounds, and hydrogen peroxide.
DIN	Drug Identification Number. Registration number given by Health Canada for approval of disinfectants. Specifies the organisms against which the disinfectant is effective, and requirements for mixing, storage, application, and rinsing, if required.
Designated Substance	Hazardous materials (asbestos, lead, silica, mercury and others) designated by the Ontario Ministry of Labour for specific regulation under the Occupational Health and Safety Act. Property owners must notify contractors bidding on projects of the presence of Designated Substances. In addition to a regulation on asbestos, the Ontario Ministry of Labour has issued guidelines for the potential exposure from silica, lead, mercury and isocyanates on construction projects.
Dust Suppression	Measures taken to reduce the release of spores and other Mould-derived particulate matter during Mould Abatement.
Filtering Facepiece	Particulate-filtering Respirator where the facepiece is also the filter.
Fit-test	A qualitative or quantitative method to evaluate the fit of a specific make, model and size of Respirator on an individual.
Guano	Bird or bat dung, considered a risk for infection by Moulds or other micro-organisms.
HEPA Filtered Exhaust Fan	Portable exhaust fan in sealed cabinet equipped with HEPA filtration used to exhaust filtered air out of an enclosed Mould Abatement work area for the purpose of establishing and maintaining a Negative Pressure in the Mould Abatement work area with respect to surrounding areas, and also to provide general ventilation of the Abatement area.

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Appendix E: Definitions

Health and Safety Professional	An individual qualified by knowledge, skills, education, training and experience to perform assessments of Mould contamination, collect and interpret environmental tests, develop recommendations for Abatement work and provide inspection and Quality Assurance services.
HEPA	High Efficiency Particulate Air filter capable of trapping and retaining particles greater than or equal to 0.3 micrometers in diameter, at a minimum efficiency of 99.97%
Histoplasma capsulatum	A fungus frequently found growing in deposits of bird and bat Guano, and a risk for human infections during remediation work, renovation and demolition.
HVAC	Heating, ventilating and air conditioning (equipment).
Mould	Normally refers to fungi with filamentous growth form, often giving rise to "fuzzy", cottony, wooly or powdery textured colonies. Moulds produce spores that are poorly visible or not visible at all to the naked eye and that in many species are specialized to become airborne.
Microbial	Referring to any of Mould, bacteria, viruses or other micro-organisms.
MSDS	Material Safety Data Sheet, required by Workplace Hazardous Materials Information System (WHMIS) legislation, and giving information on hazardous materials, including properties, hazards, first-aid, emergency response, and personal protection.
N95	A Respirator particulate filter, 95% efficient at stopping a 0.3 micrometer aerosol, and not resistant to oil, a classification of particulate filters set by NIOSH.
Negative Pressure	A reduced pressure established within a Mould Abatement enclosure by extracting air directly from Abatement area, and discharging this air outside the work area. The discharged air must be HEPA filtered, the exhaust unit should be leak-checked and preferably the air is discharged outside the building.
NIOSH	National Institute for Occupational Safety and Health, part of the U.S. Centers for Disease Control and Prevention.
100 Series Filter	Any Respirator particulate filter, 99.97% efficient at stopping a 0.3 micrometer aerosol. A classification of particulate filters set by NIOSH.
Polyethylene Sheeting	Polyethylene Sheeting or rip-proof Polyethylene Sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required providing a continuous membrane to protect underlying surfaces from damage, and to prevent escape of airborne contamination through sheeting into occupied areas.
Porous	Permeable to Mould growth, allowing growth to extend significantly below the immediate surface.
Project Authority	Individual who has overall management responsibility for the project.
P100	A Respirator particulate filter, 99.97% efficient at stopping a 0.3 micrometer aerosol, and resistant to oil droplets, a classification of particulate filters set by NIOSH.
Quality Assurance	Measures of inspection, testing and documentation to promote confidence that the Abatement process will meet the desired goals.
Respirator	A device to protect the user from inhaling a hazardous atmosphere.
Susceptible Occupants	Persons with elevated risks of reacting to Mould exposure, usually due to allergic pre-disposition or compromised immune state. Examples include but are not limited to infants (less than 12 months old), persons recovering from recent surgery, or

Appendix E: Definitions

	people with immune suppression, asthma, severe allergies, sinusitis or other chronic inflammatory lung diseases.
Unsanitary Water	Water containing the known or presumed presence of harmful micro-organism such as *E. coli*, viruses or bacteria. Examples of Unsanitary Water include water originating from a sanitary sewer system, or flooding from over-land water or waterways.
Waste Decontamination Facility	A series of two rooms (Double-bagging and Transfer) constructed in such a way as to allow waste and equipment to enter and leave a Mould Abatement area without spreading contaminants beyond the Abatement area.
Worker Decontamination Facility	A series to two rooms (Clean and Dirty) constructed in such a way as to allow persons to enter and leave a Mould Abatement area without spreading the contaminants beyond the Abatement area.

NOTES

Appendix G
Division 13 – Standby Generator System Process Control Narrative

Standby Generator System Process Control Narrative

RC Harris WWTC Standby Generator ELS-GEN-0100

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1 Standby Generator System

1.1 General Description

A new 300kW natural gas generator ELS-GEN-0100 will be installed in the RMF building. The standby generator will be located in a generator room in the piping gallery along with its supporting systems. A new mechanical control panel provides operator control of auxiliary and status indication of auxiliary equipment and is interfaced with the generator controller and gas detection system controller. Existing SCADA PLC's are utilized for monitoring only.

1.2 SCADA Equipment

A list of all the equipment that is utilized/monitored through the SCADA system is presented in Table 1.

1.3 Control Details

The Mechanical Control Panel ELS-CP-0111 consists of operator control switches and status indicators to provide control of auxiliary equipment such as the exhaust fan, combustion air supply fan, and combustion air damper. It also interfaces with the generator control panel ELS-GEN-0100 and gas detection system controller ELS-CT-0101 to provide hardwired interlocking and status monitoring to the existing SCADA. The vendor supplied generator includes a genset controller and remote annunciation panel. The gas detection system controller monitors for methane gas and CO gas within the generator room and controls a horn and beacon for visible and audible alarming. Existing SCADA PLC's are utilized for monitoring only of the generator, auxiliary equipment, gas detection system, and ATS. Only digital inputs (DI) and analog inputs (AI) are connected to the existing PLC's.

Table 1 Equipment and Instrument List

EQUIPMENT TAG NAME	EQUIPMENT OR INSTRUMENTATION DESCRIPTION	EQUIPMENT OR INSTRUMENTATION SUPPLIER	EQUIPMENT OR INSTRUMENTATION MODEL#	EQUIPMENT CAPACITY OR INSTRUMENTATION RANGE
FHA-ACC-FSH-6822	COMBUSTION AIR SUPPLY FLOW SWITCH	Dwyer	AVFS	1 to 10 m/s
FHA-ELS-LSH-0101	GENERATOR CONTAINMENT FLOAT	APG	FS-410	
FHA-ELS-TIT-0101	GENERATOR ROOM TEMPERATURE	Pribusin	TWTS-X	0°C to 40°C
FHA-ELS-FIT-0101	COOLING WATER LINE FLOW METER	MJK	Magflux series	0 to 10 L/s
FHA-ELS-FIT-0102	NATURAL GAS LINE FLOW METER	Kurz	B series	0 to 4MM BTU, 10-12” WC
FHA-ELS-CT-0101	GAS DETECTION SYSTEM CONTROLLER	MSA	Sentry iO	
FHA-ELS-LTG-0101	HORN AND BEACON	Honeywell/System Sensor	P2RL	
FHA-ELS-FDT-0101	GENERATOR ROOM FLAME DETECTOR	MSA	FlameGard5	
FHA-NGS-AIT-0101	GENERATOR ROOM NATURAL GAS DETECTOR	MSA	Ultima X5000	0 to 100% LEL
FHA-COS-AIT-0102	GENERATOR ROOM CO GAS DETECTOR	MSA	Ultima X5000	0 to 100 PPM

The project consists of the following components:

1.3.1 Generator

The vendor supplied generator ELS-GEN-0100 is equipped with a genset controller that controls two natural gas valves (NGS-V-0102 and NGS-V-0103) and interfaces with the Mechanical Control Panel ELS-CP-0111 and Gas Detection System controller ELS-CT-0101. The generator controller's I/O board are wired and configured as follows:

Digital Inputs (hardwired local):

- Natural gas valve 1 NGS-V-0102 Open
- Natural gas valve 1 NGS-V-0102 Closed
- Natural gas valve 2 NGS-V-0103 Open
- Natural gas valve 2 NGS-V-0103 Closed
- Natural gas high pressure switch NGS-PSH-0101
- Natural gas low pressure switch NGS-PSL-0102
- Alarm interlock from Mechanical Control Panel ELS-CP-0111

Digital Outputs (hardwired local):

- Natural gas valve 1 NGS-V-0102 Open Command
- Natural gas valve 2 NGS-V-0103 Open Command
- Generator ELS-GEN-0100 running interlock to Mechanical Control Panel ELS-CP-0111

SCADA Monitoring (Digital Outputs to existing PLC SPC-RPU-2022):

- Generator ELS-GEN-0100 In Auto Mode
- Generator ELS-GEN-0100 Running
- Generator ELS-GEN-0100 General Alarm
- Generator ELS-GEN-0100 Not Available
- Natural gas valve 1 NGS-V-0102 Open
- Natural gas valve 1 NGS-V-0102 Closed
- Natural gas valve 1 NGS-V-0102 interlock active
- Natural gas valve 2 NGS-V-0103 Open
- Natural gas valve 2 NGS-V-0103 Closed
- Natural gas valve 2 NGS-V-0103 interlock active

1.3.2 Mechanical Control Panel

The Mechanical Control Panel ELS-CP-0111 is a hardwired relay based system with operator control switches and status indicator lights on the front of the panel. It provides relay based control of auxiliary equipment such as the exhaust fan, combustion air supply fan, and combustion air damper. External connections to the mechanical control panel are wired as follows:

Inputs (hardwired local):

- Generator ELS-GEN-0100 Running from Generator Control Panel ELS-GEN-0100

- Fan Coil Cooler ELS-FN-0101 In Auto Mode
- Exhaust fan ACC-FN-6822 In Auto Mode
- Combustion Air Supply Fan ACC-FN-6823 In Auto Mode
- Methane Gas High-High Alarm interlock from Gas Detection System Controller ELS-CT-0101
- CO Gas High-High Alarm interlock from Gas Detection System Controller ELS-CT-0101
- Flame Detection Alarm interlock from Gas Detection System Controller ELS-CT-0101

Outputs (hardwired local):

- Exhaust fan ACC-FN-6822 Run Command
- Combustion Air Supply Fan ACC-FN-6823 Run Command
- Combustion Air Damper ACC-DM-6822 Open Command
- Generator Water Solenoid Valve ELS-V-0101 Open Command
- Fan Coil Water Solenoid Valve ELS-V-0102 Open Command
- Alarm Interlock to Generator Control Panel ELS-GEN-0100

SCADA Monitoring (Digital Outputs to existing PLC SPC-RPU-2022):

- Fan Coil Cooler ELS-FN-0101 In Auto Mode
- Exhaust fan ACC-FN-6822 In Auto Mode
- Combustion Air Supply Fan ACC-FN-6823 In Auto Mode
- Combustion Air Supply Fan ACC-FN-6823 Failure Alarm
- Combustion Air Supply Damper ACC-DM-6822 Failure Alarm

1.3.3 Gas Detection System

The Gas Detection System Controller ELS-CT-0101 monitors the generator room for natural gas, CO gas, and flame detection. External connections to the gas detection system controller are wired as follows:

Inputs:

- Natural gas analyzer ELS-AIT-0101 Indication
- CO gas analyzer ELS-AIT-0102 Indication
- Flame detector ELS-FDT-0101 Indication

Outputs:

- Methane gas High-High alarm interlock to Mechanical Control Panel ELS-CP-0111
- CO gas alarm High-High interlock to Mechanical Control Panel ELS-CP-0111
- Flame detection alarm interlock to Mechanical Control Panel ELS-CP-0111
- Horn and Beacon ELS-LTG-0101 Active command

SCADA Monitoring (output to existing PLC SPC-RPU-2022):

- Natural gas analyzer ELS-AIT-0101 General Alarm
- Natural gas analyzer ELS-AIT-0101 High Alarm

- Natural gas analyzer ELS-AIT-0101 High-High Alarm
- Natural gas analyzer ELS-AIT-0101 Indication
- CO gas analyzer ELS-AIT-0102 General Alarm
- CO gas analyzer ELS-AIT-0102 High Alarm
- CO gas analyzer ELS-AIT-0102 High-High Alarm
- CO gas analyzer ELS-AIT-0102 Indication
- Flame Detector ELS-FDT-0101 General Alarm
- Flame Detector ELS-FDT-0101 Instantaneous Alarm
- Flame Detector ELS-FDT-0101 Sustained Alarm

1.3.4 Automatic Transfer Switches

The automatic transfer switch ELS-TS-0300 in the pumping station building is connected to an existing PLC panel SPC-RPU-1223 for SCADA monitoring. The automatic transfer switch ELS-TS-0400 located in the RMF building is connected to the existing PLC panel SPC-RPU-2022 for SCADA monitoring. The monitoring points are wired as follows:

SCADA Monitoring (to existing PLC SPC-RPU-1223):

- Automatic Transfer Switch ELS-TS-0300 In Auto Mode
- Automatic Transfer Switch ELS-TS-0300 General Alarm
- Automatic Transfer Switch ELS-TS-0300 Normal Power Position
- Automatic Transfer Switch ELS-TS-0300 Emergency Power Position

SCADA Monitoring (to existing PLC SPC-RPU-2022):

- Automatic Transfer Switch ELS-TS-0400 In Auto Mode
- Automatic Transfer Switch ELS-TS-0400 General Alarm
- Automatic Transfer Switch ELS-TS-0400 Normal Power Position
- Automatic Transfer Switch ELS-TS-0400 Emergency Power Position

1.3.5 Control Modes

The following three (3) modes of control are provided for the exhaust fan, combustion air supply fan, and fan coil cooler:

- HAND
- OFF
- AUTO

1.3.5.1 Hand Mode

In Hand mode the exhaust fan, combustion air supply fan, and fan coil cooler can run continuously.

1.3.5.2 Auto Mode

In Auto mode the exhaust fan, combustion air supply fan, and fan coil cooler runs as follows:

Exhaust Fan - The exhaust fan starts and runs under the following conditions:

- Genset running

Combustion Air Supply Fan - The combustion air supply fan starts and runs under the following conditions:

- Genset running

Combustion Air Damper - The combustion air damper opens under the following conditions:

- Combustion air supply fan running

Fan Coil Cooler – The fan coil cooler ELS-FN-0101 runs under the following conditions:

- Genset running

Generator Water Solenoid valve – The generator water solenoid valve ELS-V-0101 opens under the following conditions:

- Genset running

Fan Coil Water Solenoid valve – The fan coil water solenoid valve ELS-V-0102 opens under the following conditions:

- Genset running

1.3.6 Control Mode Settings

Table 2 summarizes the control modes in which the generator auxiliary equipment will operate.

Table 2 Process Control Mode Settings

EQUIPMENT TAG NAME	EQUIPMENT DESCRIPTION	HAND MODE		HAND MODE	
		SWITCH	CONTROL	SWITCH	CONTROL
ACC-FN-6822	Exhaust Fan	Local	ON	Auto	ON/OFF
ACC-FN-6823	Combustion Air Supply Fan	Local	ON	Auto	ON/OFF
ACC-FSH-6822	Combustion Air Damper	Local	ON	Auto	ON/OFF

1.4 Normal Operation

1.4.1 Generator

The generator is a standby generator that starts up automatically on utility power failure. The generator controller directly controls the natural gas valves which are open when the generator is running. A natural gas flowmeter and cooling water flow meter are installed on the supply lines to monitor the natural gas and water usage. The flow meters are wired to SCADA for monitoring and provide no control function. A level float switch is installed in the generator containment for SCADA monitoring of spills and leakages within the containment.

1.4.2 Generator Auxiliary Equipment

Auxiliary equipment that supports the operation of the generator include the following:

- Exhaust fan
- Combustion air supply fan and air flow switch
- Combustion air damper and damper open switch
- Fan coil cooler
- Generator water solenoid valve
- Fan coil water solenoid valve

These equipment are controlled from the Mechanical Control panel by hardwired relays and turn ON or Open when the generator is running. A generator running signal is wired from the generator control panel to the Mechanical Control panel which facilitates the start of these equipment.

1.4.3 Generator Room Monitoring

The generator room is monitored for hi levels of CO gas and Methane gas, and for flame detection. The combination CO and Methane gas sensor is connected to the Gas Detection System Controller. The controller provides alarm outputs to the Mechanical Control Panel and outputs to SCADA for monitoring. A horn and beacon installed above the door of the generator room provides audible and visual alarm indication. A generator room ambient temperature sensor is connected to SCADA for monitoring.

1.5 Fault Response Operation

An alarm light is lit at the Mechanical Control Panel and a horn and beacon will turn ON for any gas and flame detection alarms. All alarm conditions are described below and are monitored by SCADA.

1.5.1 Generator

The vendor supplied generator is packaged with a genset controller that handles generator fault conditions. A generator fault is monitored by SCADA but not action is performed by SCADA.

1.5.2 Natural Gas Solenoid Valves

The natural gas solenoid valves (NGS-V-0102, NGS-V-0103) are controlled by the genset controller. The valves are de-energized and closed if there is a generator fault.

1.5.3 Combustion Air Supply Fan

The combustion air supply fan starts when the generator starts. Air flow must be detected by the airflow switch ACC-FSH-6822 within 20 seconds of the fan starting or else a combustion air supply failure will alarm in SCADA. No action is performed by SCADA.

1.5.4 Combustion Air Damper

The combustion air damper opens when the combustion air supply fan is running. The air damper must be at least 85% open as detected by the limit switch ACC-ZSH-6822 or else a combustion air damper failure will alarm in SCADA. No action is performed by SCADA.

1.6 Interlocks

Table 3 is a summary of interlocks for the system.

Table 3 Summary of Interlocks

EQUIPMENT TAG NAME	EQUIPMENT DESCRIPTION	TYPE OF INTERLOCK	HARD-WARE	SOFT-WARE	DESCRIPTION OF INTERLOCK CONDITIONS
ELS-GEN-0100	Generator	STOP, NO START	√	√	• Methane Hi-Hi alarm • Methane General alarm • Flame detector Instantaneous alarm • Flame detector Sustained alarm
NGS-V-0102 NGS-V-0103	Natural gas valve 1 Natural gas valve 2	STOP, NO START	√	√	• Methane Hi-Hi alarm • Methane General alarm • Flame detector Instantaneous alarm • Flame detector Sustained alarm
ACC-FN-6822	Exhaust fan	START	√	√	The exhaust fan starts automatically on: • Methane Hi-Hi alarm • Methane General alarm • CO Hi-Hi alarm • CO General alarm • Flame detector Instantaneous alarm • Flame detector Sustained alarm

1.6.1 Generator

The generator is interlocked from running under the following conditions. These alarms are combined into one alarm interlock signal from the Mechanical Control Panel that is wired to an input at the Generator Control Panel. The combined alarms are:

- Methane gas high-high alarm
- Methane gas general alarm
- Flame detector instantaneous alarm
- Flame detector sustained alarm

1.6.2 Natural Gas Solenoid Valves

The natural gas solenoid valves (NGS-V-0102, NGS-V-0103) are controlled from the Generator Control Panel. The valves are closed under any of the following alarm conditions. These alarms are combined into one alarm interlock signal from the Mechanical Control Panel that is wired to an input at the Generator Control Panel. The combined alarms are:

- Methane gas high-high alarm
- Methane gas general alarm
- Flame detector instantaneous alarm
- Flame detector sustained alarm

1.6.3 Exhaust Fan

The exhaust fan starts running automatically under the following conditions:

- Methane gas high-high alarm
- Methane gas general alarm

- CO gas high-high alarm
- CO gas general alarm
- Flame detector instantaneous alarm
- Flame detector sustained alarm

1.7 Alarms

Table 4 is a summary of alarms.

1.8 Input/Output List

The available Input/Output signals are summarized in **Table 5**.

Table 4 Alarms Summary

EQUIPMENT TAG NAME	ALARM	LOW LOW		LOW		HIGH		HIGH HIGH		DEADBAND		OPERATOR	SECURITY
		DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	ADJUSTABLE	LEVEL
ELS-GEN_-0100-YN	Generator not in auto alarm											No	
ELS-GEN_-0100-XA	Generator general alarm											No	
ELS-GEN_-0100-YA	Generator not available											No	
NGS-V-0102-XA	Natural gas valve 1 interlock active											No	
NGS-V-0103-XA	Natural gas valve 2 interlock active											No	
ELS-LSH-0101-LAH	RMF building containment float high alarm											No	
ELS-FN-0101-YN	Fan coil cooler not in auto alarm											No	
ACC-FN-6822-YN	Exhaust fan not in auto alarm											No	
ACC-FN-6823-YN	Combustion air supply fan not in auto alarm											No	
ACC-FN-6823-XA	Combustion air supply fan failure alarm											No	
ACC-DM-6822-XA	Combustion air damper failure alarm											No	
ELS-AIT-0101-XA	Natural gas analyzer general alarm											No	
ELS-AIT-0101-AAH	Natural gas high alarm											No	
ELS-AIT-0101-AHH	Natural gas high-high alarm											No	
ELS-AIT-0102-XA	CO gas analyzer general alarm											No	
ELS-AIT-0102-AAH	CO gas high alarm											No	
ELS-AIT-0102-AHH	CO gas high-high alarm											No	
ELS-FDT-0101-XA	Flame detector general alarm											No	
ELS-FDT-0101-AAH	Flame detector instantaneous alarm											No	
ELS-FDT-0101-AHH	Flame detector sustained alarm											No	
ELS-TIT-0101-TI	Generator room temperature high alarm											Yes	
ELS-FIT-0102-XA	Natural gas flow meter fault											No	
ELS-FIT-0101-XA	Generator room cooling water flow meter fault											No	
ELS-TS-0300-YN	ATS 0300 not in auto alarm											No	
ELS-TS-0300-XA	ATS 0300 general alarm											No	
ELS-TS-0300-UP	ATS 0300 emergency power position											No	

EQUIPMENT TAG NAME	ALARM	LOW LOW		LOW		HIGH		HIGH HIGH		DEADBAND		OPERATOR	SECURITY
		DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	ADJUSTABLE	LEVEL
ELS-TS-0400-YN	ATS 0400 not in auto alarm											No	
ELS-TS-0400-XA	ATS 0400 general alarm											No	
ELS-TS-0400-UP	ATS 0400 emergency power position											No	

Table 5 Input/Output List

PLC (MODULE /YTPE)	PLC (RACK/SLOT/POINT) PLC (POINT AND REGISTER ID WHERE APPLICABLE)	REAL/VIRTUAL	TYPE	TAG NUMBER	DESCRIPTION	PRIMARY SOFTWARE ADDRESS	RANGE/UNITE	EVENT LOGGING	ALARMING/PRIORITY	TRENDING	HISTORICAL DATA LOGGING/INTERVAL
SPC-RPU-2022	R0, Slot 3, IN-11	Real	DI	ACC-FN-6822-YN	Exhaust fan in auto mode			√			√
SPC-RPU-2022	R0, Slot 3, IN-12	Real	DI	ACC-FN-6823-YN	Combustion air supply fan in auto mode			√			√
SPC-RPU-2022	R0, Slot 3, IN-13	Real	DI	ACC-FN-6823-XA	Combustion air supply fan failure alarm			√			√
SPC-RPU-2022	R0, Slot 3, IN-14	Real	DI	ACC-DM-6822-XA	Combustion air damper failure alarm			√			√
SPC-RPU-2022	R0, Slot 3, IN-15	Real	DI	ELS-FN-0101-YN	Fan coil cooler in auto mode			√			√
SPC-RPU-2022	R0, Slot 3, IN-16	Real	DI	ELS-LSH-0101-LAH	Generator containment high level alarm			√			√
SPC-RPU-2022	R0, Slot 4, IN-10	Real	DI	ELS-FIT-0101-XA	Cooling water flow meter fault			√			√
SPC-RPU-2022	R0, Slot 4, IN-11	Real	DI	ELS-FIT-0101-FH	Cooling water flow totalizer pulse						
SPC-RPU-2022	R0, Slot 4, IN-12	Real	DI	ELS-FIT-0102-XA	Natural gas flow meter fault			√			√
SPC-RPU-2022	R0, Slot 4, IN-13	Real	DI	ELS-FIT-0102-FH	Natural gas flow totalizer pulse						
SPC-RPU-2022	R0, Slot 4, IN-14	Real	DI	ELS-FDT-0101-XA	Flame detector general alarm			√			√
SPC-RPU-2022	R0, Slot 4, IN-15	Real	DI	ELS-FDT-0101-AAH	Flame detector instantaneous alarm			√			√
SPC-RPU-2022	R0, Slot 4, IN-16	Real	DI	ELS-FDT-0101-AHH	Flame detector sustained alarm			√			√
SPC-RPU-2022	R0, Slot 5, IN-10	Real	DI	ELS-AIT-0101	Natural gas detector general alarm			√			√

PLC (MODULE /YTPE)	PLC (RACK/SLOT/POINT) PLC (POINT AND REGISTER ID WHERE APPLICABLE)	REAL/VIRTUAL	TYPE	TAG NUMBER	DESCRIPTION	PRIMARY SOFTWARE ADDRESS	RANGE/UNITE	EVENT LOGGING	ALARMING/PRIORITY	TRENDING	HISTORICAL DATA LOGGING/INTERVAL
SPC-RPU-2022	R0, Slot 5, IN-11	Real	DI	ELS-AIT-0101	Natural gas detector high level alarm			√			√
SPC-RPU-2022	R0, Slot 5, IN-12	Real	DI	ELS-AIT-0101	Natural gas detector high-high level alarm			√			√
SPC-RPU-2022	R0, Slot 5, IN-13	Real	DI	ELS-AIT-0102	CO gas detector general alarm			√			√
SPC-RPU-2022	R0, Slot 5, IN-14	Real	DI	ELS-AIT-0102	CO gas detector high level alarm			√			√
SPC-RPU-2022	R0, Slot 5, IN-15	Real	DI	ELS-AIT-0102	CO gas detector high-high level alarm			√			√
SPC-RPU-2022	R0, Slot 6, IN-11	Real	DI	ELS-TS-0400-YN	ATS 0400E in auto mode			√			√
SPC-RPU-2022	R0, Slot 6, IN-12	Real	DI	ELS-TS-0400-XA	ATS 0400E general alarm			√			√
SPC-RPU-2022	R0, Slot 6, IN-13	Real	DI	ELS-TS-0400-UP	ATS 0400E normal power position			√			√
SPC-RPU-2022	R0, Slot 6, IN-14	Real	DI	ELS-TS-0400-EN	ATS 0400E emergency power position			√			√
SPC-RPU-2022	R0, Slot 7, IN-3	Real	DI	ELS-GEN-0100-YN	Generator in auto mode			√			√
SPC-RPU-2022	R0, Slot 7, IN-4	Real	DI	ELS-GEN-0100-MN	Generator running			√			√
SPC-RPU-2022	R0, Slot 7, IN-5	Real	DI	ELS-GEN-0100-XA	Generator general alarm			√			√
SPC-RPU-2022	R0, Slot 7, IN-6	Real	DI	ELS-GEN-0100-YA	Generator not available			√			√
SPC-RPU-2022	R0, Slot 7, IN-7	Real	DI	NGS-V-0102-ZH	Natural gas valve 1 open			√			√
SPC-RPU-2022	R0, Slot 7, IN-8	Real	DI	NGS-V-0102-ZL	Natural gas valve 1 closed			√			√
SPC-RPU-2022	R0, Slot 7, IN-9	Real	DI	NGS-V-0102-XA	Natural gas valve 1 interlock active			√			√
SPC-RPU-2022	R0, Slot 7, IN-10	Real	DI	NGS-V-0103-ZH	Natural gas valve 2 open			√			√
SPC-RPU-2022	R0, Slot 7, IN-11	Real	DI	NGS-V-0103-ZL	Natural gas valve 2 closed			√			√
SPC-RPU-2022	R0, Slot 7, IN-12	Real	DI	NGS-V-0103-XA	Natural gas valve 2 interlock active			√			√
SPC-RPU-2022	R1, Slot 4, IN-7	Real	AI	ELS-TIT-0101-TI	Generator room temperature indication		Deg.C			√	√
SPC-RPU-2022	R1, Slot 4, IN-8	Real	AI	ELS-FIT-0101-XA	Cooling water line flow indication		m3/h			√	√
SPC-RPU-2022	R1, Slot 4, IN-9	Real	AI	ELS-FIT-0102-FI	Natural gas line flow indication		BTU			√	√

PLC (MODULE /YTPE)	PLC (RACK/SLOT/POINT) PLC (POINT AND REGISTER ID WHERE APPLICABLE)	REAL/VIRTUAL	TYPE	TAG NUMBER	DESCRIPTION	PRIMARY SOFTWARE ADDRESS	RANGE/UNITE	EVENT LOGGING	ALARMING/PRIORITY	TRENDING	HISTORICAL DATA LOGGING/INTERVAL
SPC-RPU-2022	R1, Slot 4, IN-10	Real	AI	ELS-AIT-0101-AI	Natural gas detector indication		LEL			√	√
SPC-RPU-2022	R1, Slot 4, IN-11	Real	AI	ELS-AIT-0102-AI	CO gas detector indication		PPM			√	√
SPC-RPU-1223	R0, Slot 6, IN-4	Real	DI	ELS-TS-0300-YN	ATS 0300E in auto mode			√			√
SPC-RPU-1223	R0, Slot 6, IN-5	Real	DI	ELS-TS-0300-XA	ATS 0300E general alarm			√			√
SPC-RPU-1223	R0, Slot 6, IN-6	Real	DI	ELS-TS-0300-UP	ATS 0300E normal power position			√			√
SPC-RPU-1223	R0, Slot 6, IN-7	Real	DI	ELS-TS-0300-EN	ATS 0300E emergency power position			√			√

Appendix H
Section 13040 – Appendix A-Common System Tagging Loop Reservation

Appendix A- Common System Tagging Loop Reservation

1 Wastewater Plants

1.1 Highland Creek Wastewater

THC-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
0001-0299	Admin Building, and Legacy Tags	
0300-0399	Incinerator, Dewatering	
0400-0499	Anaerobic Digesters	
0500-0599	Incinerator, Dewatering	
0600-0699	Dewatering & South Effluent P.S	
0700-0799	TWAS	
0800-0899	Sludge Storage Bldg.	
0900-0999	Reserved for De-Chl. Bldg.	
1000-1199	Phase 1	
1200-1999	FBI Building	
2000-2999	Available	
3000-3999	Plant Wide Hot Water system & Boiler Bldg.	
4000-4199	Phase 4	
4200-4899	Available	
4900-4999	Chlorination Bldg.	
5000-5299	Old Plant	
5300-5999	Reserved for Old Plant Tunnels T31 & T33	
5400-5799	New Plant Stores	
5800-5899	Reserved for THC Team 2 Workshop	
5900-5999	Reserved for Air Treatment Bldg.	
6000-6799	Headworks	
6800-6899	Reserved New Ferrous Chl. Bldg.	
6900-6999	Available	
7000-7999	Available	
8000-8999	Reserved North East Plant	
9000-9999	Available	

1.2 Ashbridges Bay Wastewater

TAB-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
0001-0199	Boiler Room and Primary Loop - Plant Wide	
0200-0299	Domestic Hot Water System 1	
0300-0399	Domestic Hot Water System 2	
0400-0499	Proposed for Connection to Co-Gen Plant Heat Recovery	
0500-0599	Available	
0600-0699	Admin Bldg. Radiant Heat	
0700-0799	Available	
0800-0899	Admin Bldg. Reheat Coils	
0900-0999	Available	
1000-1099	D Bldg. Process Heating	
1100-1199	D Bldg. Space Heating	
1200-1299	Flotation Space Heating - Z Bldg.	D-Building Legacy tags
1300-1399	Available	D-Building Legacy tags
1400-1499	Proposed Boiler Bldg. Space Heating - Z Bldg.	
1500-1599	Contractor Training Centre	
1600-1699	P Bldg. Process Heating	D-Building Legacy tags
1700-1799	OPS Process Heating	
1800-1899	Blower Bldg. Space Heating	
1900-1999	Available	
2000-2099	Aeration / Ferric Gallery Space Heating	
2100-2199	Reserved for Final Tanks Tunnels, RAS Gallery	
2200-2299	Reserved for New Ferrous Chloride Facility	
2300-2399	TWAS Building	
2400-2499	Available	
2500-2599	Available	
2600-2699	Pumping and Distribution, Centrifugal	
2700-2799	Pumping and Distribution, NaCLO	
2800-2899	Dewatering - Centrifuge Bldg. Space Heating	
2900-2999	Available	
3000-3099	Chlorine Bldg. Space Heating	
3100-3199	Available	

TAB-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
3200-3299	Sludge Holding Tanks Space Heating	
3300-3399	Available	
3400-3499	Dewatering - Old Filter Bldg. Space Heating	
3500-3599	Available	
3600-3699	PMO Office Space Heating/OPS Space Heating	
3700-3799	Available	
3800-3899	Dewatering - Old Filter Bldg./Heat Recovery/Incinerator Bldg. Space Heating	
3900-3999	new TWAS building	
4000-4099	Silo Bldg. Space Heating	
4100-4199	Available	
4200-4299	Reserved for Pelletizer Bldg.	
4300-4399	Available	
4400-4499	Auxiliary - Service Air Bldg.	
4500-4599	Digester 1-4 Process and Space Heating	
4600-4699	Digester 19-22 Space Heating	
4700-4799	Available	
4800-4899	Digester 19-22 Process Heating	
4900-4999	Available	
5000-5099	Digester Gas Control Bldg. Space Heating	
5100-5199	Available	
5200-5299	Digester 13-16 Space Heating	
5300-5399	Proposed for Seawall Substation Space Heating	
5400-5499	Plant Water Pumping Station Space Heating	
5500-5599	Proposed for Seawall Tunnel Expansion Space Heating	
5600-5699	Proposed for UV Disinfection Facility Space Heating	
5700-5799	Available	
5800-5899	Truck Loading Facility Space Heating	
5900-5999	Available	
6000-6099	Digester 13-16 Process Heating	
6100-6199	Digester 5-8 Space Heating	
6200-6299	Digester 5-12 Process Heating	
6300-6399	Proposed for Digester 9-12 Space Heating	
6400-6499	Proposed for P Bldg. Space Heating	
6500-6599	Proposed for Waste Gas Burner Bldg. Space Heating	
6700-6799	Available	
6800-6899	Available	

TAB-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
6900-6999	Available	
7000-7099	Proposed for Steam Plant - Z Bldg.	
7100-7199	Proposed for Steam Plant - Z Bldg.	
7200-7299	Proposed for Steam Plant - Z Bldg.	
7300-7399	Proposed for Steam Plant - Z Bldg.	
7400-7499	Proposed for Steam Plant - Z Bldg.	
7500-7599	Proposed for Steam Plant - Z Bldg.	
7600-7699	Proposed for Steam Plant - Z Bldg.	
7700-7799	Proposed for Steam Plant - Z Bldg.	
7800-7899	Proposed for Steam Plant - Z Bldg.	
7900-7999	Proposed for Steam Plant - Z Bldg.	
8000-8199	M Bldg. Space Heating	
8100-8199	M Bldg. Space Heating	
8200-8299	M Bldg. Space Heating	
8300-8399	M Bldg. Space Heating	
8400-8499	Available	
8500-8599	T Building	
8600-8699	T Building	
8700-8799	Z Building	
8800-8899	Z Building	
8900-8999	Z Building	
9000-9199	New Pelletizer Building	
9100-9199	New Pelletizer Building	
9200-9299	New Pelletizer Building	
9300-9399	New Pelletizer Building	
9400-9499	New Pelletizer Building	
9500-9599	IPS(Integrated Pumping Station)	
9600-9699	IPS(Integrated Pumping Station)	
9700-9799	Available	
9800-9999	IPS(Integrated Pumping Station)	

1.3 Humber Wastewater

THR-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
0001-0299(Legacy)	Sludge Thickening Bldg. & Tunnel 11	
0300-0399	South Primary & Tunnel 12 South	
0400-0499	Gallery 3&4(Digesters 7-10)	
0500-0599	North Truck Loading/Access Building and Digesters Electrical & Scrubber Buildings	
0600-0699	Gallery 1 & 2 (Digesters 1-6)	
0700-0799	Compressor Building & WGB Building	
0800-0999	Grit Building & North Boilers Building (Hot Water, North Boilers, HVAC)	
1000-1099	North Primary & Tunnel 12 North	
0100-0199 (Legacy)	Head House & Engine House (Hot Water / South Boilers)	
1100-1799 (Legacy)		
2100-2899		
1300-1499	Engine House (HVAC)	
1800-2099	Administration Building	
2100-2199	ECS Trailer	
2900-2999	Not Assigned	
3000-3099	North Aeration Tanks & Tunnel 14 North & Tunnel 16	
3100-3299	Final Sedimentation Tanks 9 to 21 & Tunnels 19,21,23	
3300-3399	High Pressure Blower Building	
3400-3499	Filtered Plant Water Building	
3500-3599	Chemical (Ferrous) Building	
3600-3699	Service Building	
3700-3799	Low Pressure Blower Building	
3800-3999	Main Substation	
4000-4199	South Aeration Tanks & Tunnel 14 South, Tunnels 17,20A	
4200-4399	Final Sedimentation Tanks 1 to 8& Tunnels 13,15	
4400-4499	Air Compressor Building	
4500-4599	RAS PS Building, RAS Electrical Building North	
4600-4699	Air Scrubbers Buildings	
4700-4799	RAS Electrical Building South	
4800-4899	West Sub Station	

THR-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
4900-4999	Effluent P.S	
5000-5099	Disinfection Facility Building	
5100-5199	Plant (Raw) Water Pumping Station -New	
5200-5299	Storage / Garage Building	
5300-5399	Maintenance Workshop	
5400-5499	North Substation	

1.4 North Toronto Wastewater

TNT-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	
0001-0099	Legacy	
1000-1299	Boiler Building	
1300-1399	Control Gallery	
1400-1499	Admin Building	
1500-1599	Operation Gallery	
1600-1699	Digesters	
1700-1799	Filter Building Main	
1800-1899	Filter Building Basement	
1900-1999	Maintenance Shop	
2000-2099	Available	
2100-2299	Boiler Building	
2300-2999	Available	
3000-3099	Boiler Building (Legacy)	
3100-3999	Available	
4000-4499	Polymer Lab	
5000-5299	Boiler Building (Legacy)	
5300-9999	Available	

2 Water Treatment Plants

2.1 RL Clark Water Treatment Plant

FCL-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
0001-0099	Gaseous Chemical Building Legacy -Other Legacy	
0100-0199	Low Lift PS Building	
0200-0299	Dry Chemical Building, Sedimentation & Flocculation	
0300-0399	Admin Building	
0400-0499	High Lift PS Building, 27.4 kV Switchgear	
0500-0699	Filter Building	
0700-0799	Gaseous Chemical Building	
0800-0899	Surge Building	
0900-0999	RMF Clarification	
1000-1099	Generator Building	
1100-9999	Available	

2.2 R.C. Harris Water Treatment Plant

FHA-ACC(Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
0001-0099	Legacy - Various Areas	
0100-0299	PS Building (HL, Switchgear, LL, Intake, Scarborough PS)	
0300-0399	Service Building	
0400-0499	RMF	
0500-0899	Filter Building	
0900-0999	Admin Building	
1000-1099	Available	
1100-1299	PS Building (HL, Switchgear, LL, Intake, Scarborough PS)	
1300-1399	Service Building	
1400-5999	Available	
6000-6999	Residue Management Facility (Legacy)	
7000-9999	Available	

2.3 F.J. Horgan Water Treatment Plant

FHO-ACC(Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
0001-0099	In Developing Phase	
0100-0199	Admin. Building / Legacy	Note 5
0200-0399	Chemical Building	
0400-0499	High Lift Pumping Station	
0500-0699	Raw Water Building	
0700-0799	Legacy / Do not use	Note 1
0800-0899	Legacy / Do not use	Note 2
0900-0999	Filter Building (1-8)	Note 3
1000-1099	Legacy / Do Not use	Note 4
1100-1199	Clarifier Building	
1200-1299	Flocculation Building	
1300-1499	In Developing Phase	
1500-1599	DOZ Building	
1600-1699	Standby Power Building	
1700-1799	Filter Building	
1800-5999	In Developing Phase	
6000-6999	Portable Devices	
7000-9999	In Developing Phase	

Note 1 - Used for High Lift (TRW) Pumping Station and Chemical Building

Note 2 - Used for Chemical Building, Switchgear Room and High Lift (TRW) Pumping Station

Note 3 - Used for Filter Building & Admin Building. Consider Admin Building Tag as Legacy in this range and use this range only for Filter (1-8) Building

Note 4 - Used for TW Suction Channel, Surge Building and Admin Building

Note5 - Flocculation Building loop numbers (0100-0199) considered as Legacy. Use 1200-1299 for any new device in Flocculation Building

2.4 Island Water Treatment Plant

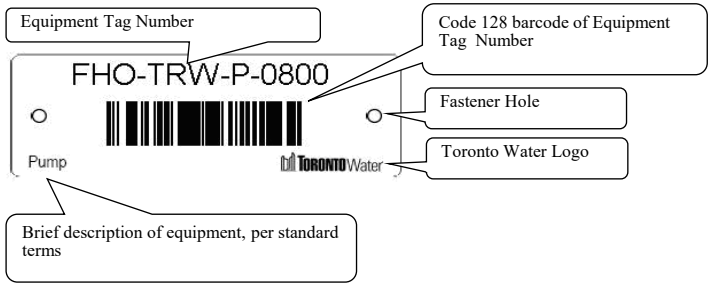
FIS-ACC (Typical for Common systems AUX/CW/GRK/MCS/PWA/SES/ etc)		
Tag Range	**Area**	**Notes**
0001-0299	Legacy Various Areas- Raw Water Building	
0300-0399	Storage Building	
0400-0599	Filter Building	
0600-0799	Admin. Building	
0700-0899	In Developing Phase	
0900-0999	In Developing Phase	
1000-1099	In Developing Phase	
1100-1299	Filter Building - Legacy	
1300-1399	Chemical Mixing Building	
1400-1499	Chemical Sampling Building	
1500-1599	Filter Building - Legacy	
1600-1899	Raw Water Intake Building, Raw Water Building and Flume	
1900-2199	Storage Building - Legacy	
2200-2799	Filter Building - Legacy	
2800-2899	Chemical Mixing Building - Legacy	
2900-2999	Chemical Sampling Building - Legacy	
3000-3099	Polymer Storage & Feeding Building & RMF Facilities	
3100-3499	UV/RMF facility	
3500-3599	Gaseous Chemical Building	
3600-3999	Available	
4000-4099	Marin PAD Building	
4100-4499	Available	
4500-4599	Workshop Building	
4600-4999	Available	
5000-5099	Fluoride & Ammonia Building	
5100-5999	Available	
6000-9999	Portable Devices	

Appendix I
Section 13040 – Appendix B-Equipment (Asset) Tags List-Aluminum (Example)

EGUIPMENT (ASSET) TAG LIST - ALUMINUM TAGS

Tag Description (Entity Name)	Equipment Tag Number	Brief Description of Equipment	Quantity	Size	Material	Colour
Pump, Main Oil, Blower 4002, Secondary Treatment, Blower Room	TAB-STR-P-4002	Pump	1	75mm x 25mm (3” x 1”)	Aluminium	BLACK lettering teflon coated
Valve, Butterfly, Suction, Glycol Pump 3416, Heat Treatment Air Blower Room	THC-ACC-V-3415	Valve, Butterfly	1	75mm x 25mm (3” x 1”)	Aluminium	BLACK lettering teflon coated
Valve, Cone, Actuated, Discharge, Pump 0900, Treated Water Pumping Station	FCL-TRW-V-0903	Valve, Cone, Act.	1	75mm x 25mm (3” x 1”)	Aluminium	BLACK lettering teflon coated
		TOTAL:				

Example Tag from Toronto Water 13040 Equipment Tag Standard



Physical tag specifications:

Size:	75mm x 25mm (3” x 1”) (all equipment)
Thickness:	Aluminum: 0.8 mm (0.032“), Lamacoid: 1.5mm (0.060”), Stainless Steel (S.S): 0.8mm (0.032“) .
Material:	Teflon coated Aluminum unless approved differently by the TW
Coating:	3M Teflon UV and anti paint topcoat
Fastener hole size:	3mm (1/8”)
Fastening Method:	Specified rivets only unless approved differently by the TW 1.2mm (3/64") Stainless Steel wire cable with swaged coupling for devices to small to rivet.
Rivet Specifications:	3mm (1/8') SS round head or blind SS pop rivets 
Equipment Tag Number FONT:	Arial, 16pt
Barcode FONT:	Code 128 auto, X-Dimension: 0.33mm (0.013"), Ratio: 3:1, Height: 9.5mm (0.375")
Barcode size:	45mm x 9.5mm (1.75” x 0.375”)
Equipment description Font:	Arial, 10 pt
Toronto Water LOGO:	22mm x 4.5mm (0.875” x 0.175”)
Adhesives and Wire for affixing labels:	Not allowed unless approved by the TW, or design of the device would be compromised by drilling.

Appendix J
Section 13040 – Appendix C-Equipment (Asset) Tag List-Lamacoid (Example)

EQUIPMENT (ASSET) TAG LIST - LAMACOID TAGS (EXAMPLE)

Tag Description (Entity Name)	Tag Description Line 1	Tag Description Line 2	TYPE	Quantity	SIZE mm (inch)	Colour Text	Colour Background	Font Height (mm) Line 1	Font Height (mm) Line 2
Motor Control Centre, Lower Plant Blower Area	THC-ELS-MCC-0101	LOWER PLANT BLDG. A 600 V MCC	K	1	250 x 50 (10" x 2')	Black	White	15	9
Switchgear, 4160V, Effluent Pumping Station	THR-ELS-BUS-6101	EFFLUENT PS 4160 V SWITCHGEAR	K	1	250 x 50 (10" x 2')	Black	White	15	9
Motor Control Center, Filter Building, Electrical Switchgear Room	FCL-ELS-MCC-0501	FILTERS BUILDING 600 V MCC	K	1	250 x 50 (10" x 2')	Black	White	15	9
		TOTAL	K						
Switchgear, Overhead, Line 1323, Main South Substation	THR-ELS-SW-0001	MAIN 27.6 KV LB-HYDRO FEEDER 1	J	1	150 x 31 (6" x 1 ¼")	Black	White	6.5	6.5
Transformer, Power, Dry, Effluent Pumping Station (MCC-1700, 1702 & 1703)	THR-ELS-TR-0300	NORTH SUBSTATION TRANS. 27.6 KV/4160 V	J	1	150 x 31 (6" x 1 ¼")	Black	White	6.5	6.5
Switchgear, Main 4160V Feeder 1, Admin. Bldg.	THC-ELS-SWG-0101A	MAIN	J	1	150 x 31 (6" x 1 ¼")	Black	White	6.5	6.5
Switchgear, Main 4160V Feeder 2, Admin. Bldg.	THC-ELS-SWG-0202A	MAIN	J	1	150 x 31 (6" x 1 ¼")	Black	White	6.5	6.5
Switchgear, Tie 4160V, Feeder 1 & 2, Admin Bldg.	THC-ELS-SWG-0102	TIE: BUS-0101A & BUS-0202A	J	1	150 x 31 (6" x 1 ¼")	Black	White	6.5	6.5
		TOTAL	J						
Circuit Breaker, Main, 600 V, Plant Water MCC 3301	THR-ELS-CB-3301	MAIN	D	1	75 x 31 (3" x 1 ¼")	Black	White	6.5	5
Circuit Breaker, Main, 600 V, Plant Water MCC 3302	THR-ELS-CB-3302	MAIN	D	1	75 x 31 (3" x 1 ¼")	Black	White	6.5	5
Circuit Breaker, Tie, 600 V, Plant Water MCC-3301 & 3302	THR-ELS-TB-3300	TIE: MCC-03301 & MCC-03302	D	1	75 x 31 (3" x 1 ¼")	Black	White	6.5	5
		TOTAL	D						

Lamacoid Tag Specification:
Material to be engraved gravoploy laminate nameplates, 1.5mm thick with bevelled edges
Use text with the following characteristics:

- Lettering: Uppercase
- Font: Times New Roman
- Style: Regular
- Size: Maximum to fit label width, minimum 3mm
- Character Spac Normal
- Justification: Center lettering on each line

Scale text with to fit label where needed

Appendix K
Section 13040 – Appendix D-Supplemental Tag List-MCC Starter Disconnect-Lamocoid (Example)

LAMACOID SUPPLEMENTAL TAG LIST - MCC STARTER/DISCONNECT (EXAMPLE)

	MCC/Switchgear/PDP	
Tag Description (Entity Name)	Tag	Cell No.
Pump, Centrifugal, Treated Water, To StClair/Eglington, High Lift PS	FHA-ELS-BUS-5201	4B
Pump, Centrifugal, Backwash, Level S2 Backwash Area	FHO-ELS-BUS-0302	5B
Pump, Centrifugal, Water, Ellesmere Pumping Station	WTR-PEL-BUS-0001B	7B

Tag Description				SIZE	Colour		Font Hight (mm)	
Line 1	**Line 2**	**TYPE**	**Quantity**	**mm (inch)**	**Text**	**Background**	**Line 1**	**Line 2**
TREATED WATER PUMP	FHA-TRW-P-0300B	J	1	150 x 31 (6” x 1 ¼”)	Black	White	6.5	6.5
BACKWASH PUMP	FHO-BW-P-1501	J	1	150 x 31 (6” x 1 ¼”)	Black	White	6.5	6.5
BOOSTER PUMP	WTR-PEL-P-0300	J	1	150 x 31 (6” x 1 ¼”)	Black	White	6.5	6.5
	TOTAL	J						

Valve, Butterfly, Act., Air to Waste Water Tank 1, Air Blower System	FHO-ELS-MCC-0109	5C
Gate, Sluice, Bypass Channel, Raw Sewage, Headhouse	THC-ELS-MCC-1103E	4G
Fan, Exhaust, Diesel Room, Cumber PS	COL-PCU-MCC-0002	3B

PROCESS AIR VALVE	FHO-WWW-V-0904	D	1	75 x 31 (3” x 1 ¼”)	Black	White	6.5	5
BYPASS CHENNEL GATE	THC-PLT-G-5151	D	1	75 x 31 (3” x 1 ¼”)	Black	White	6.5	5
DIESEL ROOM EXAUST FAN	COL-PCU-FN-0001	D	1	75 x 31 (3” x 1 ¼”)	Black	White	6.5	5
	TOTAL	D						

Lamacoid Tag Specification:
Material to be engraved gravoploy laminate nameplates, 1.5 mm thick
Use text with the following characteristics:

Lettering:	Uppercase
Font:	Times New Roman
Style:	Regular
Size:	Maximum to fit label width, minimum 3mm
Character Spa	Normal
Justification:	Center lettering on each line

Scale text with to fit label where needed

Appendix L
Section 13040 – Appendix E-Supplemental Tag List-Source of Power-Lamacoid (Example)

LAMACOID SUPPLEMENTAL TAGS LIST - SOURCE OF POWER (EXAMPLE)

Tag Description (Entity Name)	Tag Description Line 1	Line 2	Line 3	TYPE	Quantity	SIZE mm (inch)	Colour Text	Colour Background	Font Height (mm) Line 1	Line 2	Line 3
Pump, Centrifugal, Treated Water, To St. Clair/Eglington, High Lift PS	FHA-TRW-P-0300B	ELECTRICAL SUPPLY FROM	FHA-ELS-BUS-5201	F		75 x 31 (3" x 1 ¼")	Black	White	5	5	5
Pump, Centrifugal, Backwash, Level S2 Backwash Area	FHO-BW-P-1501	ELECTRICAL SUPPLY FROM	FHO-ELS-BUS-0302	F		75 x 31 (3" x 1 ¼")	Black	White	5	5	5
Pump, Centrifugal, Water, Ellesmere Pumping Station	WTR-PEL-P-0300	ELECTRICAL SUPPLY FROM	WTR-PEL-BUS-0001B	F		75 x 31 (3" x 1 ¼")	Black	White	5	5	5
Valve, Butterfly, Act., Air to Waste Water Tank 1, Air Blower System	FHO-WWW-V-0904	ELECTRICAL SUPPLY FROM	FHO-ELS-MCC-0109	F		75 x 31 (3" x 1 ¼")	Black	White	5	5	5
Gate, Sluice, Bypass Channel, Raw Sewage, Headhouse	THC-PLT-G-5151	ELECTRICAL SUPPLY FROM	THC-ELS-MCC-1103E	F		75 x 31 (3" x 1 ¼")	Black	White	5	5	5
Fan, Exhaust, Diesel Room, Cumber PS	COL-PCU-FN-0001	ELECTRICAL SUPPLY FROM	COL-PCU-MCC-0002	F		75 x 31 (3" x 1 ¼")	Black	White	5	5	5
			TOTAL	F							

Lamacoid Tag Specification:
Material to be engraved gravoploy laminate nameplates, 1.5 mm thick with bevelled edges
Use text with the following characteristics:

- Letterin Uppercase
- Font: Times New Roman
- Style: Regular
- Size: 5 mm
- Charact Normal
- Justifica Center lettering on each line

Scale text with to fit label where needed

Appendix M
Section 13040 – Appendix F-Supplemental Tag List-Control Station-Lamacoid (Example)

Tag Description (Entity Name)	Asset (Aluminum) Tag Installed on:	Suplemental Tag Installed on:
Pump 1,Sump,Headhouse	Pump	Control Station
Valve, Sluice Gate, Act., Suction, Pump 2208, Raw Sewage Pumping and Distribution Building M	Valve	Control Station
Service Air Compressor, Instrument Air, Service Building	Air Compressor	Control Station
Motor,AC,Blower 6080,Old Plant Blower Building	(>100HP)	Motor Base
Transmitter, Flow, Outlet, Mixed Liquor, Tank 0100, Secondary Treatment, Aeration - Tanks 0100 to 0300	Transmitter	Remote Display
Transmitter, Level Indicating, Raw Water Pumps Suction Well, Screening	Transmitter	Sensor (Remote)
Transmitter, H2S, Analyzer 9251, Walkway (North End) to Incinerator, Plant Services	Analyzer	Sensor (Remote)

LAMACOID SUPPLEMENTAL TAG LIST - CONTROL STATION (EXAMPLE)

Tag Description Line 1	TYPE	Quantity	SIZE mm (inch)	Colour Text	Colour Bacground	Font Hight (mm) Line 1
THC-PLT-P-5110	C	1	75 x 25 (3" x 1")	Black	White	5
TAB-RSP-G-2208A	C	1	75 x 25 (3" x 1")	Black	White	5
FHA-AUX-C-0201	C	1	75 x 25 (3" x 1")	Black	White	5
THC-AER-M-6080	C	1	75 x 25 (3" x 1")	Black	White	5
TAB-STR-FIT-0101	C	1	75 x 25 (3" x 1")	Black	White	5
FIS-RW-LIT-0001	C	1	75 x 25 (3" x 1")	Black	White	5
TAB-SLO-AIT-9251E	C	1	75 x 25 (3" x 1")	Black	White	5
TOTAL	C					

Lamacoid Tag Specification:
Material to be engraved gravoploy laminate namaplates, 1.5 mm thick with bevelled edges
Use text with the following characteristics:

Lettering:	Uppercase
Font:	Times New Roman
Style:	Regular
Size:	5 mm
Character Spacing:	Normal
Justification:	Center lettering on each line

Appendix N
Filtration and Backwash - FHA- PCN

R.C. HARRIS WATER FILTRATION PLANT
FILTRATION & BACKWASH - Process Control Narrative

Version	Date	Notes
1.0	August 2001	Draft 1 – Issued for Review.
2.0	October 2001	Draft 2 – Issued for Review.
3.0	November 2001	Process Narrative Issue For Tender
4.0	September 2004	Process Narrative Issued for As Built
5.0	January 2008	Added UPS Monitoring
6.0	March 2012	Updated for Scope of Legacy Alarms Improvement Project: • Updated I/O Descriptions • Added Description of Chlorine Analyzers Control/Reference Selection • Updated Analog Alarms Set Points Tables • Updated Alarm Lists in the Appendix
7.0	May 2015	Modified Filters for SLC Replacement Logic
8.0	February 2017	Updated Chlorine and Liquid Chemical Sections to Reflect Removal of SLC's
9.0	March 2017	Corrosion Control Section Added
10.0	July 2017	Updated Formatting to Create Master Package with RMF PCN
11.0	March 2025	Added section 9.2 C2.8 Power Supply Failure

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List of Acronyms

ACP	Area Control Panel
AI	Analog Input
AO	Analog Output
CA	Computer Auto
CBP	Central Back-Up Panel
CM	Computer Manual
CT	Concentration & Time
DI	Digital Input
DO	Digital Output
EBCT	Empty Bed Contact Time
FHA	R.C. Harris Filtration Plant
GAC	Granular Activated Carbon
HMI	Human Machine Interface
I/O	Input/Output
LA	Local Auto
LCP	Local Control Panel
LM	Local Manual
MCC	Motor Control Center
NTU	Nephelometric Turbidity Units

PCN	Process Control Narrative
PCS	Process Control Systems
PID	Proportional, Integrative, Derivative
P&ID	Process & Instrumentation Diagram
PLC	Programmable Logic Controller
PV	Process Variable
PVC	Polyvinyl Chloride
RMF	Residue Management Facility
RPM	Revolutions Per Minute
RPU	Remote Processing Unit
RW	Raw Water
SBS	Sodium Bisulphite
SCADA	Supervisory Control and Data Acquisition
SLC	Single Loop Controller
SP	Set Point
SV	Set-Point Variable
TOO	Transmission Operations Optimizer
VFD	Variable Frequency Drive

9. FILTRATION & BACKWASH

9.1 PROCESS DESCRIPTION

A. Process Overview

- **Reference P&ID Drawing(s)2F-P&ID-I-1201**
- 2F-P&ID-I-1301
- 2F-P&ID-I-1302
- 2F-P&ID-I-1303
- 2F-P&ID-I-1304
- 2F-P&ID-I-1305
- 2F-P&ID-I-1306
- 2F-P&ID-I-1307
- 2F-P&ID-I-1308
- 2F-P&ID-I-1309
- 2F-P&ID-I-1310
- 2F-P&ID-I-1311
- 2F-P&ID-I-1312
- 2F-P&ID-I-1313
- 2F-P&ID-I-1314
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- 2F-P&ID-I-1317
- 2F-P&ID-I-1318
- 2F-P&ID-I-1319
- 2F-P&ID-I-1320
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- 2F-P&ID-I-1322
- 2F-P&ID-I-1323
- 2F-P&ID-I-1324
- 2F-P&ID-I-1325
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- 2F-P&ID-I-1327
- 2F-P&ID-I-1328
- 2F-P&ID-I-1329
- 2F-P&ID-I-1330
- 2F-P&ID-I-1331
- 2F-P&ID-I-1332
- 2F-P&ID-I-1333
- 2F-P&ID-I-1334
- 2F-P&ID-I-1335
- 2F-P&ID-I-1336
- 2F-P&ID-I-1337
- 2F-P&ID-I-1338
- 2F-P&ID-I-1339
- 2F-P&ID-I-1340
- 2F-P&ID-I-1401
- 2F-P&ID-I-1402
- 2F-P&ID-I-8501
- 2F-P&ID-I-8502

The filtration process consists of the filter system and the backwash system. The filter system is comprised of 40 dual media (GAC/sand) filters fed from the East and West common settled water conduit. Each filter has the following equipment:

- Filter rate control valve
- Venturi flow meter on effluent line
- Turbidimeter on effluent line
- Filter inlet gate
- Filter drain gate
- Filter head loss monitor
- Filter backwash valve
- Surface sweep valve
- Level switches

The backwash system includes the following equipment:

- 3 Backwash pumps
- 1 Venturi flow meter

- 2 Backwash water holding tanks
- 2 Backwash header valves
- 2 Backwash flow meters

Filtration occurs directly after the sedimentation process and prior to discharge to the plant reservoir via the filtered water conduits.

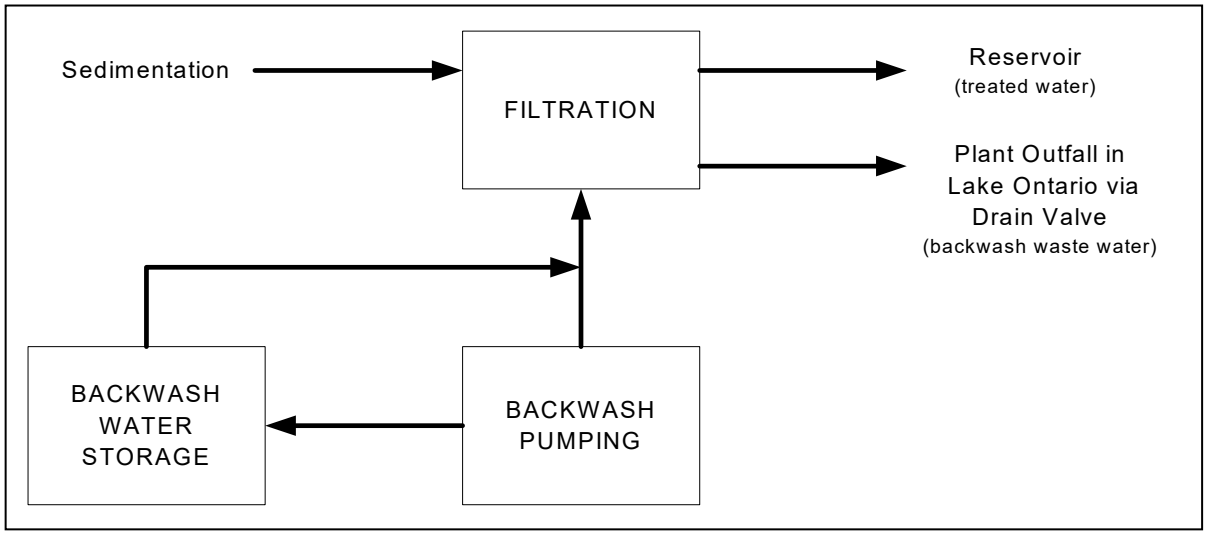

Figure 1: Filtration & Backwash Process Schematic

B. Objectives

The purpose of the filtration process at the R.C. Harris Water Filtration Plant is to remove particles from pre-treated water that have not been removed by the sedimentation process.

The quality objectives of the filter system are to consistently achieve the City of Toronto's filter effluent turbidity targets and to maximize particulate removal through this process. Filtration acts as the main removal barrier to water borne pathogens in the overall treatment process.

The objectives of the backwash system are to efficiently and effectively remove particulate matter that has been trapped in the filter during filtration, while minimizing media, sand and GAC loss and minimizing process waste production.

C. Process Control Strategy

At any given time, individual filters are:

- In-service
- Out-of-service – available for production
- Out-of-service – not available for production
- Backwashing (including filters queued for backwash)

The process control strategy for filtering is designed to evenly distribute the required plant filter flow among all in-service filters by maintaining a constant settled water conduit level or a constant master filtration rate.

At any time, a filter will be taken out of service and placed in the backwash queue if any of the following parameters are exceeded:

- Filter runtime of 96 hours
- Terminal head loss of 1.50 m

- Filter effluent turbidity > operator adjustable action level (0.15 NTU)
- Idle time exceeds 24 hours.

D. Influent Sources

The Filtration & Backwash System is fed by three (3) influent streams:

- Settled water from the Settled Water Conduits
- Potable water for backwashing
- Potable water for surface sweeps

E. Effluent Destinations

The Filtration & Backwash System feeds two (2) effluent destination:

- Filtered water to the plant Reservoir via the Filtered Water Conduits
- Backwash water to the Decant Tank(s) via the Diversion Chamber in the RMF

F. Process Equipment & Control Devices

The following table outlines the process equipment associated with the Filtration & Backwash System. Note that tags are only given for Filter #1 for brevity. All filters contain similar equipment.

Table 1: Filtration & Backwash Process Equipment

Tag No	Equipment Description	Device Operation	Control Objectives
FHA-FLT-F-0101	Filter #1	Filters Water	None
FHA-FLT-V-0101	Filter Rate Control Valve	Modulates to control effluent flow from the filter.	To evenly distribute the plant flow to each in-service filter based on the Master Filter Rate, which is the raw water divided by the number of filters in service. Hardware Interlocked with Surface Sweep Valves and Filter Backwash Valves to close when the later are open, and on UPS fault.
FHA-FLT-G-0101	Filter Inlet Gate	Opens/closes in response to control signals to control water flow into Filter	Act as a part of service mode control.
FHA-FLT-G-0102	Filter Drain Gate	Opens/closes in response to control signals to allow backwash wastewater to flow from the filter.	Act as a part of service mode control.
FHA-FLT-V-0102	Filter Backwash Valve	Opens/closes in response to control signals to control backwash flowrate.	To maintain the desired backwash flow rate. Hardwired interlock with Filter Rate Control Valves to close when the latter is open.
FHA-FLT-V-0103	Surface Sweep Valve	Opens/closes in response to control signals to control flow to surface sweeps.	On/Off control of the surface wash function. Hardware Interlocked with Filter Rate Control Valves to close when the latter is open.
FHA-BW-T-0101	Wash Water Tank #1	Stores water for backwashing	None
FHA-BW-T-0201	Wash Water Tank #2	Stores water for backwashing	None

Tag No	Equipment Description	Device Operation	Control Objectives
FHA-BW-V-0105	West Washwater header Valve	Opens/closes in response to control signals to control flow of washwater	Maintain desired flow during a backwash cycle
FHA-BW-V-0205	East Washwater header Valve		
FHA-BW-P-0501 FHA-BW-P-0601 FHA-BW-P-0701	Backwash Pump(s)	Pumps water to Wash Water Tanks	Maintain water level in Wash Water Tanks sufficient for backwash requirements.
FHA-BW-P-0503 FHA-BW-P-0603 FHA-BW-P-0703	Backwash Pump Discharge Valve	Opens/closes in response to control signals to isolate pump	Interlocked with pump control
FHA-BW-V-0001 FHA-BW-V-0002	Backwash Pump Inlet Isolation Valve	Opens/closes manually to isolate common pump header	Manually operated
FHA-BW-V-0501 FHA-BW-V-0601 FHA-BW-V-0701	Backwash Pump Suction valve	Opens/closes manually to isolate inlet to respective Backwash Pump	Manually operated
FHA-BW-V-0502 FHA-BW-V-0602 FHA-BW-V-0702	Backwash Pump Check Valve	Prevents backflow through respective Backwash pump	None

The following table outlines the control instruments associated with the Filtration & Backwash System:

Table 2: Filtration & Backwash Control Instruments

Tag No	Instrument Description	Device Operation	Control Objectives
FHA-FLT-LIT-0101	West Settled Water Conduit Level Transmitter	Continuously monitors water level in the West Settled Water Conduit	To match total filtration rate to low lift production, or total plant flow before backwashing. Compared to the West and East Settled Water Conduit set-point via PID controller to generate Master Filter Rate.
FHA-FLT-LIT-0201	East Settled Water Conduit Level Transmitter	Continuously monitors water level in the East Settled Water Conduit	
FHA-FLT-LSHL-0101	Filter Water Level Switch	Continuously monitor water level in the filter	Interlocked with filter rate control valve to take filter out-of-service if contact made
FHA-FLT-AIT-0101	Filter Effluent Turbidimeter	Continuously monitors effluent turbidity of a given filter	Signal a backwash when set point is exceeded
FHA-FLT-FIT-0101	Filter Effluent Venturi Flowmeter	Continuously monitors effluent flow from a given filter	To evenly distribute the plant flow to each in-service filter based on the Master Filter Rate divided by the number of filters in service. Compared to individual filter flow set-point via PID loop to modulate filter effluent control valve.
FHA-FLT-PDIT-0101	Filter Head Loss Transmitter	Continuously monitors head loss through a given filter	Signal a backwash when set point is exceeded
FHA-BW-FIT-0001	Wash Water Venturi Flowmeter	Monitors flow from Backwash Pumps	Trending/tracking of flow
FHA-BW-FIT-0101	West backwash Flowmeter	Monitors flow of wash water to west filters	Maintain desired flow during backwash cycles

Tag No	Instrument Description	Device Operation	Control Objectives
FHA-FLT-LIT-0101	West Settled Water Conduit Level Transmitter	Continuously monitors water level in the West Settled Water Conduit	To match total filtration rate to low lift production, or total plant flow before backwashing. Compared to the West and East Settled Water Conduit set-point via PID controller to generate Master Filter Rate.
FHA-FLT-LIT-0201	East Settled Water Conduit Level Transmitter	Continuously monitors water level in the East Settled Water Conduit	
FHA-BW-FIT-0201	East Backwash Flowmeter	Monitors flow of wash water to east filters	

9.2 CONTROL SYSTEM DESCRIPTION

A. Control Modes & Hierarchy

A.1 Hierarchal Overview

For the Filtration & Backwashing Process, 4 levels of control exist. However, depending upon the extent of complexity, some equipment may have fewer levels of control.

- Level 1: Field Device Control
- Level 2: Local / Area Control
- Level 3: RPU Control
- Level 4: SCADA Control

Level 1: A selection switch Local/Remote (L/R) is provided at the field device. By selecting L at the device, operation is disabled from any higher level. By selecting R, the device control is passed on to the next higher level.

Level 2: A selection switch Computer/Local (C/L) is provided at this level on the Local/Area Control Panel. By selecting L at this level the device is operable from the panel and operation from any higher level is disabled. By selecting C, the control is passed on to the next higher level and commands from SCADA are in effect.

Level 3: This level consists of the RPU for the process and all automated control and monitoring functionality is at this level.

Level 4: This level consists of the Supervisory Control and Data Acquisition (SCADA) work stations. These work stations are networked and placed at various locations throughout the facility. The SCADA system provides the following functionality and includes the database necessary for its support:

- Level 2 Computer / Local status
- Manual/Auto mode command
- Manual/Auto mode status

There are a total of 13 PLC's associated with the filtration process. There is a PLC dedicated to every set of four filters (1, 2, 3 & 4 / 5, 6, 7 & 8, etc.) that controls the automatic backwashing aspects of the filtration process. There is a totalizer PLC associated with totalizing values to be used for process on the other PLCs. There is a CBP PLC dedicated to calculating the master flow set point based on the current settled water conduit level. The filter 17-20 PLC is designated as the master PLC and is backed up by the filter 21-24 PLC in case of failure. The master PLC handles backwash queuing and automatic filter start-up/shut-down operation. There is one master CBP PLC working with two Indicator/Controllers to control the master filter rates based on the raw water flow and the settled water conduit levels. The master CBP PLC will automatically calculate the flow rates and send that information to the Master Filter PLCs via the SCADA network. In the case that the Master CBP PLC is not operational, the

Indicator/Controllers can be used to manually enter a flow signal to be sent out to all of the east or west filter PLCs. This flow would require manual calculations to be done by operations. Additionally the backwash pumping system has a PLC of its own. The system can be operated manually or automatically in SCADA mode.

The backwash pumps and associated discharge valves both have Local/Remote switches. In Local, this equipment can be operated locally and manually. In Remote, control of this equipment is passed up to a higher level of control.

A.2 Process Control Modes

The Control Modes for the Filtration & Backwash Process are as follows:

Local Manual (LM): This mode is available at Level 1 and 2.

Level 1:
- H/O/A switch on the LCP/actuator for a given valve is set to H
- L/R switch on the ACP for a given backwash pump is set to L
- L/R switch on the LCP/actuator for a given backwash discharge valve is set to L

It is recommended that operation in FIELD/MANUAL only be used in emergency situations as its inherent limitations in overall monitoring makes operating awkward and possibly unsafe. A maintenance test can also be performed with a push-button from the switchgear when withdrawn in the test position. Control circuitry is applied and main power disconnected. All interlocks are bypassed.

The Suction Valve must be opened and Discharge Valve must be closed for a Backwash Pump start command. Automatic start and stop of the backwash pumps can only be achieved with the hardwired emergency backup washwater tank level transmitters.

Filter valves are opened/closed manually by the operator at the device. Backwash pumps are started/stopped locally. There is an interlock on the backwash pump start command that opens the respective discharge valve. However, the discharge valve can be manually adjusted locally if necessary.

Level 2:
- H/O/A switch on the LCPs/actuators for all filter valves are set to A
- ACP/PLC switch on the PLC panel is set to ACP

Filter valves are opened/closed manually at the ACP. The filter rate valve is controlled via the Indicator/Controller by inputting the desired valve position. Backwash sequencing cannot be achieved automatically in this mode.

To operate the backwash pumps in this mode:

- H/O/A switches on the LCP for all the backwash pumps are set to A
- L/R switch on the ACP is set to L

Automatic start and stop of the backwash pumps can only be achieved with the hardwired emergency backup washwater tank level transmitters.

Computer Manual (CM): This mode is available at Level 4. SCADA manual control is typically available at the area operator workstation and central operator station.

- H/O/A switches on the LCPs/actuators for all filter valves is set to A
- ACP/PLC switch on the PLC panel is set to PLC
- SCADA/MANUAL is selected at an HMI

The filtration control mode for each of the filters to be operated in this mode must be selected as SCADA/MANUAL at the SCADA view node. Filter valves are opened/closed manually at the SCADA HMI. The filter rate valve is

controlled via the SCADA HMI by inputting the desired valve position (in per cent). Backwash sequencing cannot be achieved automatically in this mode.

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP can be either L or A

Automatic start and stop of the backwash pumps can only be achieved with the CBP L/A Switch in Auto or by the hardwired emergency washwater tank level transmitters.

Computer Auto (CA): This mode is available at Level 4. The devices are set to automatic mode at area operator workstation or the central operator station.

SCADA/AUTO:

- H/O/A switch on the LCPs/actuators for all filter valves is set to A
- ACP/PLC switch on the PLC panel is set to PLC
- L/R switch on the ACP for a given backwash discharge valve is set to R
- Filter has flow >25 L/s and SCADA HMI indicates "Filtering"
- SCADA/AUTO is selected at an HMI

The filtration control mode for each of the filters to be operated in this mode must be selected as SCADA/AUTO at the SCADA HMI. In other words, it is possible to operate some filters in another mode, while operating the majority in SCADA/AUTO. Filter valves are opened/closed automatically by the PLC. The filter rate valve is controlled automatically based on an operator entered flow set point on the SCADA HMI. A flow set point is entered in the rate control valve popup to automatically control the rate valve position and maintain the desired flow.

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP is set to A

SCADA/MASTER:

- H/O/A switch on the LCPs/actuators for all filter valves is set to A
- ACP/PLC switch on the PLC panel is set to PLC
- L/R switch for a given backwash pump is set to R
- L/R switch on the LCP for a given backwash discharge valve is set to R
- SCADA/MASTER is selected at an HMI

In SCADA/MASTER mode, the “START” button on the Filter Control popup may be pressed if the Filter is “IDLE” or “OUT OF SERVICE”. The Filter will be considered “FILTERING” once a filter flow rate of 25 L/s or greater has been achieved. The filtration control mode for each of the filters to be operated in this mode must be selected as SCADA/MASTER at the SCADA view node. In other words, it is possible to operate some filters in another mode, while operating the majority in SCADA/MASTER. Filter valves are opened/closed automatically by the PLC. The filter rate valve is controlled automatically based on the Master Flow Rate set point received from the Master PLC.

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP is set to A

All of the backwash pumps to be operated in this mode must be set to Computer-Auto to automatically start and stop based one operator wash water tank set points. The pumps will start in a staggered fashion (20 seconds apart).

CBP/LOCAL:

To operate the backwash pumps in this mode:

- L/R switch on the ACP is set to R
- L/A switch on the CBP is set to L

Pumps in this mode are started with a spring return switch.

The following table identifies the control modes and their hierarchy level for the equipment in the Filtration & Backwash Process:

Table 3: Filtration & Backwash Control Modes & Hierarchy

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Master Filter Rate Control Valve(s) #1 - 4 FHA-FLT-V-0101 FHA-FLT-V-0201 FHA-FLT-V-0301 FHA-FLT-V-0401	L/R at Valve	None	RPU-1721	Status monitoring and control
Master Filter Rate Control Valve(s) #5 - 8 FHA-FLT-V-0501 FHA-FLT-V-0601 FHA-FLT-V-0701 FHA-FLT-V-0801	L/R at Valve	None	RPU-1722	Status monitoring and control
Master Filter Rate Control Valve(s) #9 - 12 FHA-FLT-V-0901 FHA-FLT-V-1001 FHA-FLT-V-1101 FHA-FLT-V-1201	L/R at Valve	None	RPU-1723	Status monitoring and control
Master Filter Rate Control Valve(s) #13 - 16 FHA-FLT-V-1301 FHA-FLT-V-1401 FHA-FLT-V-1501 FHA-FLT-V-1601	L/R at Valve	None	RPU-1724	Status monitoring and control
Master Filter Rate Control Valve(s) #17 - 20 FHA-FLT-V-1701 FHA-FLT-V-1801 FHA-FLT-V-1901 FHA-FLT-V-2001	L/R at Valve	None	RPU-1822	Status monitoring and control
Master Filter Rate Control Valve(s) #21 - 24 FHA-FLT-V-2101 FHA-FLT-V-2201 FHA-FLT-V-2301 FHA-FLT-V-2401	L/R at Valve	None	RPU-1823	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Master Filter Rate Control Valve(s) #25 - 28 FHA-FLT-V-2501 FHA-FLT-V-2601 FHA-FLT-V-2701 FHA-FLT-V-2801	L/R at Valve	None	RPU-1621	Status monitoring and control
Master Filter Rate Control Valve(s) #29 - 32 FHA-FLT-V-2901 FHA-FLT-V-3001 FHA-FLT-V-3101 FHA-FLT-V-3201	L/R at Valve	None	RPU-1622	Status monitoring and control
Master Filter Rate Control Valve(s) #33 - 36 FHA-FLT-V-3301 FHA-FLT-V-3401 FHA-FLT-V-3501 FHA-FLT-V-3601	L/R at Valve	None	RPU-1623	Status monitoring and control
Master Filter Rate Control Valve(s) #37 - 40 FHA-FLT-V-3701 FHA-FLT-V-3801 FHA-FLT-V-3901 FHA-FLT-V-4001	L/R at Valve	None	RPU-1624	Status monitoring and control
Filter Inlet Gate(s) #1 - 4 FHA-FLT-G-0101 FHA-FLT-G-0201 FHA-FLT-G-0301 FHA-FLT-G-0401	L/R at Gate	Respective Filter Console	RPU-1721	Status monitoring and control
Filter Inlet Gate(s) #5 - 8 FHA-FLT-G-0501 FHA-FLT-G-0601 FHA-FLT-G-0701 FHA-FLT-G-0801	L/R at Gate	Respective Filter Console	RPU-1722	Status monitoring and control
Filter Inlet Gate(s) #9 - 12 FHA-FLT-G-0901 FHA-FLT-G-1001 FHA-FLT-G-1101 FHA-FLT-G-1201	L/R at Gate	Respective Filter Console	RPU-1723	Status monitoring and control
Filter Inlet Gate(s) #13 - 16 FHA-FLT-G-1301 FHA-FLT-G-1401 FHA-FLT-G-1501 FHA-FLT-G-1601	L/R at Gate	Respective Filter Console	RPU-1724	Status monitoring and control
Filter Inlet Gate(s) #17 - 20 FHA-FLT-G-1701 FHA-FLT-G-1801 FHA-FLT-G-1901 FHA-FLT-G-2001	L/R at Gate	Respective Filter Console	RPU-1822	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Filter Inlet Gate(s) #21 - 24 FHA-FLT-G-2101 FHA-FLT-G-2201 FHA-FLT-G-2301 FHA-FLT-G-2401	L/R at Gate	Respective Filter Console	RPU-1823	Status monitoring and control
Filter Inlet Gate(s) #25 - 28 FHA-FLT-G-2501 FHA-FLT-G-2601 FHA-FLT-G-2701 FHA-FLT-G-2801	L/R at Gate	Respective Filter Console	RPU-1621	Status monitoring and control
Filter Inlet Gate(s) #29 - 32 FHA-FLT-G-2901 FHA-FLT-G-3001 FHA-FLT-G-3101 FHA-FLT-G-3201	L/R at Gate	Respective Filter Console	RPU-1622	Status monitoring and control
Filter Inlet Gate(s) #33 - 36 FHA-FLT-G-3301 FHA-FLT-G-3401 FHA-FLT-G-3501 FHA-FLT-G-3601	L/R at Gate	Respective Filter Console	RPU-1623	Status monitoring and control
Filter Inlet Gate(s) #37 - 40 FHA-FLT-G-3701 FHA-FLT-G-3801 FHA-FLT-G-3901 FHA-FLT-G-4001	L/R at Gate	Respective Filter Console	RPU-1624	Status monitoring and control
Filter Drain Gate(s) #1 - 4 FHA-FLT-G-0102 FHA-FLT-G-0202 FHA-FLT-G-0302 FHA-FLT-G-0402	L/R at Gate	Respective Filter Console	RPU-1721	Status monitoring and control
Filter Drain Gate(s) #5 - 8 FHA-FLT-G-0502 FHA-FLT-G-0602 FHA-FLT-G-0702 FHA-FLT-G-0802	L/R at Gate	Respective Filter Console	RPU-1722	Status monitoring and control
Filter Drain Gate(s) #9 - 12 FHA-FLT-G-0902 FHA-FLT-G-1002 FHA-FLT-G-1102 FHA-FLT-G-1202	L/R at Gate	Respective Filter Console	RPU-1723	Status monitoring and control
Filter Drain Gate(s) #13 - 16 FHA-FLT-G-1302 FHA-FLT-G-1402 FHA-FLT-G-1502 FHA-FLT-G-1602	L/R at Gate	Respective Filter Console	RPU-1724	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Filter Drain Gate(s) #17 - 20 FHA-FLT-G-1702 FHA-FLT-G-1802 FHA-FLT-G-1902 FHA-FLT-G-2002	L/R at Gate	Respective Filter Console	RPU-1822	Status monitoring and control
Filter Drain Gate(s) #21 - 24 FHA-FLT-G-2102 FHA-FLT-G-2202 FHA-FLT-G-2302 FHA-FLT-G-2402	L/R at Gate	Respective Filter Console	RPU-1823	Status monitoring and control
Filter Drain Gate(s) #25 - 28 FHA-FLT-G-2502 FHA-FLT-G-2602 FHA-FLT-G-2702 FHA-FLT-G-2802	L/R at Gate	Respective Filter Console	RPU-1621	Status monitoring and control
Filter Drain Gate(s) #29 - 32 FHA-FLT-G-2902 FHA-FLT-G-3002 FHA-FLT-G-3102 FHA-FLT-G-3202	L/R at Gate	Respective Filter Console	RPU-1622	Status monitoring and control
Filter Drain Gate(s) #33 - 36 FHA-FLT-G-3302 FHA-FLT-G-3402 FHA-FLT-G-3502 FHA-FLT-G-3602	L/R at Gate	Respective Filter Console	RPU-1623	Status monitoring and control
Filter Drain Gate(s) #37 - 40 FHA-FLT-G-3702 FHA-FLT-G-3802 FHA-FLT-G-3902 FHA-FLT-G-4002	L/R at Gate	Respective Filter Console	RPU-1624	Status monitoring and control
Backwash Valve(s) #1 - 4 FHA-FLT-V-0102 FHA-FLT-V-0202 FHA-FLT-V-0302 FHA-FLT-V-0402	L/R at Valve	Respective Filter Console	RPU-1721	Status monitoring and control
Backwash Valve(s) #5 - 8 FHA-FLT-V-0502 FHA-FLT-V-0602 FHA-FLT-V-0702 FHA-FLT-V-0802	L/R at Valve	Respective Filter Console	RPU-1722	Status monitoring and control
Backwash Valve(s) #9 - 12 FHA-FLT-V-0902 FHA-FLT-V-1002 FHA-FLT-V-1102 FHA-FLT-V-1202	L/R at Valve	Respective Filter Console	RPU-1723	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Backwash Valve(s) #13 - 16 FHA-FLT-V-1302 FHA-FLT-V-1402 FHA-FLT-V-1502 FHA-FLT-V-1602	L/R at Valve	Respective Filter Console	RPU-1724	Status monitoring and control
Backwash Valve(s) #17 - 20 FHA-FLT-V-1702 FHA-FLT-V-1802 FHA-FLT-V-1902 FHA-FLT-V-2002	L/R at Valve	Respective Filter Console	RPU-1822	Status monitoring and control
Backwash Valve(s) #21 - 24 FHA-FLT-V-2102 FHA-FLT-V-2202 FHA-FLT-V-2302 FHA-FLT-V-2402	L/R at Valve	Respective Filter Console	RPU-1823	Status monitoring and control
Backwash Valve(s) #25 - 28 FHA-FLT-V-2502 FHA-FLT-V-2602 FHA-FLT-V-2702 FHA-FLT-V-2802	L/R at Valve	Respective Filter Console	RPU-1621	Status monitoring and control
Backwash Valve(s) #29 - 32 FHA-FLT-V-2902 FHA-FLT-V-3002 FHA-FLT-V-3102 FHA-FLT-V-3202	L/R at Valve	Respective Filter Console	RPU-1622	Status monitoring and control
Backwash Valve(s) #33 - 36 FHA-FLT-V-3302 FHA-FLT-V-3402 FHA-FLT-V-3502 FHA-FLT-V-3602	L/R at Valve	Respective Filter Console	RPU-1623	Status monitoring and control
Backwash Valve(s) #37 - 40 FHA-FLT-V-3702 FHA-FLT-V-3802 FHA-FLT-V-3902 FHA-FLT-V-4002	L/R at Valve	Respective Filter Console	RPU-1624	Status monitoring and control
Surface Sweep Valve(s) #1 - 4 FHA-FLT-V-0103 FHA-FLT-V-0203 FHA-FLT-V-0303 FHA-FLT-V-0403	O/C	Respective Filter Console	RPU-1721	Status monitoring and control
Surface Sweep Valve(s) #5 - 8 FHA-FLT-V-0503 FHA-FLT-V-0603 FHA-FLT-V-0703 FHA-FLT-V-0803	O/C	Respective Filter Console	RPU-1722	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Surface Sweep Valve(s) #9 - 12 FHA-FLT-V-0903 FHA-FLT-V-1003 FHA-FLT-V-1103 FHA-FLT-V-1203	O/C	Respective Filter Console	RPU-1723	Status monitoring and control
Surface Sweep Valve(s) #13 - 16 FHA-FLT-V-1303 FHA-FLT-V-1403 FHA-FLT-V-1503 FHA-FLT-V-1603	O/C	Respective Filter Console	RPU-1724	Status monitoring and control
Surface Sweep Valve(s) #17 - 20 FHA-FLT-V-1703 FHA-FLT-V-1803 FHA-FLT-V-1903 FHA-FLT-V-2003	O/C	Respective Filter Console	RPU-1822	Status monitoring and control
Surface Sweep Valve(s) #21 - 24 FHA-FLT-V-2103 FHA-FLT-V-2203 FHA-FLT-V-2303 FHA-FLT-V-2403	O/C	Respective Filter Console	RPU-1823	Status monitoring and control
Surface Sweep Valve(s) #25 - 28 FHA-FLT-V-2503 FHA-FLT-V-2603 FHA-FLT-V-2703 FHA-FLT-V-2803	O/C	Respective Filter Console	RPU-1621	Status monitoring and control
Surface Sweep Valve(s) #29 - 32 FHA-FLT-V-2903 FHA-FLT-V-3003 FHA-FLT-V-3103 FHA-FLT-V-3203	O/C	Respective Filter Console	RPU-1622	Status monitoring and control
Surface Sweep Valve(s) #33 - 36 FHA-FLT-V-3303 FHA-FLT-V-3403 FHA-FLT-V-3503 FHA-FLT-V-3603	O/C	Respective Filter Console	RPU-1623	Status monitoring and control
Surface Sweep Valve(s) #37 - 40 FHA-FLT-V-3703 FHA-FLT-V-3803 FHA-FLT-V-3903 FHA-FLT-V-4003	O/C	Respective Filter Console	RPU-1624	Status monitoring and control
Washwater Header Valve(s) FHA-BW-V-0105 FHA-BW-V-0205	L/R at Valve	None	RPU-1223	Status monitoring and control
Backwash Pump(s) FHA-BW-P-0501 FHA-BW-P-0601 FHA-BW-P-0701	None	L/M/R at control panel in MCC	RPU-1223	Status monitoring and control

Equipment Description / Tag No	Level 1 (LM)	Level 2 (LM)	RPU Level 3	SCADA Level 4 (CM/CA)
Backwash Pump Discharge Valve(s) FHA-BW-V-0503 FHA-BW-V-0603 FHA-BW-V-0703	L/R at Valve	None	RPU-1223	Status monitoring and control
Backwash Pump Suction Valve(s) FHA-BW-V-0501 FHA-BW-V-0601 FHA-BW-V-070	O/C	None	RPU-1223	Status monitoring
Backwash Pump Inlet Isolation valve(s) FHA-BW-V-0001 FHA-BW-V-0002	O/C	None	RPU-1223	Status monitoring

B. RPU Input / Output Signal List

Table 4: Filtration & Backwash RPU I/O List

I/O Tag No	Description	Type	RPU
FHA-FLT-ZIT-0101-ZI	FILTER #1 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0101-AI	FILTER #1 TURBIDITY	AI	1721
FHA-FLT-ZIT-0201-ZI	FILTER #2 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0201-AI	FILTER #2 TURBIDITY	AI	1721
FHA-FLT-ZIT-0301-ZI	FILTER #3 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0301-AI	FILTER #3 TURBIDITY	AI	1721
FHA-FLT-ZIT-0401-ZI	FILTER #4 RATE CONT VLV POSITION	AI	1721
FHA-FLT-AIT-0401-AI	FILTER #4 TURBIDITY	AI	1721
FHA-SED-AIT-0101-AI	SEW TRB ANALYZER - WEST	AI	1721
FHA-DCL-AIT-0002B-AI	POST-SO2 CLR RESID#2B	AI	1721
FHA-DCL-AIT-0001-AI	PRE-SO2 CHLORINE RESID	AI	1721
FHA-DCL-AIT-0002A-AI	POST-SO2 CLR RESID#2A	AI	1721
FHA-TRW-AIT-0001-AI	TRW TOT CLR ANALYZER	AI	1721
FHA-TRW-AIT-0002-AI	TRW TRB ANALYZER	AI	1721
FHA-TRW-AIT-0003-AI	FLUORIDE ANALYZER	AI	1721
FHA-FLT-FIT-0101-FI	FILTER #1 FLOW	AI	1721
FHA-FLT-PDIT-0101-PDI	FILTER #1 HEAD LOSS	AI	1721
FHA-FLT-FIT-0201-FI	FILTER #2 FLOW	AI	1721
FHA-FLT-PDIT-0201-PDI	FILTER #2 HEAD LOSS	AI	1721
FHA-FLT-FIT-0301-FI	FILTER #3 FLOW	AI	1721
FHA-FLT-PDIT-0301-PDI	FILTER #3 HEAD LOSS	AI	1721
FHA-FLT-FIT-0401-FI	FILTER #4 FLOW	AI	1721
FHA-FLT-PDIT-0401-PDI	FILTER #4 HEAD LOSS	AI	1721
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1721
FHA-FLT-V-0101-ZC	FILTER #1 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-FLT-V-0201-ZC	FILTER #2 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-FLT-V-0301-ZC	FILTER #3 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-FLT-V-0401-ZC	FILTER #4 RATE CONTROL VALVE POSITION SETPOINT	AO	1721
FHA-SPC-UPS-1721-EA	FILTERS 1-4 PLC UPS - POWER FAILURE	DI	1721
FHA-SPC-UPS-1721-EAL	FILTERS 1-4 PLC UPS - LOW BATTERY	DI	1721
FHA-SPC-UPS-1721-XA	FILTERS 1-4 PLC UPS - UPS FAILURE	DI	1721

I/O Tag No	Description	Type	RPU
FHA-SPC-RPU-1721-TAH	FILTER #1-4 PANEL SMOKE/HEAT ALARM	DI	1721
FHA-FLT-G-0101-YN	FILTER #1 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0101-YA	FILTER #1 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0101-ZH	FILTER #1 INLET GATE OPENED	DI	1721
FHA-FLT-G-0101-ZL	FILTER #1 INLET GATE CLOSED	DI	1721
vFHA-FLT-G-0102-YN	FILTER #1 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0102-YA	FILTER #1 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0102-ZH	FILTER #1 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0102-ZL	FILTER #1 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0101-YN	FILTER #1 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0101-YA	FILTER #1 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0101-ZH	FILTER #1 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0101-ZL	FILTER #1 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0102-YN	FILTER #1 BACKWASH VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0102-YA	FILTER #1 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0102-ZH	FILTER #1 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0102-ZL	FILTER #1 BACKWASH VALVE CLOSED	DI	1721
FHA-FLT-V-0103-YN	FILTER #1 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0103-YA	FILTER #1 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0103-ZH	FILTER #1 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0103-ZL	FILTER #1 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-G-0201-YN	FILTER #2 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0201-YA	FILTER #2 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0201-ZH	FILTER #2 INLET GATE OPENED	DI	1721
FHA-FLT-G-0201-ZL	FILTER #2 INLET GATE CLOSED	DI	1721
FHA-FLT-G-0202-YN	FILTER #2 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0202-YA	FILTER #2 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0202-ZH	FILTER #2 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0202-ZL	FILTER #2 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0201-YN	FILTER #2 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0201-YA	FILTER #2 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0201-ZH	FILTER #2 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0201-ZL	FILTER #2 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0202-YN	FILTER #2 BACKWASH VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0202-YA	FILTER #2 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0202-ZH	FILTER #2 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0202-ZL	FILTER #2 BACKWASH VALVE CLOSED	DI	1721

I/O Tag No	Description	Type	RPU
FHA-FLT-V-0203-YN	FILTER #2 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0203-YA	FILTER #2 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0203-ZH	FILTER #2 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0203-ZL	FILTER #2 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-G-0301-YN	FILTER #3 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0301-YA	FILTER #3 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0301-ZH	FILTER #3 INLET GATE OPENED	DI	1721
FHA-FLT-G-0301-ZL	FILTER #3 INLET GATE CLOSED	DI	1721
FHA-FLT-G-0302-YN	FILTER #3 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0302-YA	FILTER #3 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0302-ZH	FILTER #3 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0302-ZL	FILTER #3 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0301-YN	FILTER #3 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0301-YA	FILTER #3 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0301-ZH	FILTER #3 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0301-ZL	FILTER #3 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0302-YN	FILTER #3 BACKWASH VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0302-YA	FILTER #3 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0302-ZH	FILTER #3 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0302-ZL	FILTER #3 BACKWASH VALVE CLOSED	DI	1721
FHA-FLT-V-0303-YN	FILTER #3 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0303-YA	FILTER #3 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0303-ZH	FILTER #3 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0303-ZL	FILTER #3 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-G-0401-YN	FILTER #4 INLET GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0401-YA	FILTER #4 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0401-ZH	FILTER #4 INLET GATE OPENED	DI	1721
FHA-FLT-G-0401-ZL	FILTER #4 INLET GATE CLOSED	DI	1721
FHA-FLT-G-0402-YN	FILTER #4 DRAIN GATE COMPUTER MODE	DI	1721
FHA-FLT-G-0402-YA	FILTER #4 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-G-0402-ZH	FILTER #4 DRAIN GATE OPENED	DI	1721
FHA-FLT-G-0402-ZL	FILTER #4 DRAIN GATE CLOSED	DI	1721
FHA-FLT-V-0401-YN	FILTER #4 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0401-YA	FILTER #4 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0401-ZH	FILTER #4 EFFLUENT RATE CONTROL VALVE OPENED	DI	1721
FHA-FLT-V-0401-ZL	FILTER #4 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1721
FHA-FLT-V-0402-YN	FILTER #4 BACKWASH VALVE COMPUTER MODE	DI	1721

I/O Tag No	Description	Type	RPU
FHA-FLT-V-0402-YA	FILTER #4 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0402-ZH	FILTER #4 BACKWASH VALVE OPENED	DI	1721
FHA-FLT-V-0402-ZL	FILTER #4 BACKWASH VALVE CLOSED	DI	1721
FHA-FLT-V-0403-YN	FILTER #4 SURFACE SWEEP VALVE COMPUTER MODE	DI	1721
FHA-FLT-V-0403-YA	FILTER #4 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1721
FHA-FLT-V-0403-ZH	FILTER #4 SURFACE SWEEP VALVE OPENED	DI	1721
FHA-FLT-V-0403-ZL	FILTER #4 SURFACE SWEEP VALVE CLOSED	DI	1721
FHA-FLT-HS-0101-ZL	FILTER #1 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-HS-0201-ZL	FILTER #2 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-HS-0301-ZL	FILTER #3 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-HS-0401-ZL	FILTER #4 VALVE ACP ENABLE/DISABLE SWITCH	DI	1721
FHA-FLT-AIT-0101-YA	FILTER #1EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-AIT-0201-YA	FILTER #2 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-AIT-0301-YA	FILTER #3 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-AIT-0401-YA	FILTER #4 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-LSHL-0101-LAH	FILTER #1 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0101-LAL	FILTER #1 LO LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0201-LAH	FILTER #2 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0201-LAL	FILTER #2 LO LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0301-LAH	FILTER #3 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0301-LAL	FILTER #3 LO LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0401-LAH	FILTER #4 HI LEVEL SWITCH	DI	1721
FHA-FLT-LSHL-0401-LAL	FILTER #4 LO LEVEL SWITCH	DI	1721
FHA-SED-P-0101-YN	SEW SAMPLE PUMP - WEST COMPUTER MODE	DI	1721
FHA-SED-P-0101-MN	SEW SAMPLE PUMP - WEST RUNNING	DI	1721
FHA-SED-V-0102-YN	SEW SMP PUMP SUCT VLV-W COMPUTER MODE	DI	1721
FHA-SED-V-0102-YA	SEW SMP PUMP SUCT VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0102-ZH	SEW SMP PUMP SUCT VLV-W OPENED	DI	1721
FHA-SED-V-0102-ZL	SEW SMP PUMP SUCT VLV-W CLOSED	DI	1721
FHA-SED-V-0109-YN	SEW SMP PUMP TRB VLV-W COMPUTER MODE	DI	1721
FHA-SED-V-0109-YA	SEW SMP PUMP TRB VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0109-ZH	SEW SMP PUMP TRB VLV-W OPENED	DI	1721
FHA-SED-V-0109-ZL	SEW SMP PUMP TRB VLV-W CLOSED	DI	1721
FHA-SED-V-0110-YN	SEW SUCT FLUSH VLV-W COMPUTER MODE	DI	1721
FHA-SED-V-0110-YA	SEW SUCT FLUSH VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0110-ZH	SEW SUCT FLUSH VLV-W OPENED	DI	1721
FHA-SED-V-0110-ZL	SEW SUCT FLUSH VLV-W CLOSED	DI	1721
FHA-SED-V-0111-YN	SEW DISCH FLUSH VLV-W COMPUTER MODE	DI	1721

I/O Tag No	Description	Type	RPU
FHA-SED-V-0111-YA	SEW DISCH FLUSH VLV-W NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-SED-V-0111-ZH	SEW DISCH FLUSH VLV-W OPENED	DI	1721
FHA-SED-V-0111-ZL	SEW DISCH FLUSH VLV-W CLOSED	DI	1721
FHA-SED-FSL-0101-FAL	SEW SMP PUMP-WEST FLOW LOW ALARM	DI	1721
FHA-SED-FSL-0102-FAL	SEW TRB ANALYZER-WEST FLOW LOW ALARM	DI	1721
FHA-SED-AIT-0101-YA	SEW TRB ANALYZER - WEST INSTRUMENT FAULT	DI	1721
FHA-DCL-V-0013-YN	BFR-SO2 SMP DRAIN VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0013-YA	BFR-SO2 SMP DRAIN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0013-ZH	BFR-SO2 SMP DRAIN VLV OPENED	DI	1721
FHA-DCL-V-0013-ZL	BFR-SO2 SMP DRAIN VLV CLOSED	DI	1721
FHA-DCL-V-0014-YN	BFR-SO2 SMP FLUSH VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0014-YA	BFR-SO2 SMP FLUSH VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0014-ZH	BFR-SO2 SMP FLUSH VLV OPENED	DI	1721
FHA-DCL-V-0014-ZL	BFR-SO2 SMP FLUSH VLV CLOSED	DI	1721
FHA-DCL-V-0015-YN	BFR-SO2 TRB INLET VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0015-YA	BFR-SO2 TRB INLET VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0015-ZH	BFR-SO2 TRB INLET VLV OPENED	DI	1721
FHA-DCL-V-0015-ZL	BFR-SO2 TRB INLET VLV CLOSED	DI	1721
FHA-DCL-V-0016-YN	BFR-SO2 LAB SAMPLE VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0016-YA	BFR-SO2 LAB SAMPLE VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0016-ZH	BFR-SO2 LAB SAMPLE VLV OPENED	DI	1721
FHA-DCL-V-0016-ZL	BFR-SO2 LAB SAMPLE VLV CLOSED	DI	1721
FHA-DCL-P-0001A-YN	BFR-SO2 SMP PUMP P-0001A COMPUTER MODE	DI	1721
FHA-DCL-P-0001A-MN	BFR-SO2 SMP PUMP P-0001A RUNNING	DI	1721
FHA-DCL-P-0001B-YN	BFR-SO2 SMP PUMP P-0001B COMPUTER MODE	DI	1721
FHA-DCL-P-0001B-MN	BFR-SO2 SMP PUMP P-0001B RUNNING	DI	1721
FHA-DCL-AIT-0001-YA	BFR-SO2 CLR RESID ANALYZER INSTRUMENT FAULT	DI	1721
FHA-DCL-FSL-0001A-FAL	BFR-SO2 SMP PUMP P-0001A FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0001B-FAL	BFR-SO2 SMP PUMP P-0001B FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0002-FAL	BFR-SO2 CLR RESID ANALYZER FLOW LOW ALARM	DI	1721
FHA-DCL-V-0026-YN	AFT-SO2 SMP FLUSH VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0026-YA	AFT-SO2 SMP FLUSH VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0026-ZH	AFT-SO2 SMP FLUSH VLV OPENED	DI	1721
FHA-DCL-V-0026-ZL	AFT-SO2 SMP FLUSH VLV CLOSED	DI	1721
FHA-DCL-V-0027-YN	AFT-SO2 SMP DRAIN VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0027-YA	AFT-SO2 SMP DRAIN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0027-ZH	AFT-SO2 SMP DRAIN VLV OPENED	DI	1721
FHA-DCL-V-0027-ZL	AFT-SO2 SMP DRAIN VLV CLOSED	DI	1721
FHA-DCL-V-0028-YN	AFT-SO2 ANALYZER ISLN VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0028-YA	AFT-SO2 ANALYZER ISLN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721

I/O Tag No	Description	Type	RPU
FHA-DCL-V-0028-ZH	AFT-SO2 ANALYZER ISLN VLV OPENED	DI	1721
FHA-DCL-V-0028-ZL	AFT-SO2 ANALYZER ISLN VLV CLOSED	DI	1721
FHA-DCL-V-0030-YN	AFT-SO2 LAB SAMPLE VLV COMPUTER MODE	DI	1721
FHA-DCL-V-0030-YA	AFT-SO2 LAB SAMPLE VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-DCL-V-0030-ZH	AFT-SO2 LAB SAMPLE VLV OPENED	DI	1721
FHA-DCL-V-0030-ZL	AFT-SO2 LAB SAMPLE VLV CLOSED	DI	1721
FHA-DCL-P-0002A-YN	AFT-SO2 SMP PUMP P-0002A COMPUTER MODE	DI	1721
FHA-DCL-P-0002A-MN	AFT-SO2 SMP PUMP P-0002A RUNNING	DI	1721
FHA-DCL-P-0002B-YN	AFT-SO2 SMP PUMP P-0002B COMPUTER MODE	DI	1721
FHA-DCL-P-0002B-MN	AFT-SO2 SMP PUMP P-0002B RUNNING	DI	1721
FHA-DCL-FSL-0003A-FAL	AFT-SO2 SMP PUMP P-0002A FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0003B-FAL	AFT-SO2 SMP PUMP P-0002B FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0004A-FAL	AFT-SO2 CLR ANALYZER 2A FLOW LOW ALARM	DI	1721
FHA-DCL-FSL-0004B-FAL	AFT-SO2 CLR ANALYZER 2B FLOW LOW ALARM	DI	1721
FHA-DCL-AIT-0002A-YA	AFT-SO2 CLR RESID ANALYZE2A INSTRUMENT FAULT	DI	1721
FHA-DCL-AIT-0002B-YA	AFT-SO2 CLR RESID ANALYZE2B INSTRUMENT FAULT	DI	1721
FHA-TRW-V-0010-YN	TRW LAB ISLN VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0010-YA	TRW LAB ISLN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0010-ZH	TRW LAB ISLN VLV OPENED	DI	1721
FHA-TRW-V-0010-ZL	TRW LAB ISLN VLV CLOSED	DI	1721
FHA-TRW-V-0013-YN	ANALYZER ISOLATION VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0013-YA	ANALYZER ISOLATION VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0013-ZH	ANALYZER ISOLATION VLV OPENED	DI	1721
FHA-TRW-V-0013-ZL	ANALYZER ISOLATION VLV CLOSED	DI	1721
FHA-TRW-V-0017-YN	TRW DRAIN VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0017-YA	TRW DRAIN VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0017-ZH	TRW DRAIN VLV OPENED	DI	1721
FHA-TRW-V-0017-ZL	TRW DRAIN VLV CLOSED	DI	1721
FHA-TRW-V-0018-YN	TRW SMP FLUSH VLV COMPUTER MODE	DI	1721
FHA-TRW-V-0018-YA	TRW SMP FLUSH VLV NOT AVAILABLE MAIN/CONTROL POWER FAIL	DI	1721
FHA-TRW-V-0018-ZH	TRW SMP FLUSH VLV OPENED	DI	1721
FHA-TRW-V-0018-ZL	TRW SMP FLUSH VLV CLOSED	DI	1721
FHA-TRW-P-0002A-YN	TRW SMP PUMP P-0002A COMPUTER MODE	DI	1721
FHA-TRW-P-0002A-MN	TRW SMP PUMP P-0002A RUNNING	DI	1721
FHA-TRW-P-0002B-YN	TRW SMP PUMP P-0002B COMPUTER MODE	DI	1721
FHA-TRW-P-0002B-MN	TRW SMP PUMP P-0002B RUNNING	DI	1721
FHA-TRW-FSL-0001A-FAL	TRW SMP PUMP P-0002A FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0001B-FAL	TRW SMP PUMP P-0002B FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0002-FAL	CLR ANALYZER OUTLET#1 FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0003-FAL	TRB ANALYZER OUTLET#1 FLOW LOW ALARM	DI	1721
FHA-TRW-FSL-0004-FAL	FLORIDE ANALYZER FLOW LOW ALARM	DI	1721
FHA-TRW-AIT-0001-YA	TRW TOT CLR ANALYZER INSTRUMENT FAULT	DI	1721

I/O Tag No	Description	Type	RPU
FHA-TRW-AIT-0002-YA	TRW TRB ANALYZER INSTRUMENT FAULT	DI	1721
FHA-TRW-AIT-0003-YA	FLUORIDE ANALYZER INSTRUMENT FAULT	DI	1721
FHA-FLT-G-0101-VH	FILTER #1 INLET GATE OPEN	DO	1721
FHA-FLT-G-0101-VL	FILTER #1 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0102-VH	FILTER #1 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0102-VL	FILTER #1 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0102-VH	FILTER #1 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0102-VL	FILTER #1 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0103-VH	FILTER #1 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0103-VL	FILTER #1 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-FLT-G-0201-VH	FILTER #2 INLET GATE OPEN	DO	1721
FHA-FLT-G-0201-VL	FILTER #2 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0202-VH	FILTER #2 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0202-VL	FILTER #2 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0202-VH	FILTER #2 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0202-VL	FILTER #2 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0203-VH	FILTER #2 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0203-VL	FILTER #2 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-FLT-G-0301-VH	FILTER #3 INLET GATE OPEN	DO	1721
FHA-FLT-G-0301-VL	FILTER #3 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0302-VH	FILTER #3 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0302-VL	FILTER #3 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0302-VH	FILTER #3 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0302-VL	FILTER #3 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0303-VH	FILTER #3 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0303-VL	FILTER #3 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-FLT-G-0401-VH	FILTER #4 INLET GATE OPEN	DO	1721
FHA-FLT-G-0401-VL	FILTER #4 INLET GATE CLOSE	DO	1721
FHA-FLT-G-0402-VH	FILTER #4 DRAIN GATE OPEN	DO	1721
FHA-FLT-G-0402-VL	FILTER #4 DRAIN GATE CLOSE	DO	1721
FHA-FLT-V-0402-VH	FILTER #4 BACKWASH VALVE OPEN	DO	1721
FHA-FLT-V-0402-VL	FILTER #4 BACKWASH VALVE CLOSE	DO	1721
FHA-FLT-V-0403-VH	FILTER #4 SURFACE SWEEP VALVE OPEN	DO	1721
FHA-FLT-V-0403-VL	FILTER #4 SURFACE SWEEP VALVE CLOSE	DO	1721
FHA-SED-V-0102-VH	SEW SMP PUMP SUCT VLV-W OPEN	DO	1721
FHA-SED-V-0102-VL	SEW SMP PUMP SUCT VLV-W CLOSE	DO	1721
FHA-SED-V-0109-VH	SEW SMP PUMP TRB VLV-W OPEN	DO	1721
FHA-SED-V-0109-VL	SEW SMP PUMP TRB VLV-W CLOSE	DO	1721
FHA-SED-V-0110-VH	SEW SUCT FLUSH VLV-W OPEN	DO	1721
FHA-SED-V-0110-VL	SEW SUCT FLUSH VLV-W CLOSE	DO	1721
FHA-SED-V-0111-VH	SEW DISCH FLUSH VLV-W OPEN	DO	1721
FHA-SED-V-0111-VL	SEW DISCH FLUSH VLV-W CLOSE	DO	1721
FHA-SED-P-0101-MH	SEW SAMPLE PUMP - WEST START COMMAND	DO	1721
FHA-SED-P-0101-MB	SEW SAMPLE PUMP - WEST STOP COMMAND	DO	1721
FHA-DCL-V-0013-VH	BFR-SO2 SMP DRAIN VLV OPEN	DO	1721
FHA-DCL-V-0013-VL	BFR-SO2 SMP DRAIN VLV CLOSE	DO	1721
FHA-DCL-V-0014-VH	BFR-SO2 SMP FLUSH VLV OPEN	DO	1721

I/O Tag No	Description	Type	RPU
FHA-DCL-V-0014-VL	BFR-SO2 SMP FLUSH VLV CLOSE	DO	1721
FHA-DCL-V-0015-VH	BFR-SO2 TRB INLET VLV OPEN	DO	1721
FHA-DCL-V-0015-VL	BFR-SO2 TRB INLET VLV CLOSE	DO	1721
FHA-DCL-V-0016-VH	BFR-SO2 LAB SAMPLE VLV OPEN	DO	1721
FHA-DCL-V-0016-VL	BFR-SO2 LAB SAMPLE VLV CLOSE	DO	1721
FHA-DCL-P-0001A-MH	BFR-SO2 SMP PUMP P-0001A START COMMAND	DO	1721
FHA-DCL-P-0001A-MB	BFR-SO2 SMP PUMP P-0001A STOP COMMAND	DO	1721
FHA-DCL-P-0001B-MH	BFR-SO2 SMP PUMP P-0001B START COMMAND	DO	1721
FHA-DCL-P-0001B-MB	BFR-SO2 SMP PUMP P-0001B STOP COMMAND	DO	1721
FHA-DCL-V-0026-VH	AFT-SO2 SMP FLUSH VLV OPEN	DO	1721
FHA-DCL-V-0026-VL	AFT-SO2 SMP FLUSH VLV CLOSE	DO	1721
FHA-DCL-V-0027-VH	AFT-SO2 SMP DRAIN VLV OPEN	DO	1721
FHA-DCL-V-0027-VL	AFT-SO2 SMP DRAIN VLV CLOSE	DO	1721
FHA-DCL-V-0028-VH	AFT-SO2 ANALYZER ISLN VLV OPEN	DO	1721
FHA-DCL-V-0028-VL	AFT-SO2 ANALYZER ISLN VLV CLOSE	DO	1721
FHA-DCL-V-0030-VH	AFT-SO2 LAB SAMPLE VLV OPEN	DO	1721
FHA-DCL-V-0030-VL	AFT-SO2 LAB SAMPLE VLV CLOSE	DO	1721
FHA-DCL-P-0002A-MH	AFT-SO2 SMP PUMP P-0002A START COMMAND	DO	1721
FHA-DCL-P-0002A-MB	AFT-SO2 SMP PUMP P-0002A STOP COMMAND	DO	1721
FHA-DCL-P-0002B-MH	AFT-SO2 SMP PUMP P-0002B START COMMAND	DO	1721
FHA-DCL-P-0002B-MB	AFT-SO2 SMP PUMP P-0002B STOP COMMAND	DO	1721
FHA-TRW-V-0009A-VH	PUMP P-0002A DISCH VLV OPEN	DO	1721
FHA-TRW-V-0009A-VL	PUMP P-0002A DISCH VLV CLOSE	DO	1721
FHA-TRW-V-0010-VH	PUMP P-0002B LAB VLV OPEN	DO	1721
FHA-TRW-V-0010-VL	PUMP P-0002B LAB VLV CLOSE	DO	1721
FHA-TRW-V-0013-VH	ANALYZER ISOLATION VLV OPEN	DO	1721
FHA-TRW-V-0013-VL	ANALYZER ISOLATION VLV CLOSE	DO	1721
FHA-TRW-V-0017-VH	TRW DRAIN VLV OPEN	DO	1721
FHA-TRW-V-0017-VL	TRW DRAIN VLV CLOSE	DO	1721
FHA-TRW-V-0018-VH	TRW SMP FLUSH VLV OPEN	DO	1721
FHA-TRW-V-0018-VL	TRW SMP FLUSH VLV CLOSE	DO	1721
FHA-TRW-P-0002A-MH	TRW SMP PUMP P-0002A START COMMAND	DO	1721
FHA-TRW-P-0002A-MB	TRW SMP PUMP P-0002A STOP COMMAND	DO	1721
FHA-TRW-P-0002B-MH	TRW SMP PUMP P-0002B START COMMAND	DO	1721
FHA-TRW-P-0002B-MB	TRW SMP PUMP P-0002B STOP COMMAND	DO	1721
FHA-DCL-AIT-0002A-DUTY	AFT-SO2 CLR RESID ANALYZER 2A-2B CONTROL/REFERENCE SELECTION	AI	1721
FHA-FLT-ZIT-0501-ZI	FILTER #5 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0501-AI	FILTER #5 TURBIDITY	AI	1722
FHA-FLT-ZIT-0601-ZI	FILTER #6 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0601-AI	FILTER #6 TURBIDITY	AI	1722
FHA-FLT-ZIT-0701-ZI	FILTER #7 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0701-AI	FILTER #7 TURBIDITY	AI	1722
FHA-FLT-ZIT-0801-ZI	FILTER #8 RATE CONT VLV POSITION	AI	1722
FHA-FLT-AIT-0801-AI	FILTER #8 TURBIDITY	AI	1722
FHA-FLT-FIT-0501-FT	FILTER #5 FLOW	AI	1722
FHA-FLT-PDIT-0501-PDI	FILTER #5 HEAD LOSS	AI	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-FIT-0601-FT	FILTER #6 FLOW	AI	1722
FHA-FLT-PDIT-0601-PDI	FILTER #6 HEAD LOSS	AI	1722
FHA-FLT-FIT-0701-FT	FILTER #7 FLOW	AI	1722
FHA-FLT-PDIT-0701-PDI	FILTER #7 HEAD LOSS	AI	1722
FHA-FLT-FIT-0801-FT	FILTER #8 FLOW	AI	1722
FHA-FLT-PDIT-0801-PDI	FILTER #8 HEAD LOSS	AI	1722
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1722
FHA-FLT-V-0501-ZC	FILTER #5 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-FLT-V-0601-ZC	FILTER #6 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-FLT-V-0701-ZC	FILTER #7 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-FLT-V-0801-ZC	FILTER #8 RATE CONTROL VALVE POSITION SETPOINT	AO	1722
FHA-SPC-UPS-1722-EA	FILTERS 5-8 PLC UPS - POWER FAILURE	DI	1722
FHA-SPC-UPS-1722-EAL	FILTERS 5-8 PLC UPS - LOW BATTERY	DI	1722
FHA-SPC-UPS-1722-XA	FILTERS 5-8 PLC UPS - UPS FAILURE	DI	1722
FHA-SPC-RPU-1722-TAH	FILTER #5-8 PANEL SMOKE/HEAT ALARM	DI	1722
FHA-FLT-G-0501-YN	FILTER #5 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0501-YA	FILTER #5 INLET GATE NOT AVAILABLE	DI	1722
FHA-FLT-G-0501-ZH	FILTER #5 INLET GATE OPENED	DI	1722
FHA-FLT-G-0501-ZL	FILTER #5 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0502-YN	FILTER #5 DRAIN GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0502-YA	FILTER #5 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0502-ZH	FILTER #5 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0502-ZL	FILTER #5 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0501-YN	FILTER #5 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0501-YA	FILTER #5 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE	DI	1722
FHA-FLT-V-0501-ZH	FILTER #5 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0501-ZL	FILTER #5 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0502-YN	FILTER #5 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0502-YA	FILTER #5 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0502-ZH	FILTER #5 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0502-ZL	FILTER #5 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0503-YN	FILTER #5 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0503-YA	FILTER #5 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0503-ZH	FILTER #5 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0503-ZL	FILTER #5 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-G-0601-YN	FILTER #6 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0601-YA	FILTER #6 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0601-ZH	FILTER #6 INLET GATE OPENED	DI	1722
FHA-FLT-G-0601-ZL	FILTER #6 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0602-YN	FILTER #6 DRAIN GATE COMPUTER MODE	DI	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-G-0602-YA	FILTER #6 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0602-ZH	FILTER #6 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0602-ZL	FILTER #6 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0601-YN	FILTER #6 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0601-YA	FILTER #6 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0601-ZH	FILTER #6 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0601-ZL	FILTER #6 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0602-YN	FILTER #6 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0602-YA	FILTER #6 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0602-ZH	FILTER #6 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0602-ZL	FILTER #6 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0603-YN	FILTER #6 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0603-YA	FILTER #6 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0603-ZH	FILTER #6 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0603-ZL	FILTER #6 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-G-0701-YN	FILTER #7 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0701-YA	FILTER #7 INLET GATE NOT AVAILABLE	DI	1722
FHA-FLT-G-0701-ZH	FILTER #7 INLET GATE OPENED	DI	1722
FHA-FLT-G-0701-ZL	FILTER #7 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0702-YN	FILTER #7 DRAIN GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0702-YA	FILTER #7 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0702-ZH	FILTER #7 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0702-ZL	FILTER #7 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0701-YN	FILTER #7 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0701-YA	FILTER #7 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0701-ZH	FILTER #7 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0701-ZL	FILTER #7 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0702-YN	FILTER #7 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0702-YA	FILTER #7 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0702-ZH	FILTER #7 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0702-ZL	FILTER #7 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0703-YN	FILTER #7 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0703-YA	FILTER #7 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0703-ZH	FILTER #7 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0703-ZL	FILTER #7 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-G-0801-YN	FILTER #8 INLET GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0801-YA	FILTER #8 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-G-0801-ZH	FILTER #8 INLET GATE OPENED	DI	1722
FHA-FLT-G-0801-ZL	FILTER #8 INLET GATE CLOSED	DI	1722
FHA-FLT-G-0802-YN	FILTER #8 DRAIN GATE COMPUTER MODE	DI	1722
FHA-FLT-G-0802-YA	FILTER #8 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-G-0802-ZH	FILTER #8 DRAIN GATE OPENED	DI	1722
FHA-FLT-G-0802-ZL	FILTER #8 DRAIN GATE CLOSED	DI	1722
FHA-FLT-V-0801-YN	FILTER #8 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0801-YA	FILTER #8 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0801-ZH	FILTER #8 EFFLUENT RATE CONTROL VALVE OPENED	DI	1722
FHA-FLT-V-0801-ZL	FILTER #8 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1722
FHA-FLT-V-0802-YN	FILTER #8 BACKWASH VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0802-YA	FILTER #8 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0802-ZH	FILTER #8 BACKWASH VALVE OPENED	DI	1722
FHA-FLT-V-0802-ZL	FILTER #8 BACKWASH VALVE CLOSED	DI	1722
FHA-FLT-V-0803-YN	FILTER #8 SURFACE SWEEP VALVE COMPUTER MODE	DI	1722
FHA-FLT-V-0803-YA	FILTER #8 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1722
FHA-FLT-V-0803-ZH	FILTER #8 SURFACE SWEEP VALVE OPENED	DI	1722
FHA-FLT-V-0803-ZL	FILTER #8 SURFACE SWEEP VALVE CLOSED	DI	1722
FHA-FLT-HS-0501-ZL	FILTER #5 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-HS-0601-ZL	FILTER #6 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-HS-0701-ZL	FILTER #7 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-HS-0801-ZL	FILTER #8 VALVE ACP ENABLE/DISABLE SWITCH	DI	1722
FHA-FLT-AIT-0501-YA	FILTER #5 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-AIT-0601-YA	FILTER #6 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-AIT-0701-YA	FILTER #7 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-AIT-0801-YA	FILTER #8 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1722
FHA-FLT-LSHL-0501-LAH	FILTER #5 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0501-LAL	FILTER #5 LO LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0601-LAH	FILTER #6 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0601-LAL	FILTER #6 LO LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0701-LAH	FILTER #7 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0701-LAL	FILTER #7 LO LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0801-LAH	FILTER #8 HI LEVEL SWITCH	DI	1722
FHA-FLT-LSHL-0801-LAL	FILTER #8 LO LEVEL SWITCH	DI	1722
FHA-FLT-G-0501-VH	FILTER #5 INLET GATE OPEN	DO	1722
FHA-FLT-G-0501-VL	FILTER #5 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0502-VH	FILTER #5 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0502-VL	FILTER #5 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0502-VH	FILTER #5 BACKWASH VALVE OPEN	DO	1722

I/O Tag No	Description	Type	RPU
FHA-FLT-V-0502-VL	FILTER #5 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0503-VH	FILTER #5 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0503-VL	FILTER #5 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-G-0601-VH	FILTER #6 INLET GATE OPEN	DO	1722
FHA-FLT-G-0601-VL	FILTER #6 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0602-VH	FILTER #6 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0602-VL	FILTER #6 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0602-VH	FILTER #6 BACKWASH VALVE OPEN	DO	1722
FHA-FLT-V-0602-VL	FILTER #6 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0603-VH	FILTER #6 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0603-VL	FILTER #6 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-G-0701-VH	FILTER #7 INLET GATE OPEN	DO	1722
FHA-FLT-G-0701-VL	FILTER #7 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0702-VH	FILTER #7 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0702-VL	FILTER #7 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0702-VH	FILTER #7 BACKWASH VALVE OPEN	DO	1722
FHA-FLT-V-0702-VL	FILTER #7 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0703-VH	FILTER #7 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0703-VL	FILTER #7 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-G-0801-VH	FILTER #8 INLET GATE OPEN	DO	1722
FHA-FLT-G-0801-VL	FILTER #8 INLET GATE CLOSE	DO	1722
FHA-FLT-G-0802-VH	FILTER #8 DRAIN GATE OPEN	DO	1722
FHA-FLT-G-0802-VL	FILTER #8 DRAIN GATE CLOSE	DO	1722
FHA-FLT-V-0802-VH	FILTER #8 BACKWASH VALVE OPEN	DO	1722
FHA-FLT-V-0802-VL	FILTER #8 BACKWASH VALVE CLOSE	DO	1722
FHA-FLT-V-0803-VH	FILTER #8 SURFACE SWEEP VALVE OPEN	DO	1722
FHA-FLT-V-0803-VL	FILTER #8 SURFACE SWEEP VALVE CLOSE	DO	1722
FHA-FLT-ZIT-0901-ZI	FILTER #9 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-0901-AI	FILTER #9 TURBIDITY	AI	1723
FHA-FLT-ZIT-1001-ZI	FILTER #10 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-1001-AI	FILTER #10 TURBIDITY	AI	1723
FHA-FLT-ZIT-1101-ZI	FILTER #11 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-1101-AI	FILTER #11 TURBIDITY	AI	1723
FHA-FLT-ZIT-1201-ZI	FILTER #12 RATE CONT VLV POSITION	AI	1723
FHA-FLT-AIT-1201-AI	FILTER #12 TURBIDITY	AI	1723
FHA-FLT-FIT-0901-FT	FILTER #9 FLOW	AI	1723
FHA-FLT-PDIT-0901-PDI	FILTER #9 HEAD LOSS	AI	1723
FHA-FLT-FIT-1001-FT	FILTER #10 FLOW	AI	1723
FHA-FLT-PDIT-1001-PDI	FILTER #10 HEAD LOSS	AI	1723
FHA-FLT-FIT-1101-FT	FILTER #11 FLOW	AI	1723
FHA-FLT-PDIT-1101-PDI	FILTER #11 HEAD LOSS	AI	1723
FHA-FLT-FIT-1201-FT	FILTER #12 FLOW	AI	1723
FHA-FLT-PDIT-1201-PDI	FILTER #12 HEAD LOSS	AI	1723
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1723
FHA-FLT-V-0901-ZC	FILTER #9 RATE CONTROL VALVE POSITION SETPOINT	AO	1723
FHA-FLT-V-1001-ZC	FILTER #10 RATE CONTROL VALVE POSITION SETPOINT	AO	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1101-ZC	FILTER #11 RATE CONTROL VALVE POSITION SETPOINT	AO	1723
FHA-FLT-V-1201-ZC	FILTER #12 RATE CONTROL VALVE POSITION SETPOINT	AO	1723
FHA-SPC-UPS-1723-EA	FILTERS 9-12 PLC UPS - POWER FAILURE	DI	1723
FHA-SPC-UPS-1723-EAL	FILTERS 9-12 PLC UPS - LOW BATTERY	DI	1723
FHA-SPC-UPS-1723-XA	FILTERS 9-12 PLC UPS - UPS FAILURE	DI	1723
FHA-SPC-RPU-1723-TAH	FILTER #9-12 PANEL SMOKE/HEAT ALARM	DI	1723
FHA-FLT-G-0901-YN	FILTER #9 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-0901-YA	FILTER #9 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-0901-ZH	FILTER #9 INLET GATE OPENED	DI	1723
FHA-FLT-G-0901-ZL	FILTER #9 INLET GATE CLOSED	DI	1723
FHA-FLT-G-0902-YN	FILTER #9 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-0902-YA	FILTER #9 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-0902-ZH	FILTER #9 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-0902-ZL	FILTER #9 DRAIN GATE CLOSED	DI	1723
FHA-FLT-V-0901-YN	FILTER #9 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-0901-YA	FILTER #9 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-0901-ZH	FILTER #9 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-0901-ZL	FILTER #9 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-0902-YN	FILTER #9 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-0902-YA	FILTER #9 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-0902-ZH	FILTER #9 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-0902-ZL	FILTER #9 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-0903-YN	FILTER #9 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-0903-YA	FILTER #9 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-0903-ZH	FILTER #9 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-0903-ZL	FILTER #9 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-G-1001-YN	FILTER #10 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1001-YA	FILTER #10 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1001-ZH	FILTER #10 INLET GATE OPENED	DI	1723
FHA-FLT-G-1001-ZL	FILTER #10 INLET GATE CLOSED	DI	1723
FHA-FLT-G-1002-YN	FILTER #10 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1002-YA	FILTER #10 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1002-ZH	FILTER #10 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-1002-ZL	FILTER #10 DRAIN GATE CLOSED	DI	1723
FHA-FLT-V-1001-YN	FILTER #10 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1001-YA	FILTER #10 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1001-ZH	FILTER #10 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-1001-ZL	FILTER #10 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-1002-YN	FILTER #10 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1002-YA	FILTER #10 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1002-ZH	FILTER #10 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-1002-ZL	FILTER #10 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-1003-YN	FILTER #10 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1003-YA	FILTER #10 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1003-ZH	FILTER #10 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-1003-ZL	FILTER #10 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-G-1101-YN	FILTER #11 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1101-YA	FILTER #11 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1101-ZH	FILTER #11 INLET GATE OPENED	DI	1723
FHA-FLT-G-1101-ZL	FILTER #11 INLET GATE CLOSED	DI	1723
FHA-FLT-G-1102-YN	FILTER #11 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1102-YA	FILTER #11 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1102-ZH	FILTER #11 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-1102-ZL	FILTER #11 DRAIN GATE CLOSED	DI	1723
FHA-FLT-V-1101-YN	FILTER #11 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1101-YA	FILTER #11 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1101-ZH	FILTER #11 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-1101-ZL	FILTER #11 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-1102-YN	FILTER #11 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1102-YA	FILTER #11 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1102-ZH	FILTER #11 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-1102-ZL	FILTER #11 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-1103-YN	FILTER #11 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1103-YA	FILTER #11 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1103-ZH	FILTER #11 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-1103-ZL	FILTER #11 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-G-1201-YN	FILTER #12 INLET GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1201-YA	FILTER #12 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1201-ZH	FILTER #12 INLET GATE OPENED	DI	1723
FHA-FLT-G-1201-ZL	FILTER #12 INLET GATE CLOSED	DI	1723
FHA-FLT-G-1202-YN	FILTER #12 DRAIN GATE COMPUTER MODE	DI	1723
FHA-FLT-G-1202-YA	FILTER #12 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-G-1202-ZH	FILTER #12 DRAIN GATE OPENED	DI	1723
FHA-FLT-G-1202-ZL	FILTER #12 DRAIN GATE CLOSED	DI	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1201-YN	FILTER #12 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1201-YA	FILTER #12 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1201-ZH	FILTER #12 EFFLUENT RATE CONTROL VALVE OPENED	DI	1723
FHA-FLT-V-1201-ZL	FILTER #12 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1723
FHA-FLT-V-1202-YN	FILTER #12 BACKWASH VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1202-YA	FILTER #12 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1202-ZH	FILTER #12 BACKWASH VALVE OPENED	DI	1723
FHA-FLT-V-1202-ZL	FILTER #12 BACKWASH VALVE CLOSED	DI	1723
FHA-FLT-V-1203-YN	FILTER #12 SURFACE SWEEP VALVE COMPUTER MODE	DI	1723
FHA-FLT-V-1203-YA	FILTER #12 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1723
FHA-FLT-V-1203-ZH	FILTER #12 SURFACE SWEEP VALVE OPENED	DI	1723
FHA-FLT-V-1203-ZL	FILTER #12 SURFACE SWEEP VALVE CLOSED	DI	1723
FHA-FLT-HS-0901-ZL	FILTER #9 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-HS-1001-ZL	FILTER #10 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-HS-1101-ZL	FILTER #11 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-HS-1201-ZL	FILTER #12 VALVE ACP ENABLE/DISABLE SWITCH	DI	1723
FHA-FLT-AIT-0901-YA	FILTER #9 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-AIT-1001-YA	FILTER #10 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-AIT-1101-YA	FILTER #11 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-AIT-1201-YA	FILTER #12 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1723
FHA-FLT-LSHL-0901-LAH	FILTER #9 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-0901-LAL	FILTER #9 LO LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1001-LAH	FILTER #10 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1001-LAL	FILTER #10 LO LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1101-LAH	FILTER #11 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1101-LAL	FILTER #11 LO LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1201-LAH	FILTER #12 HI LEVEL SWITCH	DI	1723
FHA-FLT-LSHL-1201-LAL	FILTER #12 LO LEVEL SWITCH	DI	1723
FHA-FLT-G-0901-VH	FILTER #9 INLET GATE OPEN	DO	1723
FHA-FLT-G-0901-VL	FILTER #9 INLET GATE CLOSE	DO	1723
FHA-FLT-G-0902-VH	FILTER #9 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-0902-VL	FILTER #9 DRAIN GATE CLOSE	DO	1723
FHA-FLT-V-0902-VH	FILTER #9 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-0902-VL	FILTER #9 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-0903-VH	FILTER #9 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-0903-VL	FILTER #9 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-G-1001-VH	FILTER #10 INLET GATE OPEN	DO	1723
FHA-FLT-G-1001-VL	FILTER #10 INLET GATE CLOSE	DO	1723
FHA-FLT-G-1002-VH	FILTER #10 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-1002-VL	FILTER #10 DRAIN GATE CLOSE	DO	1723

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1002-VH	FILTER #10 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-1002-VL	FILTER #10 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-1003-VH	FILTER #10 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-1003-VL	FILTER #10 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-G-1101-VH	FILTER #11 INLET GATE OPEN	DO	1723
FHA-FLT-G-1101-VL	FILTER #11 INLET GATE CLOSE	DO	1723
FHA-FLT-G-1102-VH	FILTER #11 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-1102-VL	FILTER #11 DRAIN GATE CLOSE	DO	1723
FHA-FLT-V-1102-VH	FILTER #11 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-1102-VL	FILTER #11 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-1103-VH	FILTER #11 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-1103-VL	FILTER #11 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-G-1201-VH	FILTER #12 INLET GATE OPEN	DO	1723
FHA-FLT-G-1201-VL	FILTER #12 INLET GATE CLOSE	DO	1723
FHA-FLT-G-1202-VH	FILTER #12 DRAIN GATE OPEN	DO	1723
FHA-FLT-G-1202-VL	FILTER #12 DRAIN GATE CLOSE	DO	1723
FHA-FLT-V-1202-VH	FILTER #12 BACKWASH VALVE OPEN	DO	1723
FHA-FLT-V-1202-VL	FILTER #12 BACKWASH VALVE CLOSE	DO	1723
FHA-FLT-V-1203-VH	FILTER #12 SURFACE SWEEP VALVE OPEN	DO	1723
FHA-FLT-V-1203-VL	FILTER #12 SURFACE SWEEP VALVE CLOSE	DO	1723
FHA-FLT-ZIT-1301-ZI	FILTER #13 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1301-AI	FILTER #13 TURBIDITY	AI	1724
FHA-FLT-ZIT-1401-ZI	FILTER #14 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1401-AI	FILTER #14 TURBIDITY	AI	1724
FHA-FLT-ZIT-1501-ZI	FILTER #15 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1501-AI	FILTER #15 TURBIDITY	AI	1724
FHA-FLT-ZIT-1601-ZI	FILTER #16 RATE CONT VLV POSITION	AI	1724
FHA-FLT-AIT-1601-AI	FILTER #16 TURBIDITY	AI	1724
FHA-FLT-AIT-4101-AI	W FILTER TRB ANALYZER	AI	1724
FHA-FLT-AIT-4102-AI	W FLE RESID CLR ANALYZER	AI	1724
FHA-FLT-FIT-1301-FT	FILTER #13 FLOW	AI	1724
FHA-FLT-PDIT-1301-PDI	FILTER #13 HEAD LOSS	AI	1724
FHA-FLT-FIT-1401-FT	FILTER #14 FLOW	AI	1724
FHA-FLT-PDIT-1401-PDI	FILTER #14 HEAD LOSS	AI	1724
FHA-FLT-FIT-1501-FT	FILTER #15 FLOW	AI	1724
FHA-FLT-PDIT-1501-PDI	FILTER #15 HEAD LOSS	AI	1724
FHA-FLT-FIT-1601-FT	FILTER #16 FLOW	AI	1724
FHA-FLT-PDIT-1601-PDI	FILTER #16 HEAD LOSS	AI	1724
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1724
FHA-FLT-V-1301-ZC	FILTER #13 RATE CONTROL VALVE POSITION SETPOINT	AO	1724
FHA-FLT-V-1401-ZC	FILTER #14 RATE CONTROL VALVE POSITION SETPOINT	AO	1724
FHA-FLT-V-1501-ZC	FILTER #15 RATE CONTROL VALVE POSITION SETPOINT	AO	1724
FHA-FLT-V-1601-ZC	FILTER #16 RATE CONTROL VALVE POSITION SETPOINT	AO	1724

I/O Tag No	Description	Type	RPU
FHA-SPC-UPS-1724-EA	FILTERS 13-16 PLC UPS - POWER FAILURE	DI	1724
FHA-SPC-UPS-1724-EAL	FILTERS 13-16 PLC UPS - LOW BATTERY	DI	1724
FHA-SPC-UPS-1724-XA	FILTERS 13-16 PLC UPS - UPS FAILURE	DI	1724
FHA-SPC-RPU-1724-TAH	FILTER #13-16 PANEL SMOKE/HEAT ALARM	DI	1724
FHA-FLT-G-1301-YN	FILTER #13 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1301-YA	FILTER #13 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1301-ZH	FILTER #13 INLET GATE OPENED	DI	1724
FHA-FLT-G-1301-ZL	FILTER #13 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1302-YN	FILTER #13 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1302-YA	FILTER #13 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1302-ZH	FILTER #13 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1302-ZL	FILTER #13 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1301-YN	FILTER #13 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1301-YA	FILTER #13 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1301-ZH	FILTER #13 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1301-ZL	FILTER #13 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1302-YN	FILTER #13 BACKWASH VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1302-YA	FILTER #13 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1302-ZH	FILTER #13 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1302-ZL	FILTER #13 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1303-YN	FILTER #13 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1303-YA	FILTER #13 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1303-ZH	FILTER #13 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1303-ZL	FILTER #13 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-G-1401-YN	FILTER #14 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1401-YA	FILTER #14 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1401-ZH	FILTER #14 INLET GATE OPENED	DI	1724
FHA-FLT-G-1401-ZL	FILTER #14 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1402-YN	FILTER #14 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1402-YA	FILTER #14 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1402-ZH	FILTER #14 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1402-ZL	FILTER #14 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1401-YN	FILTER #14 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1401-YA	FILTER #14 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1401-ZH	FILTER #14 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1401-ZL	FILTER #14 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1402-YN	FILTER #14 BACKWASH VALVE COMPUTER MODE	DI	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1402-YA	FILTER #14 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1402-ZH	FILTER #14 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1402-ZL	FILTER #14 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1403-YN	FILTER #14 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1403-YA	FILTER #14 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1403-ZH	FILTER #14 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1403-ZL	FILTER #14 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-G-1501-YN	FILTER #15 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1501-YA	FILTER #15 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1501-ZH	FILTER #15 INLET GATE OPENED	DI	1724
FHA-FLT-G-1501-ZL	FILTER #15 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1502-YN	FILTER #15 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1502-YA	FILTER #15 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1502-ZH	FILTER #15 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1502-ZL	FILTER #15 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1501-YN	FILTER #15 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1501-YA	FILTER #15 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1501-ZH	FILTER #15 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1501-ZL	FILTER #15 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1502-YN	FILTER #15 BACKWASH VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1502-YA	FILTER #15 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1502-ZH	FILTER #15 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1502-ZL	FILTER #15 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1503-YN	FILTER #15 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1503-YA	FILTER #15 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1503-ZH	FILTER #15 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1503-ZL	FILTER #15 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-G-1601-YN	FILTER #16 INLET GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1601-YA	FILTER #16 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1601-ZH	FILTER #16 INLET GATE OPENED	DI	1724
FHA-FLT-G-1601-ZL	FILTER #16 INLET GATE CLOSED	DI	1724
FHA-FLT-G-1602-YN	FILTER #16 DRAIN GATE COMPUTER MODE	DI	1724
FHA-FLT-G-1602-YA	FILTER #16 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-G-1602-ZH	FILTER #16 DRAIN GATE OPENED	DI	1724
FHA-FLT-G-1602-ZL	FILTER #16 DRAIN GATE CLOSED	DI	1724
FHA-FLT-V-1601-YN	FILTER #16 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1601-YA	FILTER #16 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1601-ZH	FILTER #16 EFFLUENT RATE CONTROL VALVE OPENED	DI	1724
FHA-FLT-V-1601-ZL	FILTER #16 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1724
FHA-FLT-V-1602-YN	FILTER #16 BACKWASH VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1602-YA	FILTER #16 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1602-ZH	FILTER #16 BACKWASH VALVE OPENED	DI	1724
FHA-FLT-V-1602-ZL	FILTER #16 BACKWASH VALVE CLOSED	DI	1724
FHA-FLT-V-1603-YN	FILTER #16 SURFACE SWEEP VALVE COMPUTER MODE	DI	1724
FHA-FLT-V-1603-YA	FILTER #16 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-1603-ZH	FILTER #16 SURFACE SWEEP VALVE OPENED	DI	1724
FHA-FLT-V-1603-ZL	FILTER #16 SURFACE SWEEP VALVE CLOSED	DI	1724
FHA-FLT-HS-1301-ZL	FILTER #13 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-HS-1401-ZL	FILTER #14 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-HS-1501-ZL	FILTER #15 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-HS-1601-ZL	FILTER #16 VALVE ACP ENABLE/DISABLE SWITCH	DI	1724
FHA-FLT-AIT-1301-YA	FILTER #13 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-AIT-1401-YA	FILTER #14 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-AIT-1501-YA	FILTER #15 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-AIT-1601-YA	FILTER #16 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-LSHL-1301-LAH	FILTER #13 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1301-LAL	FILTER #13 LO LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1401-LAH	FILTER #14 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1401-LAL	FILTER #14 LO LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1501-LAH	FILTER #15 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1501-LAL	FILTER #15 LO LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1601-LAH	FILTER #16 HI LEVEL SWITCH	DI	1724
FHA-FLT-LSHL-1601-LAL	FILTER #16 LO LEVEL SWITCH	DI	1724
FHA-FLT-P-4101-YN	W FILTER CMPST SMP PUMP COMPUTER MODE	DI	1724
FHA-FLT-P-4101-MN	W FILTER CMPST SMP PUMP RUNNING	DI	1724
FHA-FLT-FSL-4101-FAL	W FILTER CMPST SMP PUMP FLOW LOW ALARM	DI	1724
FHA-FLT-FSL-4102-FAL	W FILTER TRB ANALYZER FLOW LOW ALARM	DI	1724
FHA-FLT-FSL-4103-FAL	W FLE RESID CLR ANALYZER FLOW LOW ALARM	DI	1724
FHA-FLT-AIT-4101-YA	W FILTER TRB ANALYZER LOSS OF SIGNAL SIGNAL (N/A - DISABLED IN SOFTWARE LOGIC)	DI	1724
FHA-FLT-AIT-4102-YA	W FLE RESID CLR ANALYZER INSTRUMENT FAULT	DI	1724
FHA-FLT-V-4108-YN	WEST ANALYZER ISLN VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4108-YA	WEST ANALYZER ISLN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4108-ZH	WEST ANALYZER ISLN VLV OPENED	DI	1724
FHA-FLT-V-4108-ZL	WEST ANALYZER ISLN VLV CLOSED	DI	1724
FHA-FLT-V-4109-YN	WEST BACKFLUSH VLV COMPUTER MODE	DI	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-4109-YA	WEST BACKFLUSH VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4109-ZH	WEST BACKFLUSH VLV OPENED	DI	1724
FHA-FLT-V-4109-ZL	WEST BACKFLUSH VLV CLOSED	DI	1724
FHA-FLT-V-4110-YN	WEST DRAIN VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4110-YA	WEST DRAIN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4110-ZH	WEST DRAIN VLV OPENED	DI	1724
FHA-FLT-V-4110-ZL	WEST DRAIN VLV CLOSED	DI	1724
FHA-FLT-V-4106-YN	WEST LAB ISLN VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4106-YA	WEST LAB ISLN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4106-ZH	WEST LAB ISLN VLV OPENED	DI	1724
FHA-FLT-V-4106-ZL	WEST LAB ISLN VLV CLOSED	DI	1724
FHA-FLT-V-4111-YN	WEST SUCT FLUSH VLV COMPUTER MODE	DI	1724
FHA-FLT-V-4111-YA	WEST SUCT FLUSH VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1724
FHA-FLT-V-4111-ZH	WEST SUCT FLUSH VLV OPENED	DI	1724
FHA-FLT-V-4111-ZL	WEST SUCT FLUSH VLV CLOSED	DI	1724
FHA-FLT-G-1301-VH	FILTER #13 INLET GATE OPEN	DO	1724
FHA-FLT-G-1301-VL	FILTER #13 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1302-VH	FILTER #13 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1302-VL	FILTER #13 DRAIN GATE CLOSE	DO	1724
FHA-FLT-V-1302-VH	FILTER #13 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1302-VL	FILTER #13 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1303-VH	FILTER #13 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1303-VL	FILTER #13 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-G-1401-VH	FILTER #14 INLET GATE OPEN	DO	1724
FHA-FLT-G-1401-VL	FILTER #14 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1402-VH	FILTER #14 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1402-VL	FILTER #14 DRAIN GATE CLOSE	DO	1724
FHA-FLT-V-1402-VH	FILTER #14 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1402-VL	FILTER #14 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1403-VH	FILTER #14 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1403-VL	FILTER #14 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-G-1501-VH	FILTER #15 INLET GATE OPEN	DO	1724
FHA-FLT-G-1501-VL	FILTER #15 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1502-VH	FILTER #15 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1502-VL	FILTER #15 DRAIN GATE CLOSE	DO	1724
FHA-FLT-V-1502-VH	FILTER #15 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1502-VL	FILTER #15 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1503-VH	FILTER #15 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1503-VL	FILTER #15 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-G-1601-VH	FILTER #16 INLET GATE OPEN	DO	1724
FHA-FLT-G-1601-VL	FILTER #16 INLET GATE CLOSE	DO	1724
FHA-FLT-G-1602-VH	FILTER #16 DRAIN GATE OPEN	DO	1724
FHA-FLT-G-1602-VL	FILTER #16 DRAIN GATE CLOSE	DO	1724

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1602-VH	FILTER #16 BACKWASH VALVE OPEN	DO	1724
FHA-FLT-V-1602-VL	FILTER #16 BACKWASH VALVE CLOSE	DO	1724
FHA-FLT-V-1603-VH	FILTER #16 SURFACE SWEEP VALVE OPEN	DO	1724
FHA-FLT-V-1603-VL	FILTER #16 SURFACE SWEEP VALVE CLOSE	DO	1724
FHA-FLT-P-4101-MH	W FILTER CMPST SMP PUMP START COMMAND	DO	1724
FHA-FLT-P-4101-MB	W FILTER CMPST SMP PUMP STOP COMMAND	DO	1724
FHA-FLT-V-4108-VH	WEST ANALYZER ISLN VLV OPEN	DO	1724
FHA-FLT-V-4108-VL	WEST ANALYZER ISLN VLV CLOSE	DO	1724
FHA-FLT-V-4109-VH	WEST BACKFLUSH VLV OPEN	DO	1724
FHA-FLT-V-4109-VL	WEST BACKFLUSH VLV CLOSE	DO	1724
FHA-FLT-V-4110-VH	WEST DRAIN VLV OPEN	DO	1724
FHA-FLT-V-4110-VL	WEST DRAIN VLV CLOSE	DO	1724
FHA-FLT-V-4106-VH	WEST LAB ISLN VLV OPEN	DO	1724
FHA-FLT-V-4106-VL	WEST LAB ISLN VLV CLOSE	DO	1724
FHA-FLT-V-4111-VH	WEST SUCT FLUSH VLV OPEN	DO	1724
FHA-FLT-V-4111-VL	WEST SUCT FLUSH VLV CLOSE	DO	1724
FHA-FLT-AIT-1701-AI	FILTER #17 TURBIDITY	AI	1822
FHA-FLT-ZIT-1701-ZI	FILTER #17 RATE CONT VLV POSITION	AI	1822
FHA-FLT-AIT-1801-AI	FILTER #18 TURBIDITY	AI	1822
FHA-FLT-ZIT-1801-ZI	FILTER #18 RATE CONT VLV POSITION	AI	1822
FHA-FLT-AIT-1901-AI	FILTER #19 TURBIDITY	AI	1822
FHA-FLT-ZIT-1901-ZI	FILTER #19 RATE CONT VLV POSITION	AI	1822
FHA-FLT-AIT-2001-AI	FILTER #20 TURBIDITY	AI	1822
FHA-FLT-ZIT-2001-ZI	FILTER #20 RATE CONT VLV POSITION	AI	1822
FHA-BW-ZIT-0105-ZI	WEST WW RATE CONT VLV POSITION	AI	1822
FHA-CLB-AIT-0002-AI	FILTER CMPST TRB ANALYZER	AI	1822
FHA-CLB-AIT-0004-AI	AFTER POST CHLOR RESIDUAL #2	AI	1822
FHA-FLT-FIT-0001-FI	WEST FILTERS TOTAL FLOW	AI	1822
FHA-TRW-LIT-0001-LI	RESERVOIR LEVEL	AI	1822
FHA-CLB-AIT-0003-AI	AFTER POST CHLOR RESIDUAL #1	AI	1822
FHA-FLT-FIT-1701-FT	FILTER #17 FLOW	AI	1822
FHA-FLT-PDIT-1701-PDI	FILTER #17 HEAD LOSS	AI	1822
FHA-FLT-FIT-1801-FT	FILTER #18 FLOW	AI	1822
FHA-FLT-PDIT-1801-PDI	FILTER #18 HEAD LOSS	AI	1822
FHA-FLT-FIT-1901-FT	FILTER #19 FLOW	AI	1822
FHA-FLT-PDIT-1901-PDI	FILTER #19 HEAD LOSS	AI	1822
FHA-FLT-FIT-2001-FT	FILTER #20 FLOW	AI	1822
FHA-FLT-PDIT-2001-PDI	FILTER #20 HEAD LOSS	AI	1822
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1822
FHA-FLT-V-1701-ZC	FILTER #17 RATE CONTROL VALVE POSITION SETPOINT	AO	1822
FHA-FLT-V-1801-ZC	FILTER #18 RATE CONTROL VALVE POSITION SETPOINT	AO	1822
FHA-FLT-V-1901-ZC	FILTER #19 RATE CONTROL VALVE POSITION SETPOINT	AO	1822
FHA-FLT-V-2001-ZC	FILTER #20 RATE CONTROL VALVE POSITION SETPOINT	AO	1822

I/O Tag No	Description	Type	RPU
FHA-BW-V-0105-VC	WEST WW CTRL VLV PID{CV}CONTROL VARIABLE-OUTPUT	AO	1822
FHA-SPC-UPS-1822-EA	FILTERS 17-20 PLC UPS - POWER FAILURE	DI	1822
FHA-SPC-UPS-1822-EAL	FILTERS 17-20 PLC UPS - LOW BATTERY	DI	1822
FHA-SPC-UPS-1822-XA	FILTERS 17-20 PLC UPS - UPS FAILURE	DI	1822
FHA-SPC-UPS-1811-EA	WEST FILTRATION COMPUTER UPS - POWER FAILURE	DI	1822
FHA-SPC-UPS-1811-EAL	WEST FILTRATION COMPUTER UPS - LOW BATTERY	DI	1822
FHA-SPC-UPS-1811-XA	WEST FILTRATION COMPUTER UPS - UPS FAILURE	DI	1822
FHA-SPC-RPU-1822-TAH	FILTER #17-20 PANEL SMOKE/HEAT ALARM	DI	1822
FHA-FLT-G-1701-YN	FILTER #17 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1701-YA	FILTER #17 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1701-ZH	FILTER #17 INLET GATE OPENED	DI	1822
FHA-FLT-G-1701-ZL	FILTER #17 INLET GATE CLOSED	DI	1822
FHA-FLT-G-1702-YN	FILTER #17 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1702-YA	FILTER #17 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1702-ZH	FILTER #17 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-1702-ZL	FILTER #17 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-1701-YN	FILTER #17 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1701-YA	FILTER #17 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1701-ZH	FILTER #17 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-1701-ZL	FILTER #17 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-1702-YN	FILTER #17 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1702-YA	FILTER #17 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1702-ZH	FILTER #17 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-1702-ZL	FILTER #17 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-1703-YN	FILTER #17 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1703-YA	FILTER #17 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1703-ZH	FILTER #17 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-1703-ZL	FILTER #17 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-G-1801-YN	FILTER #18 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1801-YA	FILTER #18 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1801-ZH	FILTER #18 INLET GATE OPENED	DI	1822
FHA-FLT-G-1801-ZL	FILTER #18 INLET GATE CLOSED	DI	1822
FHA-FLT-G-1802-YN	FILTER #18 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1802-YA	FILTER #18 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1802-ZH	FILTER #18 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-1802-ZL	FILTER #18 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-1801-YN	FILTER #18 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1801-YA	FILTER #18 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1801-ZH	FILTER #18 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-1801-ZL	FILTER #18 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-1802-YN	FILTER #18 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1802-YA	FILTER #18 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1802-ZH	FILTER #18 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-1802-ZL	FILTER #18 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-1803-YN	FILTER #18 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1803-YA	FILTER #18 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1803-ZH	FILTER #18 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-1803-ZL	FILTER #18 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-G-1901-YN	FILTER #19 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1901-YA	FILTER #19 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1901-ZH	FILTER #19 INLET GATE OPENED	DI	1822
FHA-FLT-G-1901-ZL	FILTER #19 INLET GATE CLOSED	DI	1822
FHA-FLT-G-1902-YN	FILTER #19 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-1902-YA	FILTER #19 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-1902-ZH	FILTER #19 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-1902-ZL	FILTER #19 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-1901-YN	FILTER #19 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1901-YA	FILTER #19 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1901-ZH	FILTER #19 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-1901-ZL	FILTER #19 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-1902-YN	FILTER #19 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1902-YA	FILTER #19 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1902-ZH	FILTER #19 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-1902-ZL	FILTER #19 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-1903-YN	FILTER #19 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-1903-YA	FILTER #19 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-1903-ZH	FILTER #19 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-1903-ZL	FILTER #19 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-G-2001-YN	FILTER #20 INLET GATE COMPUTER MODE	DI	1822
FHA-FLT-G-2001-YA	FILTER #20 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-G-2001-ZH	FILTER #20 INLET GATE OPENED	DI	1822
FHA-FLT-G-2001-ZL	FILTER #20 INLET GATE CLOSED	DI	1822
FHA-FLT-G-2002-YN	FILTER #20 DRAIN GATE COMPUTER MODE	DI	1822
FHA-FLT-G-2002-YA	FILTER #20 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822

I/O Tag No	Description	Type	RPU
FHA-FLT-G-2002-ZH	FILTER #20 DRAIN GATE OPENED	DI	1822
FHA-FLT-G-2002-ZL	FILTER #20 DRAIN GATE CLOSED	DI	1822
FHA-FLT-V-2001-YN	FILTER #20 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-2001-YA	FILTER #20 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-2001-ZH	FILTER #20 EFFLUENT RATE CONTROL VALVE OPENED	DI	1822
FHA-FLT-V-2001-ZL	FILTER #20 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1822
FHA-FLT-V-2002-YN	FILTER #20 BACKWASH VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-2002-YA	FILTER #20 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-2002-ZH	FILTER #20 BACKWASH VALVE OPENED	DI	1822
FHA-FLT-V-2002-ZL	FILTER #20 BACKWASH VALVE CLOSED	DI	1822
FHA-FLT-V-2003-YN	FILTER #20 SURFACE SWEEP VALVE COMPUTER MODE	DI	1822
FHA-FLT-V-2003-YA	FILTER #20 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-FLT-V-2003-ZH	FILTER #20 SURFACE SWEEP VALVE OPENED	DI	1822
FHA-FLT-V-2003-ZL	FILTER #20 SURFACE SWEEP VALVE CLOSED	DI	1822
FHA-FLT-HS-1701-ZL	FILTER #17 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-HS-1801-ZL	FILTER #18 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-HS-1901-ZL	FILTER #19 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-HS-2001-ZL	FILTER #20 VALVE ACP ENABLE/DISABLE SWITCH	DI	1822
FHA-FLT-AIT-1701-YA	FILTER #17 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-AIT-1801-YA	FILTER #18 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-AIT-1901-YA	FILTER #19 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-AIT-2001-YA	FILTER #20 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1822
FHA-FLT-LSHL-1701-LAH	FILTER #17 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1701-LAL	FILTER #17 LO LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1801-LAH	FILTER #18 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1801-LAL	FILTER #18 LO LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1901-LAH	FILTER #19 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-1901-LAL	FILTER #19 LO LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-2001-LAH	FILTER #20 HI LEVEL SWITCH	DI	1822
FHA-FLT-LSHL-2001-LAL	FILTER #20 LO LEVEL SWITCH	DI	1822
FHA-BW-V-0105-YN	WEST WW CTRL VLV COMPUTER MODE	DI	1822
FHA-BW-V-0105-YA	WEST WW CTRL VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-BW-V-0105-ZH	WEST WW CTRL VLV OPENED	DI	1822
FHA-BW-V-0105-ZL	WEST WW CTRL VLV CLOSED	DI	1822
FHA-FLT-LIT-0101-YA	WEST SEW CONDUIT LEVEL LOSS OF SIGNAL	DI	1822
FHA-CLB-AIT-0002-YA	FILTER CMPST TRB ANALYZER INSTRUMENT FAULT	DI	1822
FHA-CLB-AIT-0003-YA	AFT POST CLR ANALYZER#1 INSTRUMENT FAULT	DI	1822
FHA-CLB-AIT-0004-YA	AFT POST CLR ANALYZER#2 INSTRUMENT FAULT	DI	1822
FHA-CLB-FSL-0001-FAL	POST CLR SMP PUMP LOW FLOW ALARM	DI	1822

I/O Tag No	Description	Type	RPU
FHA-CLB-FSL-0003-FAL	POST CLR TRB ANALYZER LOW FLOW ALARM	DI	1822
FHA-CLB-FSL-0004-FAL	AFT POST CLR ANALYZER#1 LOW FLOW ALARM	DI	1822
FHA-CLB-FSL-0005-FAL	AFT POST CLR ANALYZER#2 LOW FLOW ALARM	DI	1822
FHA-CLB-P-0001A-YN	AFTER POST SMP PUMP#1A COMPUTER MODE	DI	1822
FHA-CLB-P-0001A-MN	AFTER POST SMP PUMP#1A RUNNING	DI	1822
FHA-CLB-V-0012-YN	SMP PUMP DRAIN VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0012-YA	SMP PUMP DRAIN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-CLB-V-0012-ZH	SMP PUMP DRAIN VLV OPENED	DI	1822
FHA-CLB-V-0012-ZL	SMP PUMP DRAIN VLV CLOSED	DI	1822
FHA-CLB-V-0013-YN	BACKFLUSH VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0013-YA	BACKFLUSH VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-CLB-V-0013-ZH	BACKFLUSH VLV OPENED	DI	1822
FHA-CLB-V-0013-ZL	BACKFLUSH VLV CLOSED	DI	1822
FHA-CLB-P-0001B-YN	AFTER POST SMP PUMP#1B COMPUTER MODE	DI	1822
FHA-CLB-P-0001B-MN	AFTER POST SMP PUMP#1B RUNNING	DI	1822
FHA-CLB-V-0014-YN	ANALYZER ISLN VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0014-YA	ANALYZER ISLN VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1822
FHA-CLB-V-0014-ZH	ANALYZER ISLN VLV OPENED	DI	1822
FHA-CLB-V-0014-ZL	ANALYZER ISLN VLV CLOSED	DI	1822
FHA-CLB-V-0029-YN	LAB ISOLATION VLV COMPUTER MODE	DI	1822
FHA-CLB-V-0029-YA	LAB ISOLATION VLV NOT AVAILABLE	DI	1822
FHA-CLB-V-0029-ZH	LAB ISOLATION VLV OPENED	DI	1822
FHA-CLB-V-0029-ZL	LAB ISOLATION VLV CLOSED	DI	1822
FHA-FLT-G-1701-VH	FILTER #17 INLET GATE OPEN	DO	1822
FHA-FLT-G-1701-VL	FILTER #17 INLET GATE CLOSE	DO	1822
FHA-FLT-G-1702-VH	FILTER #17 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-1702-VL	FILTER #17 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-1702-VH	FILTER #17 BACKWASH VALVE OPEN	DO	1822
FHA-FLT-V-1702-VL	FILTER #17 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-1703-VH	FILTER #17 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-1703-VL	FILTER #17 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-FLT-G-1801-VH	FILTER #18 INLET GATE OPEN	DO	1822
FHA-FLT-G-1801-VL	FILTER #18 INLET GATE CLOSE	DO	1822
FHA-FLT-G-1802-VH	FILTER #18 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-1802-VL	FILTER #18 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-1802-VH	FILTER #18 BACKWASH VALVE OPEN	DO	1822
FHA-FLT-V-1802-VL	FILTER #18 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-1803-VH	FILTER #18 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-1803-VL	FILTER #18 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-FLT-G-1901-VH	FILTER #19 INLET GATE OPEN	DO	1822
FHA-FLT-G-1901-VL	FILTER #19 INLET GATE CLOSE	DO	1822
FHA-FLT-G-1902-VH	FILTER #19 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-1902-VL	FILTER #19 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-1902-VH	FILTER #19 BACKWASH VALVE OPEN	DO	1822

I/O Tag No	Description	Type	RPU
FHA-FLT-V-1902-VL	FILTER #19 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-1903-VH	FILTER #19 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-1903-VL	FILTER #19 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-FLT-G-2001-VH	FILTER #20 INLET GATE OPEN	DO	1822
FHA-FLT-G-2001-VL	FILTER #20 INLET GATE CLOSE	DO	1822
FHA-FLT-G-2002-VH	FILTER #20 DRAIN GATE OPEN	DO	1822
FHA-FLT-G-2002-VL	FILTER #20 DRAIN GATE CLOSE	DO	1822
FHA-FLT-V-2002-VH	FILTER #20 BACKWASH VALVE OPEN	DO	1822
FHA-FLT-V-2002-VL	FILTER #20 BACKWASH VALVE CLOSE	DO	1822
FHA-FLT-V-2003-VH	FILTER #20 SURFACE SWEEP VALVE OPEN	DO	1822
FHA-FLT-V-2003-VL	FILTER #20 SURFACE SWEEP VALVE CLOSE	DO	1822
FHA-CLB-P-0001A-MH	AFTER POST SMP PUMP#1A START COMMAND	DO	1822
FHA-CLB-P-0001A-MB	AFTER POST SMP PUMP#1A STOP COMMAND	DO	1822
FHA-CLB-P-0001B-MH	AFTER POST SMP PUMP#1B START COMMAND	DO	1822
FHA-CLB-P-0001B-MB	AFTER POST SMP PUMP#1B STOP COMMAND	DO	1822
FHA-CLB-V-0012-VH	SMP PUMP DRAIN VLV OPEN	DO	1822
FHA-CLB-V-0012-VL	SMP PUMP DRAIN VLV CLOSE	DO	1822
FHA-CLB-V-0013-VH	BACKFLUSH VLV OPEN	DO	1822
FHA-CLB-V-0013-VL	BACKFLUSH VLV CLOSE	DO	1822
FHA-CLB-V-0014-VH	ANALYZER ISLN VLV OPEN	DO	1822
FHA-CLB-V-0014-VL	ANALYZER ISLN VLV CLOSE	DO	1822
FHA-CLB-V-0029-VH	LAB ISOLATION VLV OPEN	DO	1822
FHA-CLB-V-0029-VL	LAB ISOLATION VLV CLOSE	DO	1822
FHA-CLB-AIT-0003-DUTY	AFT POST CHLORINE ANALYZER CONTROL/REFERENCE SELECTION	DO	1822
FHA-FLT-ZIT-2101-ZI	FILTER #21 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2101-AI	FILTER #21 TURBIDITY	AI	1823
FHA-FLT-ZIT-2201-ZI	FILTER #22 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2201-AI	FILTER #22 TURBIDITY	AI	1823
FHA-FLT-ZIT-2301-ZI	FILTER #23 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2301-AI	FILTER #23 TURBIDITY	AI	1823
FHA-FLT-ZIT-2401-ZI	FILTER #24 RATE CONT VLV POSITION	AI	1823
FHA-FLT-AIT-2401-AI	FILTER #24 TURBIDITY	AI	1823
FHA-BW-ZIT-0205-ZI	EAST WW RATE CONT VLV POSITION	AI	1823
FHA-FLT-FIT-0002-FI	EAST FILTERS TOTAL FLOW	AI	1823
FHA-FLT-FIT-2101-FT	FILTER #21 FLOW	AI	1823
FHA-FLT-PDIT-2101-PDI	FILTER #21 HEAD LOSS	AI	1823
FHA-FLT-FIT-2201-FT	FILTER #22 FLOW	AI	1823
FHA-FLT-PDIT-2201-PDI	FILTER #22 HEAD LOSS	AI	1823
FHA-FLT-FIT-2301-FT	FILTER #23 FLOW	AI	1823
FHA-FLT-PDIT-2301-PDI	FILTER #23 HEAD LOSS	AI	1823
FHA-FLT-FIT-2401-FT	FILTER #24 FLOW	AI	1823
FHA-FLT-PDIT-2401-PDI	FILTER #24 HEAD LOSS	AI	1823
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1823
FHA-FLT-V-2101-ZC	FILTER #21 RATE CONTROL VALVE POSITION SETPOINT	AO	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2201-ZC	FILTER #22 RATE CONTROL VALVE POSITION SETPOINT	AO	1823
FHA-FLT-V-2301-VC	FILTER #23 RATE CONTROL VALVE POSITION SETPOINT	AO	1823
FHA-FLT-V-2401-VC	FILTER #24 RATE CONTROL VALVE POSITION SETPOINT	AO	1823
FHA-BW-V-0205-VC	EAST WW CTRL VLV PID{CV}CONTROL VARIABLE-OUTPUT	AO	1823
FHA-SPC-UPS-1823-EA	FILTERS 21-24 PLC UPS - POWER FAILURE	DI	1823
FHA-SPC-UPS-1823-EAL	FILTERS 21-24 PLC UPS - LOW BATTERY	DI	1823
FHA-SPC-UPS-1823-XA	FILTERS 21-24 PLC UPS - UPS FAILURE	DI	1823
FHA-SPC-RPU-1823-TAH	FILTER #21-24 PANEL SMOKE/HEAT ALARM	DI	1823
FHA-FLT-G-2101-YN	FILTER #21 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2101-YA	FILTER #21 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2101-ZH	FILTER #21 INLET GATE OPENED	DI	1823
FHA-FLT-G-2101-ZL	FILTER #21 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2102-YN	FILTER #21 DRAIN GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2102-YA	FILTER #21 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2102-ZH	FILTER #21 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2102-ZL	FILTER #21 DRAIN GATE CLOSED	DI	1823
FHA-FLT-V-2101-YN	FILTER #21 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2101-YA	FILTER #21 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2101-ZH	FILTER #21 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2101-ZL	FILTER #21 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2102-YN	FILTER #21 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2102-YA	FILTER #21 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2102-ZH	FILTER #21 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2102-ZL	FILTER #21 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2103-YN	FILTER #21 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2103-YA	FILTER #21 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2103-ZH	FILTER #21 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2103-ZL	FILTER #21 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-G-2201-YN	FILTER #22 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2201-YA	FILTER #22 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2201-ZH	FILTER #22 INLET GATE OPENED	DI	1823
FHA-FLT-G-2201-ZL	FILTER #22 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2202-YN	FILTER #22 DRAIN GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2202-YA	FILTER #22 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2202-ZH	FILTER #22 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2202-ZL	FILTER #22 DRAIN GATE CLOSED	DI	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2201-YN	FILTER #22 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2201-YA	FILTER #22 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2201-ZH	FILTER #22 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2201-ZL	FILTER #22 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2202-YN	FILTER #22 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2202-YA	FILTER #22 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2202-ZH	FILTER #22 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2202-ZL	FILTER #22 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2203-YN	FILTER #22 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2203-YA	FILTER #22 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2203-ZH	FILTER #22 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2203-ZL	FILTER #22 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-G-2301-YN	FILTER #23 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2301-YA	FILTER #23 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2301-ZH	FILTER #23 INLET GATE OPENED	DI	1823
FHA-FLT-G-2301-ZL	FILTER #23 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2302-YN	FILTER #23 DRAIN GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2302-YA	FILTER #23 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2302-ZH	FILTER #23 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2302-ZL	FILTER #23 DRAIN GATE CLOSED	DI	1823
FHA-FLT-V-2301-YN	FILTER #23 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2301-YA	FILTER #23 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2301-ZH	FILTER #23 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2301-ZL	FILTER #23 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2302-YN	FILTER #23 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2302-YA	FILTER #23 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2302-ZH	FILTER #23 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2302-ZL	FILTER #23 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2303-YN	FILTER #23 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2303-YA	FILTER #23 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2303-ZH	FILTER #23 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2303-ZL	FILTER #23 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-G-2401-YN	FILTER #24 INLET GATE COMPUTER MODE	DI	1823
FHA-FLT-G-2401-YA	FILTER #24 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2401-ZH	FILTER #24 INLET GATE OPENED	DI	1823
FHA-FLT-G-2401-ZL	FILTER #24 INLET GATE CLOSED	DI	1823
FHA-FLT-G-2402-YN	FILTER #24 DRAIN GATE COMPUTER MODE	DI	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-G-2402-YA	FILTER #24 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-G-2402-ZH	FILTER #24 DRAIN GATE OPENED	DI	1823
FHA-FLT-G-2402-ZL	FILTER #24 DRAIN GATE CLOSED	DI	1823
FHA-FLT-V-2401-YN	FILTER #24 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2401-YA	FILTER #24 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2401-ZH	FILTER #24 EFFLUENT RATE CONTROL VALVE OPENED	DI	1823
FHA-FLT-V-2401-ZL	FILTER #24 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1823
FHA-FLT-V-2402-YN	FILTER #24 BACKWASH VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2402-YA	FILTER #24 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2402-ZH	FILTER #24 BACKWASH VALVE OPENED	DI	1823
FHA-FLT-V-2402-ZL	FILTER #24 BACKWASH VALVE CLOSED	DI	1823
FHA-FLT-V-2403-YN	FILTER #24 SURFACE SWEEP VALVE COMPUTER MODE	DI	1823
FHA-FLT-V-2403-YA	FILTER #24 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-FLT-V-2403-ZH	FILTER #24 SURFACE SWEEP VALVE OPENED	DI	1823
FHA-FLT-V-2403-ZL	FILTER #24 SURFACE SWEEP VALVE CLOSED	DI	1823
FHA-FLT-HS-2101-ZL	FILTER #21 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-HS-2201-ZL	FILTER #22 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-HS-2301-ZL	FILTER #23 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-HS-2401-ZL	FILTER #24 VALVE ACP ENABLE/DISABLE SWITCH	DI	1823
FHA-FLT-AIT-2101-YA	FILTER #21 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1823
FHA-FLT-AIT-2201-YA	FILTER #22EFFLUENT TURBIDITY INSTRUMENT FAULT	DI	1823
FHA-FLT-AIT-2301-YA	FILTER #23 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1823
FHA-FLT-AIT-2401-YA	FILTER #24 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1823
FHA-FLT-LSHL-2101-LAH	FILTER #21 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2101-LAL	FILTER #21 LO LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2201-LAH	FILTER #22 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2201-LAL	FILTER #22 LO LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2301-LAH	FILTER #23 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2301-LAL	FILTER #23 LO LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2401-LAH	FILTER #24 HI LEVEL SWITCH	DI	1823
FHA-FLT-LSHL-2401-LAL	FILTER #24 LO LEVEL SWITCH	DI	1823
FHA-BW-V-0205-YN	EAST WW CTRL VLV COMPUTER MODE	DI	1823
FHA-BW-V-0205-YA	EAST WW CTRL VLV NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1823
FHA-BW-V-0205-ZH	EAST WW CTRL VLV OPENED	DI	1823
FHA-BW-V-0205-ZL	EAST WW CTRL VLV CLOSED	DI	1823
FHA-FLT-LIT-0201-YA	EAST SEW CONDUIT LEVEL LOSS OF SIGNAL	DI	1823
FHA-FLT-V-2109-ZH	FILTER #21 EFFLUENT G VALVE OPENED	DI	1823
FHA-FLT-V-2109-ZL	FILTER #21 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-V-2209-ZH	FILTER #22 EFFLUENT G VALVE OPENED	DI	1823

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2209-ZL	FILTER #22 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-V-2309-ZH	FILTER #23 EFFLUENT G VALVE OPENED	DI	1823
FHA-FLT-V-2309-ZL	FILTER #23 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-V-2409-ZH	FILTER #24 EFFLUENT G VALVE OPENED	DI	1823
FHA-FLT-V-2409-ZL	FILTER #24 EFFLUENT G VALVE CLOSED	DI	1823
FHA-FLT-G-2101-VH	FILTER #21 INLET GATE OPEN	DO	1823
FHA-FLT-G-2101-VL	FILTER #21 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2102-VH	FILTER #21 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2102-VL	FILTER #21 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2102-VH	FILTER #21 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2102-VL	FILTER #21 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2103-VH	FILTER #21 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2103-VL	FILTER #21 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-G-2201-VH	FILTER #22 INLET GATE OPEN	DO	1823
FHA-FLT-G-2201-VL	FILTER #22 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2202-VH	FILTER #22 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2202-VL	FILTER #22 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2202-VH	FILTER #22 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2202-VL	FILTER #22 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2203-VH	FILTER #22 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2203-VL	FILTER #22 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-G-2301-VH	FILTER #23 INLET GATE OPEN	DO	1823
FHA-FLT-G-2301-VL	FILTER #23 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2302-VH	FILTER #23 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2302-VL	FILTER #23 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2302-VH	FILTER #23 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2302-VL	FILTER #23 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2303-VH	FILTER #23 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2303-VL	FILTER #23 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-G-2401-VH	FILTER #24 INLET GATE OPEN	DO	1823
FHA-FLT-G-2401-VL	FILTER #24 INLET GATE CLOSE	DO	1823
FHA-FLT-G-2402-VH	FILTER #24 DRAIN GATE OPEN	DO	1823
FHA-FLT-G-2402-VL	FILTER #24 DRAIN GATE CLOSE	DO	1823
FHA-FLT-V-2402-VH	FILTER #24 BACKWASH VALVE OPEN	DO	1823
FHA-FLT-V-2402-VL	FILTER #24 BACKWASH VALVE CLOSE	DO	1823
FHA-FLT-V-2403-VH	FILTER #24 SURFACE SWEEP VALVE OPEN	DO	1823
FHA-FLT-V-2403-VL	FILTER #24 SURFACE SWEEP VALVE CLOSE	DO	1823
FHA-FLT-ZIT-2501-ZI	FILTER #25 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2501-AI	FILTER #25 TURBIDITY	AI	1621
FHA-FLT-ZIT-2601-ZI	FILTER #26 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2601-AI	FILTER #26 TURBIDITY	AI	1621
FHA-FLT-ZIT-2701-ZI	FILTER #27 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2701-AI	FILTER #27 TURBIDITY	AI	1621
FHA-FLT-ZIT-2801-ZI	FILTER #28 RATE CONT VLV POSITION	AI	1621
FHA-FLT-AIT-2801-AI	FILTER #28 TURBIDITY	AI	1621
FHA-FLT-AIT-4201-AI	E FILTER TRB ANALYZER	AI	1621
FHA-FLT-AIT-4202-AI	E FLE RESID CLR ANALYZER	AI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-FIT-2501-FT	FILTER #25 FLOW	AI	1621
FHA-FLT-PDIT-2501-PDI	FILTER #25 HEAD LOSS	AI	1621
FHA-FLT-FIT-2601-FT	FILTER #26 FLOW	AI	1621
FHA-FLT-PDIT-2601-PDI	FILTER #26 HEAD LOSS	IA	1621
FHA-FLT-FIT-2701-FT	FILTER #27 FLOW	AI	1621
FHA-FLT-PDIT-2701-PDI	FILTER #27 HEAD LOSS	AI	1621
FHA-FLT-FIT-2801-FT	FILTER #28 FLOW	AI	1621
FHA-FLT-PDIT-2801-PDI	FILTER #28 HEAD LOSS	AI	1621
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1621
FHA-FLT-V-2501-ZC	FILTER #25 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-FLT-V-2601-ZC	FILTER #26 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-FLT-V-2701-VC	FILTER #27 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-FLT-V-2801-VC	FILTER #28 RATE CONTROL VALVE POSITION SETPOINT	AO	1621
FHA-SPC-UPS-1621-EA	FILTERS 25-28 PLC UPS - POWER FAILURE	DI	1621
FHA-SPC-UPS-1621-EAL	FILTERS 25-28 PLC UPS - LOW BATTERY	DI	1621
FHA-SPC-UPS-1621-XA	FILTERS 25-28 PLC UPS - UPS FAILURE	DI	1621
FHA-SPC-UPS-1611-EA	EAST FILTRATION COMPUTER UPS - POWER FAILURE	DI	1621
FHA-SPC-UPS-1611-EAL	EAST FILTRATION COMPUTER UPS - LOW BATTERY	DI	1621
FHA-SPC-UPS-1611-XA	EAST FILTRATION COMPUTER UPS - UPS FAILURE	DI	1621
FHA-SPC-RPU-1621-TAH	FILTER #25-28 PANEL SMOKE/HEAT ALARM	DI	1621
FHA-FLT-G-2501-YN	FILTER #25 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2501-YA	FILTER #25 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2501-ZH	FILTER #25 INLET GATE OPENED	DI	1621
FHA-FLT-G-2501-ZL	FILTER #25 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2502-YN	FILTER #25 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2502-YA	FILTER #25 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2502-ZH	FILTER #25 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2502-ZL	FILTER #25 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2501-YN	FILTER #25 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2501-YA	FILTER #25 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2501-ZH	FILTER #25 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2501-ZL	FILTER #25 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2502-YN	FILTER #25 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2502-YA	FILTER #25 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2502-ZH	FILTER #25 BACKWASH VALVE OPENED	DI	1621
FHA-FLT-V-2502-ZL	FILTER #25 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2503-YN	FILTER #25 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2503-YA	FILTER #25 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2503-ZH	FILTER #25 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2503-ZL	FILTER #25 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-G-2601-YN	FILTER #26 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2601-YA	FILTER #26 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2601-ZH	FILTER #26 INLET GATE OPENED	DI	1621
FHA-FLT-G-2601-ZL	FILTER #26 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2602-YN	FILTER #26 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2602-YA	FILTER #26 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2602-ZH	FILTER #26 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2602-ZL	FILTER #26 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2601-YN	FILTER #26 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2601-YA	FILTER #26 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2601-ZH	FILTER #26 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2601-ZL	FILTER #26 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2602-YN	FILTER #26 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2602-YA	FILTER #26 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2602-ZH	FILTER #26 BACKWASH VALVE OPENED	DI	1621
FHA-FLT-V-2602-ZL	FILTER #26 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2603-YN	FILTER #26 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2603-YA	FILTER #26 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2603-ZH	FILTER #26 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2603-ZL	FILTER #26 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-G-2701-YN	FILTER #27 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2701-YA	FILTER #27 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2701-ZH	FILTER #27 INLET GATE OPENED	DI	1621
FHA-FLT-G-2701-ZL	FILTER #27 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2702-YN	FILTER #27 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2702-YA	FILTER #27 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2702-ZH	FILTER #27 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2702-ZL	FILTER #27 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2701-YN	FILTER #27 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2701-YA	FILTER #27 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2701-ZH	FILTER #27 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2701-ZL	FILTER #27 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2702-YN	FILTER #27 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2702-YA	FILTER #27 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2702-ZH	FILTER #27 BACKWASH VALVE OPENED	DI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2702-ZL	FILTER #27 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2703-YN	FILTER #27 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2703-YA	FILTER #27 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2703-ZH	FILTER #27 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2703-ZL	FILTER #27 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-G-2801-YN	FILTER #28 INLET GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2801-YA	FILTER #28 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2801-ZH	FILTER #28 INLET GATE OPENED	DI	1621
FHA-FLT-G-2801-ZL	FILTER #28 INLET GATE CLOSED	DI	1621
FHA-FLT-G-2802-YN	FILTER #28 DRAIN GATE COMPUTER MODE	DI	1621
FHA-FLT-G-2802-YA	FILTER #28 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-G-2802-ZH	FILTER #28 DRAIN GATE OPENED	DI	1621
FHA-FLT-G-2802-ZL	FILTER #28 DRAIN GATE CLOSED	DI	1621
FHA-FLT-V-2801-YN	FILTER #28 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2801-YA	FILTER #28 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2801-ZH	FILTER #28 EFFLUENT RATE CONTROL VALVE OPENED	DI	1621
FHA-FLT-V-2801-ZL	FILTER #28 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1621
FHA-FLT-V-2802-YN	FILTER #28 BACKWASH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2802-YA	FILTER #28 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2802-ZH	FILTER #28 BACKWASH VALVE OPENED	DI	1621
FHA-FLT-V-2802-ZL	FILTER #28 BACKWASH VALVE CLOSED	DI	1621
FHA-FLT-V-2803-YN	FILTER #28 SURFACE SWEEP VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-2803-YA	FILTER #28 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-2803-ZH	FILTER #28 SURFACE SWEEP VALVE OPENED	DI	1621
FHA-FLT-V-2803-ZL	FILTER #28 SURFACE SWEEP VALVE CLOSED	DI	1621
FHA-FLT-HS-2501-ZL	FILTER #25 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-HS-2601-ZL	FILTER #26 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-HS-2701-ZL	FILTER #27 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-HS-2801-ZL	FILTER #28 VALVE ACP ENABLE/DISABLE SWITCH	DI	1621
FHA-FLT-AIT-2501-YA	FILTER #25 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-AIT-2601-YA	FILTER #26 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-AIT-2701-YA	FILTER #27 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-AIT-2801-YA	FILTER #28 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-LSHL-2501-LAH	FILTER #25 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2501-LAL	FILTER #25 LO LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2601-LAH	FILTER #26 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2601-LAL	FILTER #26 LO LEVEL SWITCH	DI	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-LSHL-2701-LAH	FILTER #27 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2701-LAL	FILTER #27 LO LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2801-LAH	FILTER #28 HI LEVEL SWITCH	DI	1621
FHA-FLT-LSHL-2801-LAL	FILTER #28 LO LEVEL SWITCH	DI	1621
FHA-FLT-V-2509-ZH	FILTER #25 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2509-ZL	FILTER #25 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-V-2609-ZH	FILTER #26 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2609-ZL	FILTER #26 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-V-2709-ZH	FILTER #27 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2709-ZL	FILTER #27 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-V-2809-ZH	FILTER #28 EFFLUENT G VALVE OPENED	DI	1621
FHA-FLT-V-2809-ZL	FILTER #28 EFFLUENT G VALVE CLOSED	DI	1621
FHA-FLT-AIT-4201-YA	FILTER TRB ANALYZER LOSS OF SIGNAL (N/A – DISABLED IN SOFTWARE LOGIC)	DI	1621
FHA-FLT-AIT-4202-YA	E FLE RESID CLR ANALYZER INSTRUMENT FAULT	DI	1621
FHA-FLT-FSL-4201-FAL	E FILTER CMPST SMP PUMP FLOW LOW ALARM	DI	1621
FHA-FLT-FSL-4202-FAL	E FILTER TRB ANALYZER FLOW LOW ALARM	DI	1621
FHA-FLT-FSL-4203-FAL	E FLE RESID CLR ANALYZER FLOW LOW ALARM	DI	1621
FHA-FLT-P-4201-YN	E FILTER CMPST SMP PUMP COMPUTER MODE	DI	1621
FHA-FLT-P-4201-MN	E FILTER CMPST SMP PUMP RUNNING	DI	1621
FHA-FLT-V-4208-YN	EAST ANALYZER ISLN VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4208-YA	EAST ANALYZER ISLN VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4208-ZH	EAST ANALYZER ISLN VALVE OPENED	DI	1621
FHA-FLT-V-4208-ZL	EAST ANALYZER ISLN VALVE CLOSED	DI	1621
FHA-FLT-V-4209-YN	EAST BACKFLUSH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4209-YA	EAST BACKFLUSH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4209-ZH	EAST BACKFLUSH VALVE OPENED	DI	1621
FHA-FLT-V-4209-ZL	EAST BACKFLUSH VALVE CLOSED	DI	1621
FHA-FLT-V-4210-YN	EAST DRAIN VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4210-YA	EAST DRAIN VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4210-ZH	EAST DRAIN VALVE OPENED	DI	1621
FHA-FLT-V-4210-ZL	EAST DRAIN VALVE CLOSED	DI	1621
FHA-FLT-V-4206-YN	EAST LAB ISLN VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4206-YA	EAST LAB ISLN VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4206-ZH	EAST LAB ISLN VALVE OPENED	DI	1621
FHA-FLT-V-4206-ZL	EAST LAB ISLN VALVE CLOSED	DI	1621
FHA-FLT-V-4211-YN	EAST SUCT FLUSH VALVE COMPUTER MODE	DI	1621
FHA-FLT-V-4211-YA	EAST SUCT FLUSH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1621
FHA-FLT-V-4211-ZH	EAST SUCT FLUSH VALVE OPENED	DI	1621
FHA-FLT-V-4211-ZL	EAST SUCT FLUSH VALVE CLOSED	DI	1621
FHA-FLT-G-2501-VH	FILTER #25 INLET GATE OPEN	DO	1621
FHA-FLT-G-2501-VL	FILTER #25 INLET GATE CLOSE	DO	1621

I/O Tag No	Description	Type	RPU
FHA-FLT-G-2502-VH	FILTER #25 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2502-VL	FILTER #25 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2502-VH	FILTER #25 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2502-VL	FILTER #25 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2503-VH	FILTER #25 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2503-VL	FILTER #25 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-G-2601-VH	FILTER #26 INLET GATE OPEN	DO	1621
FHA-FLT-G-2601-VL	FILTER #26 INLET GATE CLOSE	DO	1621
FHA-FLT-G-2602-VH	FILTER #26 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2602-VL	FILTER #26 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2602-VH	FILTER #26 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2602-VL	FILTER #26 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2603-VH	FILTER #26 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2603-VL	FILTER #26 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-G-2701-VH	FILTER #27 INLET GATE OPEN	DO	1621
FHA-FLT-G-2701-VL	FILTER #27 INLET GATE CLOSE	DO	1621
FHA-FLT-G-2702-VH	FILTER #27 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2702-VL	FILTER #27 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2702-VH	FILTER #27 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2702-VL	FILTER #27 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2703-VH	FILTER #27 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2703-VL	FILTER #27 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-G-2801-VH	FILTER #28 INLET GATE OPEN	DO	1621
FHA-FLT-G-2801-VL	FILTER #28 INLET GATE CLOSE	DO	1621
FHA-FLT-G-2802-VH	FILTER #28 DRAIN GATE OPEN	DO	1621
FHA-FLT-G-2802-VL	FILTER #28 DRAIN GATE CLOSE	DO	1621
FHA-FLT-V-2802-VH	FILTER #28 BACKWASH VALVE OPEN	DO	1621
FHA-FLT-V-2802-VL	FILTER #28 BACKWASH VALVE CLOSE	DO	1621
FHA-FLT-V-2803-VH	FILTER #28 SURFACE SWEEP VALVE OPEN	DO	1621
FHA-FLT-V-2803-VL	FILTER #28 SURFACE SWEEP VALVE CLOSE	DO	1621
FHA-FLT-P-4201-MH	E FILTER CMPST SMP PUMP START COMMAND	DO	1621
FHA-FLT-P-4201-MB	E FILTER CMPST SMP PUMP STOP COMMAND	DO	1621
FHA-FLT-V-4208-VH	EAST ANALYZER ISLN VALVE OPEN	DO	1621
FHA-FLT-V-4208-VL	EAST ANALYZER ISLN VALVE CLOSE	DO	1621
FHA-FLT-V-4209-VH	EAST BACKFLUSH VALVE OPEN	DO	1621
FHA-FLT-V-4209-VL	EAST BACKFLUSH VALVE CLOSE	DO	1621
FHA-FLT-V-4210-VH	EAST DRAIN VALVE OPEN	DO	1621
FHA-FLT-V-4210-VL	EAST DRAIN VALVE CLOSE	DO	1621
FHA-FLT-V-4206-VH	EAST LAB ISLN VALVE OPEN	DO	1621
FHA-FLT-V-4206-VL	EAST LAB ISLN VALVE CLOSE	DO	1621
FHA-FLT-V-4211-VH	EAST SUCT FLUSH VALVE OPEN	DO	1621
FHA-FLT-V-4211-VL	EAST SUCT FLUSH VALVE CLOSE	DO	1621
FHA-FLT-ZIT-2901-ZI	FILTER #29 RATE CONT VLV POSITION	AI	1622
FHA-FLT-AIT-2901-AI	FILTER #29 TURBIDITY	AI	1622
FHA-FLT-ZIT-3001-ZI	FILTER #30 RATE CONT VLV POSITION	AI	1622
FHA-FLT-AIT-3001-AI	FILTER #30 TURBIDITY	AI	1622
FHA-FLT-ZIT-3101-ZI	FILTER #31 RATE CONT VLV POSITION	AI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-AIT-3101-AI	FILTER #31 TURBIDITY	AI	1622
FHA-FLT-ZIT-3201-ZI	FILTER #32 RATE CONT VLV POSITION	AI	1622
FHA-FLT-AIT-3201-AI	FILTER #32 TURBIDITY	AI	1622
FHA-FLT-FIT-2901-FT	FILTER #29 FLOW	AI	1622
FHA-FLT-PDIT-2901-PDI	FILTER #29 HEAD LOSS	AI	1622
FHA-FLT-FIT-3001-FT	FILTER #30 FLOW	AI	1622
FHA-FLT-PDIT-3001-PDI	FILTER #30 HEAD LOSS	AI	1622
FHA-FLT-FIT-3101-FT	FILTER #31 FLOW	AI	1622
FHA-FLT-PDIT-3101-PDI	FILTER #31 HEAD LOSS	AI	1622
FHA-FLT-FIT-3201-FT	FILTER #32 FLOW	AI	1622
FHA-FLT-PDIT-3201-PDI	FILTER #32 HEAD LOSS	AI	1622
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1622
FHA-FLT-V-2901-ZC	FILTER #29 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-FLT-V-3001-ZC	FILTER #30 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-FLT-V-3101-VC	FILTER #31 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-FLT-V-3201-VC	FILTER #32 RATE CONTROL VALVE POSITION SETPOINT	AO	1622
FHA-SPC-UPS-1622-EA	FILTERS 29-32 PLC UPS - POWER FAILURE	DI	1622
FHA-SPC-UPS-1622-EAL	FILTERS 29-32 PLC UPS - LOW BATTERY	DI	1622
FHA-SPC-UPS-1622-XA	FILTERS 29-32 PLC UPS - UPS FAILURE	DI	1622
FHA-SPC-RPU-1622-TAH	FILTER #29-32 PANEL SMOKE/HEAT ALARM	DI	1622
FHA-FLT-G-2901-YN	FILTER #29 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-2901-YA	FILTER #29 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-2901-ZH	FILTER #29 INLET GATE OPENED	DI	1622
FHA-FLT-G-2901-ZL	FILTER #29 INLET GATE CLOSED	DI	1622
FHA-FLT-G-2902-YN	FILTER #29 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-2902-YA	FILTER #29 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-2902-ZH	FILTER #29 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-2902-ZL	FILTER #29 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-2901-YN	FILTER #29 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-2901-YA	FILTER #29 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-2901-ZH	FILTER #29 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-2901-ZL	FILTER #29 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-2902-YN	FILTER #29 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-2902-YA	FILTER #29 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-2902-ZH	FILTER #29 BACKWASH VALVE OPENED	DI	1622
FHA-FLT-V-2902-ZL	FILTER #29 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-2903-YN	FILTER #29 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-2903-YA	FILTER #29 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-V-2903-ZH	FILTER #29 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-2903-ZL	FILTER #29 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-G-3001-YN	FILTER #30 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3001-YA	FILTER #30 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3001-ZH	FILTER #30 INLET GATE OPENED	DI	1622
FHA-FLT-G-3001-ZL	FILTER #30 INLET GATE CLOSED	DI	1622
FHA-FLT-G-3002-YN	FILTER #30 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3002-YA	FILTER #30 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3002-ZH	FILTER #30 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-3002-ZL	FILTER #30 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-3001-YN	FILTER #30 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3001-YA	FILTER #30 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3001-ZH	FILTER #30 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-3001-ZL	FILTER #30 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-3002-YN	FILTER #30 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3002-YA	FILTER #30 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3002-ZH	FILTER #30 BACKWASH VALVE OPENED	DI	1622
FHA-FLT-V-3002-ZL	FILTER #30 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-3003-YN	FILTER #30 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3003-YA	FILTER #30 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3003-ZH	FILTER #30 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-3003-ZL	FILTER #30 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-G-3101-YN	FILTER #31 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3101-YA	FILTER #31 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3101-ZH	FILTER #31 INLET GATE OPENED	DI	1622
FHA-FLT-G-3101-ZL	FILTER #31 INLET GATE CLOSED	DI	1622
FHA-FLT-G-3102-YN	FILTER #31 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3102-YA	FILTER #31 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3102-ZH	FILTER #31 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-3102-ZL	FILTER #31 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-3101-YN	FILTER #31 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3101-YA	FILTER #31 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3101-ZH	FILTER #31 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-3101-ZL	FILTER #31 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-3102-YN	FILTER #31 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3102-YA	FILTER #31 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3102-ZH	FILTER #31 BACKWASH VALVE OPENED	DI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3102-ZL	FILTER #31 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-3103-YN	FILTER #31 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3103-YA	FILTER #31 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3103-ZH	FILTER #31 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-3103-ZL	FILTER #31 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-G-3201-YN	FILTER #32 INLET GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3201-YA	FILTER #32 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3201-ZH	FILTER #32 INLET GATE OPENED	DI	1622
FHA-FLT-G-3201-ZL	FILTER #32 INLET GATE CLOSED	DI	1622
FHA-FLT-G-3202-YN	FILTER #32 DRAIN GATE COMPUTER MODE	DI	1622
FHA-FLT-G-3202-YA	FILTER #32 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-G-3202-ZH	FILTER #32 DRAIN GATE OPENED	DI	1622
FHA-FLT-G-3202-ZL	FILTER #32 DRAIN GATE CLOSED	DI	1622
FHA-FLT-V-3201-YN	FILTER #32 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3201-YA	FILTER #32 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3201-ZH	FILTER #32 EFFLUENT RATE CONTROL VALVE OPENED	DI	1622
FHA-FLT-V-3201-ZL	FILTER #32 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1622
FHA-FLT-V-3202-YN	FILTER #32 BACKWASH VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3202-YA	FILTER #32 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3202-ZH	FILTER #32 BACKWASH VALVE OPENED	DI	1622
FHA-FLT-V-3202-ZL	FILTER #32 BACKWASH VALVE CLOSED	DI	1622
FHA-FLT-V-3203-YN	FILTER #32 SURFACE SWEEP VALVE COMPUTER MODE	DI	1622
FHA-FLT-V-3203-YA	FILTER #32 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1622
FHA-FLT-V-3203-ZH	FILTER #32 SURFACE SWEEP VALVE OPENED	DI	1622
FHA-FLT-V-3203-ZL	FILTER #32 SURFACE SWEEP VALVE CLOSED	DI	1622
FHA-FLT-HS-2901-ZL	FILTER #29 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-HS-3001-ZL	FILTER #30 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-HS-3101-ZL	FILTER #31 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-HS-3201-ZL	FILTER #32 VALVE ACP ENABLE/DISABLE SWITCH	DI	1622
FHA-FLT-AIT-2901-YA	FILTER #29 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-AIT-3001-YA	FILTER #30 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-AIT-3101-YA	FILTER #31 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-AIT-3201-YA	FILTER #32 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1622
FHA-FLT-LSHL-2901-LAH	FILTER #29 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-2901-LAL	FILTER #29 LO LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3001-LAH	FILTER #30 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3001-LAL	FILTER #30 LO LEVEL SWITCH	DI	1622

I/O Tag No	Description	Type	RPU
FHA-FLT-LSHL-3101-LAH	FILTER #31 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3101-LAL	FILTER #31 LO LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3201-LAH	FILTER #32 HI LEVEL SWITCH	DI	1622
FHA-FLT-LSHL-3201-LAL	FILTER #32 LO LEVEL SWITCH	DI	1622
FHA-FLT-V-2909-ZH	FILTER #29 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-2909-ZL	FILTER #29 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-V-3009-ZH	FILTER #30 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-3009-ZL	FILTER #30 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-V-3109-ZH	FILTER #31 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-3109-ZL	FILTER #31 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-V-3209-ZH	FILTER #32 EFFLUENT G VALVE OPENED	DI	1622
FHA-FLT-V-3209-ZL	FILTER #32 EFFLUENT G VALVE CLOSED	DI	1622
FHA-FLT-G-2901-VH	FILTER #29 INLET GATE OPEN	DO	1622
FHA-FLT-G-2901-VL	FILTER #29 INLET GATE CLOSE	DO	1622
FHA-FLT-G-2902-VH	FILTER #29 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-2902-VL	FILTER #29 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-2902-VH	FILTER #29 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-2902-VL	FILTER #29 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-2903-VH	FILTER #29 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-2903-VL	FILTER #29 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-G-3001-VH	FILTER #30 INLET GATE OPEN	DO	1622
FHA-FLT-G-3001-VL	FILTER #30 INLET GATE CLOSE	DO	1622
FHA-FLT-G-3002-VH	FILTER #30 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-3002-VL	FILTER #30 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-3002-VH	FILTER #30 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-3002-VL	FILTER #30 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-3003-VH	FILTER #30 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-3003-VL	FILTER #30 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-G-3101-VH	FILTER #31 INLET GATE OPEN	DO	1622
FHA-FLT-G-3101-VL	FILTER #31 INLET GATE CLOSE	DO	1622
FHA-FLT-G-3102-VH	FILTER #31 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-3102-VL	FILTER #31 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-3102-VH	FILTER #31 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-3102-VL	FILTER #31 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-3103-VH	FILTER #31 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-3103-VL	FILTER #31 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-G-3201-VH	FILTER #32 INLET GATE OPEN	DO	1622
FHA-FLT-G-3201-VL	FILTER #32 INLET GATE CLOSE	DO	1622
FHA-FLT-G-3202-VH	FILTER #32 DRAIN GATE OPEN	DO	1622
FHA-FLT-G-3202-VL	FILTER #32 DRAIN GATE CLOSE	DO	1622
FHA-FLT-V-3202-VH	FILTER #32 BACKWASH VALVE OPEN	DO	1622
FHA-FLT-V-3202-VL	FILTER #32 BACKWASH VALVE CLOSE	DO	1622
FHA-FLT-V-3203-VH	FILTER #32 SURFACE SWEEP VALVE OPEN	DO	1622
FHA-FLT-V-3203-VL	FILTER #32 SURFACE SWEEP VALVE CLOSE	DO	1622
FHA-FLT-ZIT-3301-ZI	FILTER #33 RATE CONT VLV POSITION	AI	1623
FHA-FLT-AIT-3301-AI	FILTER #33 TURBIDITY	AI	1623
FHA-FLT-ZIT-3401-ZI	FILTER #34 RATE CONT VLV POSITION	AI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-AIT-3401-AI	FILTER #34 TURBIDITY	AI	1623
FHA-FLT-ZIT-3501-ZI	FILTER #35 RATE CONT VLV POSITION	AI	1623
FHA-FLT-AIT-3501-AI	FILTER #35 TURBIDITY	AI	1623
FHA-FLT-ZIT-3601-ZI	FILTER #36 RATE CONT VLV POSITION	AI	1623
FHA-FLT-AIT-3601-AI	FILTER #36 TURBIDITY	AI	1623
FHA-FLT-FIT-3301-FT	FILTER #33 FLOW	AI	1623
FHA-FLT-PDIT-3301-PDI	FILTER #33 HEAD LOSS	AI	1623
FHA-FLT-FIT-3401-FT	FILTER #34 FLOW	AI	1623
FHA-FLT-PDIT-3401-PDI	FILTER #34 HEAD LOSS	AI	1623
FHA-FLT-FIT-3501-FT	FILTER #35 FLOW	AI	1623
FHA-FLT-PDIT-3501-PDI	FILTER #35 HEAD LOSS	AI	1623
FHA-FLT-FIT-3601-FT	FILTER #36 FLOW	AI	1623
FHA-FLT-PDIT-3601-PDI	FILTER #36 HEAD LOSS	AI	1623
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1623
FHA-FLT-V-3301-ZC	FILTER #33 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-FLT-V-3401-ZC	FILTER #34 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-FLT-V-3501-ZC	FILTER #35 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-FLT-V-3601-ZC	FILTER #36 RATE CONTROL VALVE POSITION SETPOINT	AO	1623
FHA-SPC-UPS-1623-EA	FILTERS 33-36 PLC UPS - POWER FAILURE	DI	1623
FHA-SPC-UPS-1623-EAL	FILTERS 33-36 PLC UPS - LOW BATTERY	DI	1623
FHA-SPC-UPS-1623-XA	FILTERS 33-36 PLC UPS - UPS FAILURE	DI	1623
FHA-SPC-RPU-1623-TAH	FILTER #33-36 PANEL SMOKE/HEAT ALARM	DI	1623
FHA-FLT-G-3301-YN	FILTER #33 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3301-YA	FILTER #33 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3301-ZH	FILTER #33 INLET GATE OPENED	DI	1623
FHA-FLT-G-3301-ZL	FILTER #33 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3302-YN	FILTER #33 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3302-YA	FILTER #33 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3302-ZH	FILTER #33 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3302-ZL	FILTER #33 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3301-YN	FILTER #33 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3301-YA	FILTER #33 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3301-ZH	FILTER #33 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3301-ZL	FILTER #33 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3302-YN	FILTER #33 BACKWASH VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3302-YA	FILTER #33 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3302-ZH	FILTER #33 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3302-ZL	FILTER #33 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3303-YN	FILTER #33 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3303-YA	FILTER #33 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3303-ZH	FILTER #33 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3303-ZL	FILTER #33 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-G-3401-YN	FILTER #34 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3401-YA	FILTER #34 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3401-ZH	FILTER #34 INLET GATE OPENED	DI	1623
FHA-FLT-G-3401-ZL	FILTER #34 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3402-YN	FILTER #34 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3402-YA	FILTER #34 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3402-ZH	FILTER #34 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3402-ZL	FILTER #34 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3401-YN	FILTER #34 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3401-YA	FILTER #34 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3401-ZH	FILTER #34 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3401-ZL	FILTER #34 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3402-YN	FILTER #34 BACKWASH VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3402-YA	FILTER #34 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3402-ZH	FILTER #34 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3402-ZL	FILTER #34 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3403-YN	FILTER #34 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3403-YA	FILTER #34 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3403-ZH	FILTER #34 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3403-ZL	FILTER #34 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-G-3501-YN	FILTER #35 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3501-YA	FILTER #35 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3501-ZH	FILTER #35 INLET GATE OPENED	DI	1623
FHA-FLT-G-3501-ZL	FILTER #35 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3502-YN	FILTER #35 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3502-YA	FILTER #35 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3502-ZH	FILTER #35 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3502-ZL	FILTER #35 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3501-YN	FILTER #35 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3501-YA	FILTER #35 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3501-ZH	FILTER #35 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3501-ZL	FILTER #35 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3502-YN	FILTER #35 BACKWASH VALVE COMPUTER MODE	DI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3502-YA	FILTER #35 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3502-ZH	FILTER #35 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3502-ZL	FILTER #35 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3503-YN	FILTER #35 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3503-YA	FILTER #35 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3503-ZH	FILTER #35 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3503-ZL	FILTER #35 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-G-3601-YN	FILTER #36 INLET GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3601-YA	FILTER #36 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3601-ZH	FILTER #36 INLET GATE OPENED	DI	1623
FHA-FLT-G-3601-ZL	FILTER #36 INLET GATE CLOSED	DI	1623
FHA-FLT-G-3602-YN	FILTER #36 DRAIN GATE COMPUTER MODE	DI	1623
FHA-FLT-G-3602-YA	FILTER #36 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-G-3602-ZH	FILTER #36 DRAIN GATE OPENED	DI	1623
FHA-FLT-G-3602-ZL	FILTER #36 DRAIN GATE CLOSED	DI	1623
FHA-FLT-V-3601-YN	FILTER #36 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3601-YA	FILTER #36 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3601-ZH	FILTER #36 EFFLUENT RATE CONTROL VALVE OPENED	DI	1623
FHA-FLT-V-3601-ZL	FILTER #36 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1623
FHA-FLT-V-3602-YN	FILTER #36 BACKWASH VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3602-YA	FILTER #36 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3602-ZH	FILTER #36 BACKWASH VALVE OPENED	DI	1623
FHA-FLT-V-3602-ZL	FILTER #36 BACKWASH VALVE CLOSED	DI	1623
FHA-FLT-V-3603-YN	FILTER #36 SURFACE SWEEP VALVE COMPUTER MODE	DI	1623
FHA-FLT-V-3603-YA	FILTER #36 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1623
FHA-FLT-V-3603-ZH	FILTER #36 SURFACE SWEEP VALVE OPENED	DI	1623
FHA-FLT-V-3603-ZL	FILTER #36 SURFACE SWEEP VALVE CLOSED	DI	1623
FHA-FLT-HS-3301-ZL	FILTER #33 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-HS-3401-ZL	FILTER #34 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-HS-3501-ZL	FILTER #35 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-HS-3601-ZL	FILTER #36 VALVE ACP ENABLE/DISABLE SWITCH	DI	1623
FHA-FLT-AIT-3301-YA	FILTER #33 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-AIT-3401-YA	FILTER #33 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-AIT-3501-YA	FILTER #35 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-AIT-3601-YA	FILTER #36 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1623
FHA-FLT-LSHL-3301-LAH	FILTER #33 HI LEVEL SWITCH	DI	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-LSHL-3301-LAL	FILTER #33 LO LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3401-LAH	FILTER #34 HI LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3401-LAL	FILTER #34 LO LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3501-LAH	FILTER #35 HI LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3501-LAL	FILTER #35 LO LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3601-LAH	FILTER #36 HI LEVEL SWITCH	DI	1623
FHA-FLT-LSHL-3601-LAL	FILTER #36 LO LEVEL SWITCH	DI	1623
FHA-FLT-V-3309-ZH	FILTER #33 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3309-ZL	FILTER #33 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-V-3409-ZH	FILTER #34 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3409-ZL	FILTER #34 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-V-3509-ZH	FILTER #35 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3509-ZL	FILTER #35 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-V-3609-ZH	FILTER #36 EFFLUENT G VALVE OPENED	DI	1623
FHA-FLT-V-3609-ZL	FILTER #36 EFFLUENT G VALVE CLOSED	DI	1623
FHA-FLT-G-3301-VH	FILTER #33 INLET GATE OPEN	DO	1623
FHA-FLT-G-3301-VL	FILTER #33 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3302-VH	FILTER #33 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3302-VL	FILTER #33 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3302-VH	FILTER #33 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3302-VL	FILTER #33 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3303-VH	FILTER #33 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3303-VL	FILTER #33 SURFACE SWEEP VALVE CLOSE	DO	1623
FHA-FLT-G-3401-VH	FILTER #34 INLET GATE OPEN	DO	1623
FHA-FLT-G-3401-VL	FILTER #34 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3402-VH	FILTER #34 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3402-VL	FILTER #34 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3402-VH	FILTER #34 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3402-VL	FILTER #34 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3403-VH	FILTER #34 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3403-VL	FILTER #34 SURFACE SWEEP VALVE CLOSE	DO	1623
FHA-FLT-G-3501-VH	FILTER #35 INLET GATE OPEN	DO	1623
FHA-FLT-G-3501-VL	FILTER #35 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3502-VH	FILTER #35 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3502-VL	FILTER #35 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3502-VH	FILTER #35 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3502-VL	FILTER #35 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3503-VH	FILTER #35 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3503-VL	FILTER #35 SURFACE SWEEP VALVE CLOSE	DO	1623
FHA-FLT-G-3601-VH	FILTER #36 INLET GATE OPEN	DO	1623
FHA-FLT-G-3601-VL	FILTER #36 INLET GATE CLOSE	DO	1623
FHA-FLT-G-3602-VH	FILTER #36 DRAIN GATE OPEN	DO	1623
FHA-FLT-G-3602-VL	FILTER #36 DRAIN GATE CLOSE	DO	1623
FHA-FLT-V-3602-VH	FILTER #36 BACKWASH VALVE OPEN	DO	1623
FHA-FLT-V-3602-VL	FILTER #36 BACKWASH VALVE CLOSE	DO	1623
FHA-FLT-V-3603-VH	FILTER #36 SURFACE SWEEP VALVE OPEN	DO	1623
FHA-FLT-V-3603-VL	FILTER #36 SURFACE SWEEP VALVE CLOSE	DO	1623

I/O Tag No	Description	Type	RPU
FHA-FLT-ZIT-3701-ZI	FILTER #37 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-3701-AI	FILTER #37 TURBIDITY	AI	1624
FHA-FLT-ZIT-3801-ZI	FILTER #38 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-3801-AI	FILTER #38 TURBIDITY	AI	1624
FHA-FLT-ZIT-3901-ZI	FILTER #39 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-3901-AI	FILTER #39 TURBIDITY	AI	1624
FHA-FLT-ZIT-4001-ZI	FILTER #40 RATE CONT VLV POSITION	AI	1624
FHA-FLT-AIT-4001-AI	FILTER #40 TURBIDITY	AI	1624
FHA-SED-AIT-0201-AI	E SEW TRB ANALYZER	AI	1624
FHA-FLT-FIT-3701-FT	FILTER #37 FLOW	AI	1624
FHA-FLT-PDIT-3701-PDI	FILTER #37 HEAD LOSS	AI	1624
FHA-FLT-FIT-3801-FT	FILTER #38 FLOW	AI	1624
FHA-FLT-PDIT-3801-PDI	FILTER #38 HEAD LOSS	AI	1624
FHA-FLT-FIT-3901-FT	FILTER #39 FLOW	AI	1624
FHA-FLT-PDIT-3901-PDI	FILTER #39 HEAD LOSS	AI	1624
FHA-FLT-FIT-4001-FT	FILTER #40 FLOW	AI	1624
FHA-FLT-PDIT-4001-PDI	FILTER #40 HEAD LOSS	AI	1624
FCL-FLT-RPU-1823-FIC-C	MASTER FLOW RATE SETPOINT INPUT EAST	AO	1624
FHA-FLT-V-3701-ZC	FILTER #37 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-FLT-V-3801-ZC	FILTER #38 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-FLT-V-3901-ZC	FILTER #39 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-FLT-V-4001-ZC	FILTER #40 RATE CONTROL VALVE POSITION SETPOINT	AO	1624
FHA-SPC-UPS-1624-EA	FILTERS 37-40 PLC UPS - POWER FAILURE	DI	1624
FHA-SPC-UPS-1624-EAL	FILTERS 37-40 PLC UPS - LOW BATTERY	DI	1624
FHA-SPC-UPS-1624-XA	FILTERS 37-40 PLC UPS - UPS FAILURE	DI	1624
FHA-SPC-RPU-1624-TAH	FILTER #37-40 PANEL SMOKE/HEAT ALARM	DI	1624
FHA-FLT-G-3701-YN	FILTER #37 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3701-YA	FILTER #37 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3701-ZH	FILTER #37 INLET GATE OPENED	DI	1624
FHA-FLT-G-3701-ZL	FILTER #37 INLET GATE CLOSED	DI	1624
FHA-FLT-G-3702-YN	FILTER #37 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3702-YA	FILTER #37 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3702-ZH	FILTER #37 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-3702-ZL	FILTER #37 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-3701-YN	FILTER #37 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3701-YA	FILTER #37 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3701-ZH	FILTER #37 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-3701-ZL	FILTER #37 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-3702-YN	FILTER #37 BACKWASH VALVE COMPUTER MODE	DI	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3702-YA	FILTER #37 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3702-ZH	FILTER #37 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-3702-ZL	FILTER #37 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-3703-YN	FILTER #37 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3703-YA	FILTER #37 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3703-ZH	FILTER #37 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-3703-ZL	FILTER #37 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-G-3801-YN	FILTER #38 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3801-YA	FILTER #38 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3801-ZH	FILTER #38 INLET GATE OPENED	DI	1624
FHA-FLT-G-3801-ZL	FILTER #38 INLET GATE CLOSED	DI	1624
FHA-FLT-G-3802-YN	FILTER #38 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3802-YA	FILTER #38 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3802-ZH	FILTER #38 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-3802-ZL	FILTER #38 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-3801-YN	FILTER #38 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3801-YA	FILTER #38 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3801-ZH	FILTER #38 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-3801-ZL	FILTER #38 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-3802-YN	FILTER #38 BACKWASH VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3802-YA	FILTER #38 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3802-ZH	FILTER #38 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-3802-ZL	FILTER #38 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-3803-YN	FILTER #38 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3803-YA	FILTER #38 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3803-ZH	FILTER #38 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-3803-ZL	FILTER #38 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-G-3901-YN	FILTER #39 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3901-YA	FILTER #39 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3901-ZH	FILTER #39 INLET GATE OPENED	DI	1624
FHA-FLT-G-3901-ZL	FILTER #39 INLET GATE CLOSED	DI	1624
FHA-FLT-G-3902-YN	FILTER #39 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-3902-YA	FILTER #39 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-3902-ZH	FILTER #39 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-3902-ZL	FILTER #39 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-3901-YN	FILTER #39 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-V-3901-YA	FILTER #39 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3901-ZH	FILTER #39 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-3901-ZL	FILTER #39 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-3902-YN	FILTER #39 BACKWASH VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3902-YA	FILTER #39 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3902-ZH	FILTER #39 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-3902-ZL	FILTER #39 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-3903-YN	FILTER #39 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-3903-YA	FILTER #39 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-3903-ZH	FILTER #39 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-3903-ZL	FILTER #39 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-G-4001-YN	FILTER #40 INLET GATE COMPUTER MODE	DI	1624
FHA-FLT-G-4001-YA	FILTER #40 INLET GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-4001-ZH	FILTER #40 INLET GATE OPENED	DI	1624
FHA-FLT-G-4001-ZL	FILTER #40 INLET GATE CLOSED	DI	1624
FHA-FLT-G-4002-YN	FILTER #40 DRAIN GATE COMPUTER MODE	DI	1624
FHA-FLT-G-4002-YA	FILTER #40 DRAIN GATE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-G-4002-ZH	FILTER #40 DRAIN GATE OPENED	DI	1624
FHA-FLT-G-4002-ZL	FILTER #40 DRAIN GATE CLOSED	DI	1624
FHA-FLT-V-4001-YN	FILTER #40 EFFLUENT RATE CONTROL VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-4001-YA	FILTER #40 EFFLUENT RATE CONTROL VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-4001-ZH	FILTER #40 EFFLUENT RATE CONTROL VALVE OPENED	DI	1624
FHA-FLT-V-4001-ZL	FILTER #40 EFFLUENT RATE CONTROL VALVE CLOSED	DI	1624
FHA-FLT-V-4002-YN	FILTER #40 BACKWASH VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-4002-YA	FILTER #40 BACKWASH VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-4002-ZH	FILTER #40 BACKWASH VALVE OPENED	DI	1624
FHA-FLT-V-4002-ZL	FILTER #40 BACKWASH VALVE CLOSED	DI	1624
FHA-FLT-V-4003-YN	FILTER #40 SURFACE SWEEP VALVE COMPUTER MODE	DI	1624
FHA-FLT-V-4003-YA	FILTER #40 SURFACE SWEEP VALVE NOT AVAILABLE– MAIN/CONTROL POWER FAIL	DI	1624
FHA-FLT-V-4003-ZH	FILTER #40 SURFACE SWEEP VALVE OPENED	DI	1624
FHA-FLT-V-4003-ZL	FILTER #40 SURFACE SWEEP VALVE CLOSED	DI	1624
FHA-FLT-HS-3701-ZL	FILTER #37 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-HS-3801-ZL	FILTER #38 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-HS-3901-ZL	FILTER #39 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-HS-4001-ZL	FILTER #40 VALVE ACP ENABLE/DISABLE SWITCH	DI	1624
FHA-FLT-AIT-3701-YA	FILTER #37 EFFLUENT TURBIDITY ANALYZER ISNTRUMENT FAULT	DI	1624
FHA-FLT-AIT-3801-YA	FILTER #38 EFFLUENT TURBIDITY ANALYZER ISNTRUMENT FAULT	DI	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-AIT-3901-YA	FILTER #39 EFFLUENT TURBIDITY ANALYZER ISNTRUMENT FAULT	DI	1624
FHA-FLT-AIT-4001-YA	FILTER #40 EFFLUENT TURBIDITY ANALYZER INSTRUMENT FAULT	DI	1624
FHA-FLT-LSHL-3701-LAH	FILTER #37 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3701-LAL	FILTER #37 LO LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3801-LAH	FILTER #38 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3801-LAL	FILTER #38 LO LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3901-LAH	FILTER #39 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-3901-LAL	FILTER #39 LO LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-4001-LAH	FILTER #40 HI LEVEL SWITCH	DI	1624
FHA-FLT-LSHL-4001-LAL	FILTER #40 LO LEVEL SWITCH	DI	1624
FHA-SED-P-0201-YN	SEW SAMPLE PUMP - EAST COMPUTER MODE	DI	1624
FHA-SED-P-0201-MN	SEW SAMPLE PUMP - EAST RUNNING	DI	1624
FHA-SED-V-0202-YN	SEW SMP PUMP SUCT VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0202-YA	SEW SMP PUMP SUCT VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0202-ZH	SEW SMP PUMP SUCT VLV-E OPENED	DI	1624
FHA-SED-V-0202-ZL	SEW SMP PUMP SUCT VLV-E CLOSED	DI	1624
FHA-SED-V-0209-YN	SEW SMP PUMP TRB VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0209-YA	SEW SMP PUMP TRB VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0209-ZH	SEW SMP PUMP TRB VLV-E OPENED	DI	1624
FHA-SED-V-0209-ZL	SEW SMP PUMP TRB VLV-E CLOSED	DI	1624
FHA-SED-V-0210-YN	SEW SUCT FLUSH VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0210-YA	SEW SUCT FLUSH VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0210-ZH	SEW SUCT FLUSH VLV-E OPENED	DI	1624
FHA-SED-V-0210-ZL	SEW SUCT FLUSH VLV-E CLOSED	DI	1624
FHA-SED-V-0211-YN	SEW DISCH FLUSH VLV-E COMPUTER MODE	DI	1624
FHA-SED-V-0211-YA	SEW DISCH FLUSH VLV-E NOT AVAILABLE – MAIN/CONTROL POWER FAIL	DI	1624
FHA-SED-V-0211-ZH	SEW DISCH FLUSH VLV-E OPENED	DI	1624
FHA-SED-V-0211-ZL	SEW DISCH FLUSH VLV-E CLOSED	DI	1624
FHA-FLT-V-3709-ZH	FILTER #37 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-3709-ZL	FILTER #37 EFFLUENT G VALVE CLOSED	DI	1624
FHA-FLT-V-3809-ZH	FILTER #38 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-3809-ZL	FILTER #38 EFFLUENT G VALVE CLOSED	DI	1624
FHA-FLT-V-3909-ZH	FILTER #39 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-3909-ZL	FILTER #39 EFFLUENT G VALVE CLOSED	DI	1624
FHA-FLT-V-4009-ZH	FILTER #40 EFFLUENT G VALVE OPENED	DI	1624
FHA-FLT-V-4009-ZL	FILTER #40 EFFLUENT G VALVE CLOSED	DI	1624
FHA-SED-FSL-0201-FAL	E SEW SMP PUMP P-0201 FLOW LOW ALARM	DI	1624
FHA-SED-FSL-0202-FAL	E SEW TRB ANALYZER FLOW LOW ALARM	DI	1624
FHA-SED-AIT-0201-YA	E SEW TRB ANALYZER INSTRUMENT FAULT	DI	1624
FHA-FLT-G-3701-VH	FILTER #37 INLET GATE OPEN	DO	1624
FHA-FLT-G-3701-VL	FILTER #37 INLET GATE CLOSE	DO	1624

I/O Tag No	Description	Type	RPU
FHA-FLT-G-3702-VH	FILTER #37 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-3702-VL	FILTER #37 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-3702-VH	FILTER #37 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-3702-VL	FILTER #37 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-3703-VH	FILTER #37 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-3703-VL	FILTER #37 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-FLT-G-3801-VH	FILTER #38 INLET GATE OPEN	DO	1624
FHA-FLT-G-3801-VL	FILTER #38 INLET GATE CLOSE	DO	1624
FHA-FLT-G-3802-VH	FILTER #38 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-3802-VL	FILTER #38 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-3802-VH	FILTER #38 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-3802-VL	FILTER #38 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-3803-VH	FILTER #38 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-3803-VL	FILTER #38 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-FLT-G-3901-VH	FILTER #39 INLET GATE OPEN	DO	1624
FHA-FLT-G-3901-VL	FILTER #39 INLET GATE CLOSE	DO	1624
FHA-FLT-G-3902-VH	FILTER #39 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-3902-VL	FILTER #39 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-3902-VH	FILTER #39 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-3902-VL	FILTER #39 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-3903-VH	FILTER #39 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-3903-VL	FILTER #39 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-FLT-G-4001-VH	FILTER #40 INLET GATE OPEN	DO	1624
FHA-FLT-G-4001-VL	FILTER #40 INLET GATE CLOSE	DO	1624
FHA-FLT-G-4002-VH	FILTER #40 DRAIN GATE OPEN	DO	1624
FHA-FLT-G-4002-VL	FILTER #40 DRAIN GATE CLOSE	DO	1624
FHA-FLT-V-4002-VH	FILTER #40 BACKWASH VALVE OPEN	DO	1624
FHA-FLT-V-4002-VL	FILTER #40 BACKWASH VALVE CLOSE	DO	1624
FHA-FLT-V-4003-VH	FILTER #40 SURFACE SWEEP VALVE OPEN	DO	1624
FHA-FLT-V-4003-VL	FILTER #40 SURFACE SWEEP VALVE CLOSE	DO	1624
FHA-SED-P-0201-MH	E SEW SMP PUMP P-0201 START COMMAND	DO	1624
FHA-SED-P-0201-MB	E SEW SMP PUMP P-0201 STOP COMMAND	DO	1624
FHA-SED-V-0202-VH	E SEW SUCT FLUSH VLV OPEN	DO	1624
FHA-SED-V-0202-VL	E SEW SUCT FLUSH VLV CLOSE	DO	1624
FHA-SED-V-0209-VH	E SEW ANALYZER ISLN VLV OPEN	DO	1624
FHA-SED-V-0209-VL	E SEW ANALYZER ISLN VLV CLOSE	DO	1624
FHA-SED-V-0210-VH	E SEW LAB ISLN VLV OPEN	DO	1624
FHA-SED-V-0210-VL	E SEW LAB ISLN VLV CLOSE	DO	1624
FHA-SED-V-0211-VH	E SEW BACKFLUSH VLV OPEN	DO	1624
FHA-SED-V-0211-VL	E SEW BACKFLUSH VLV CLOSE	DO	1624
FHA-BW-FIT-0001-FI	BACKWASH FLOW	AI	1223
FHA-SPC-UPS-1223-EA	BACKWASH PUMPS PLC UPS - POWER FAILURE	DI	1223
FHA-SPC-UPS-1223-EAL	BACKWASH PUMPS PLC UPS - LOW BATTERY	DI	1223
FHA-SPC-UPS-1223-XA	BACKWASH PUMPS PLC UPS - UPS FAILURE	DI	1223
FHA-SPC-UPS-1211-EA	SWITCHGEAR ROOM COMPUTER UPS - POWER FAILURE	DI	1223
FHA-SPC-UPS-1211-EAL	SWITCHGEAR ROOM COMPUTER UPS - LOW BATTERY	DI	1223

I/O Tag No	Description	Type	RPU
FHA-SPC-UPS-1211-XA	SWITCHGEAR ROOM COMPUTER UPS - UPS FAILURE	ID	1223
FHA-SPC-RPU-1223-TAH	PANEL SMOKE/HEAT ALM	DI	1223
FHA-BW-P-0501-YN	BACKWASH PUMP 5 COMPUTER MODE	DI	1223
FHA-BW-P-0501-YA	BACKWASH PUMP 5 NOT AVAILABLE– MULTILIN R6 FAULT	DI	1223
FHA-BW-P-0501-MN	BACKWASH PUMP 5 RUNNING	DI	1223
FHA-BW-V-0501-ZH	BACKWASH PUMP 5 INLET VALVE OPENED	DI	1223
FHA-BW-V-0501-ZL	BACKWASH PUMP 5 INLET VALVE CLOSED	DI	1223
FHA-BW-V-0503-ZH	BACKWASH PUMP 5 DISCH VALVE OPENED	DI	1223
FHA-BW-V-0503-ZL	BACKWASH PUMP 5 DISCH VALVE CLOSED	DI	1223
FHA-BW-FIT-0001-YA	BACKWASH FLOW LOSS OF SIGNAL	DI	1223
FHA-BW-P-0701-YN	BACKWASH PUMP 7 COMPUTER MODE	DI	1223
FHA-BW-P-0701-YA	BACKWASH PUMP 7 NOT AVAILABLE– MULTILIN R6 FAULT	DI	1223
FHA-BW-P-0701-MN	BACKWASH PUMP 7 RUNNING	DI	1223
FHA-BW-P-0601-YN	BACKWASH PUMP 6 COMPUTER MODE	DI	1223
FHA-BW-P-0601-YA	BACKWASH PUMP 6 NOT AVAILABLE– MULTILIN R6 FAULT	DI	1223
FHA-BW-P-0601-MN	BACKWASH PUMP 6 RUNNING	DI	1223
FHA-BW-V-0601-ZH	BACKWASH PUMP 6 INLET VALVE OPENED	DI	1223
FHA-BW-V-0601-ZL	BACKWASH PUMP 6 INLET VALVE CLOSED	DI	1223
FHA-BW-V-0603-ZH	BACKWASH PUMP 6 DISCH VALVE OPENED	DI	1223
FHA-BW-V-0603-ZL	BACKWASH PUMP 6 DISCH VALVE CLOSED	DI	1223
FHA-BW-V-0001-ZH	BACKWASH HEADER VALVE - WEST OPENED	DI	1223
FHA-BW-V-0001-ZL	BACKWASH HEADER VALVE - WEST CLOSED	DI	1223
FHA-BW-V-0002-ZH	BACKWASH HEADER VALVE - EAST OPENED	DI	1223
FHA-BW-V-0002-ZL	BACKWASH HEADER VALVE - EAST CLOSED	DI	1223
FHA-BW-V-0701-ZH	BACKWASH PUMP 7 INLET VALVE OPENED	DI	1223
FHA-BW-V-0701-ZL	BACKWASH PUMP 7 INLET VALVE CLOSED	DI	1223
FHA-BW-V-0703-ZH	BACKWASH PUMP 7 DISCH VALVE OPENED	DI	1223
FHA-BW-V-0703-ZL	BACKWASH PUMP 7 DISCH VALVE CLOSED	DI	1223
FHA-SAN-P-0101-MN	DEWATERING PUMP#1 RUNNING	DI	1223
FHA-SAN-P-0101-XA	DEWATERING PUMP#1 GENERAL ALARM	DI	1223
FHA-SAN-P-0201-MN	DEWATERING PUMP#2 RUNNING	DI	1223
FHA-SAN-P-0201-XA	DEWATERING PUMP#2 GENERAL ALARM	DI	1223
FHA-SAN-LSHH-0001-LAH	SAN WET WELL LEVEL HIGH HIGH ALARM	DI	1223
FHA-AUX-C-0201-MN	COMPRESSOR#1A RUNNING	DI	1223
FHA-AUX-C-0201-YA	COMPRESSOR#1A GENERAL ALARM	DI	1223
FHA-AUX-C-0202-MN	COMPRESSOR#1B RUNNING	DI	1223
FHA-AUX-C-0202-YA	COMPRESSOR#1B GENERAL ALARM	DI	1223
FHA-AUX-D-0201-MN	AIR DRYER#1 RUNNING	DI	1223
FHA-AUX-D-0201-YA	AIR DRYER#1 GENERAL ALARM	DI	1223
FHA-AUX-D-0202-MN	AIR DRYER#2 RUNNING	DI	1223
FHA-AUX-D-0202-YA	AIR DRYER#2 GENERAL ALARM	DI	1223
FHA-BW-P-0501-MH	BACKWASH PUMP 5 START COMMAND	DO	1223
FHA-BW-P-0501-MB	BACKWASH PUMP 5 STOP COMMAND	DO	1223
FHA-BW-P-0601-MH	BACKWASH PUMP 6 START COMMAND	DO	1223

I/O Tag No	Description	Type	RPU
FHA-BW-P-0601-MB	BACKWASH PUMP 6 STOP COMMAND	DO	1223
FHA-BW-P-0701-MH	BACKWASH PUMP 7 START COMMAND	DO	1223
FHA-BW-P-0701-MB	BACKWASH PUMP 7 STOP COMMAND	DO	1223

C. Control Logic

C.1 Normal Operation

C.1.1 Control Mode Management

The Filter PLC confirms which automatic mode is selected at the HMI, SCADA/MANUAL, SCADA/AUTO or SCADA/MASTER.

If SCADA/MANUAL is selected at the HMI – filter rate valve position is set for manual manipulation of the filter rate valve at the SCADA HMI.

If SCADA/AUTO mode has been selected on the HMI. The Filter PLC looks at the operator adjustable flow set point entered on the SCADA HMI and controls the 4-20ma position signal to the valve to maintain the desired flow.

If SCADA/MASTER mode has been selected on the HMI. The Filter PLC looks at the Master Filter Rate set point which is calculated by the Master Filter PLC. The Master Filter PLC will maintain the settled conduit level based on an operator adjustable level set point from the HMI and calculate the flow rate set point for each filter by dividing the total required flow by the number of filters in service. Total number of filters in service is determined based on each filter being in SCADA/MASTER mode. Each PLC that is in Master will receive the Master Flow Rate set point and control the 4-20ma position signal to the valve to maintain the desired flow.

C.1.2 Filtering

The normal mode of operation for each filter is SCADA/MASTER mode. In this mode, each of the filter PLCs receives a master flow rate set point from the master filter PLC. The calculation for this set point is based on the settled water conduit level and is described in equation (2).

When the master flow rate PLC determines how much flow is required to maintain the settled water conduit level, it will count the number of filters in master mode and split the total flow required between those filters. The calculation to determine this base flow rate is:

$$\boldsymbol{Q_F = \frac{Q_T - Q_{NM}}{n_F}} \quad \textbf{(2)}$$

Where:

Q_F = Individual filter flowrate (L/s)

Q_T = Master total filtration flow (L/s)

Q_{NM} = Total flow of filters not in SCADA/MASTER mode (L/s)

n_F = Number of filters in SCADA/MASTER mode

The master rate flow set point is sent through the network from the master flow rate PLC to the individual PLCs. As a backup, a 4-20mA signal is hardwired from the master flow rate PLC to the individual PLCs with this same set point.

An automatic switchover is triggered if the network fails. The individual PLCs use the master flow rate set point to modulate the rate control valve using a PID loop. A 4-20mA signal is sent to the valve actuator to open and close the valve to maintain the required flow.

The master filter PLC conditions the master rate set point using one of three methods, depending on the settled water level as described below.

The settled water conduits (east and west) level set points are entered at one of the HMI view nodes and is transmitted to the master flow rate PLC in the CBP. This set point is compared to the actual settled water conduit levels. The absolute value of this comparison is used to determine which of three signal condition methods is used to condition the master filtration rate set point.

Level 1 – Absolute value of settled water level set point minus the actual settled water level is less than Settled Water Band 1 (set to 0.02m). There is no further conditioning and the master filtration rate set point is transmitted to all the individual filter PLCs and Indicator/Controller.

Level 2 – Absolute value of a settled water level set point minus the actual settled water level is less than Settled Water Band 2 (set to 0.045m), but greater than or equal to Settled Water Band 1.

The above result is then divided by Settled Water Band 2. The result becomes the input value (in %) for the Lookup Table. The output is called the Index Value.

The master PLCs use a look-up table to condition the master filtration rate set point. The conditioned master filtration rate set point is transmitted to the respective east or west individual filtration PLCs and Indicator/Controller.

Level 3 – Absolute value of a settled water level set point minus the actual settled water level is greater than or equal to the Settled Water Band 2. The master PLCs use a PID control loop to compare the actual settled water level with the settled water level set point. The output of this PID loop becomes the master filtration rate set point and is transmitted to the respective east or west individual filtration PLCs and Indicator/Controller.

Settings for Level 1 and Level 2 of this control logic will be based on an empirically derived look-up table. A preliminary table is presented as follows. Note that fine-tuning during final implementation may be required:

Table 5: Filtration & Backwash Master Rate Control Correction Preliminary Lookup Table

INPUT (%)	OUTPUT (L/s)
0.0	0.0
10.0	14.0
20.0	25.5
30.0	36.0
40.0	44.5
50.0	51.5
60.0	58
70.0	63
80.0	67.5
90.0	71.5
100.0	75.0655

Where the input represents the % of deviation between the Level Deviation (in meters) and Settled Water Band 2 (set to 0.045m). The output is the correction of the master filtration rate set point (in L/s).

If the raw Level Deviation (PV (Level) – SV (Set point)) is positive, Base Flow – Index Value becomes the raw Master Flow Rate Set point.

If the raw Level Deviation (PV (Level) – SV (Set point)) is negative, Base Flow + Index Value becomes the raw Master Flow Rate Set point.

No adjustments are made if the level is within 0.5% of the set point.

Each filter PLC checks for control mode and if the filter is in service, uses a PID loop to compare the actual filtration rate to the conditioned master filtration rate set point. The output of this PID loop drives the filter rate valve.

C.1.3 Number of Filters In-Service & Sequencing

Filters are brought into or taken out of service based on the Individual Filter Rate. If the Rate of Production per filter drops below a predetermined action rate, two filters are taken out-of-service. If the Rate of Production per filter rises above a predetermined action rate, two filters are brought into service.

Filter run time is tracked for every filter which is either in-service, or out-of-service available. Run time is only incremented while the filter is in service. Run time is reset to zero after a backwash.

Filter idle time is tracked for every filter which is out-of-service.

If a filter is required to be brought into service, it will be the filter with the highest idle time. In the future, if a filter-to-waste cycle is implemented, then a filter will be conditioned prior to returning it to service. This means that a filter-to-waste cycle will be completed.

Whenever a filter is required to be taken out-of-service, it will be the filter with the highest run time. The filter will then be placed in the backwash queue so it will be washed prior to being available again for service.

Any leakage of a filter that is out of service, is monitored based on the reading of the filter's effluent flow meter. "Filter Out of Service Leak" alarm is generated if the detected flow is 0.2-5% of the full range (1-25 L./s).

C.1.4 Backwashing

At any time, a filter will be taken out of service and placed in the backwash queue if any of the following parameters are exceeded:

- Filter runtime of 96 hours
- Terminal head loss of 1.5 m
- Filter effluent turbidity > action level (traditionally 0.15 NTU, recommend 0.2 NTU)
- Idle time exceeds 24 hours.

Additionally, the operator is able to manually select a filter to be backwashed if necessary. The selected filter will be 'forced' to the front of the backwash queue. Note that only one filter can be backwashed at a time.

Backwash water is stored in two elevated storage tanks, which ride hydraulically on the backwash headers. The operator can select which tank level is to be used for controlling the backwash pumps. When the level in the selected tank drops below an action level, all available backwash pumps are started in a staggered fashion (20 seconds apart) to draw water from the treated water suction channel to fill the tanks.

When in SCADA/AUTO mode, the pumps will automatically start and stop based on the tank level. Additionally, an operator adjustable, hardwired backup is provided to automatically start and stop the pumps.

The supervisor is able to enable / disable surface sweeps from the SCADA HMI.

The backwash sequence consists of:

1. The filter being assigned first in the backwash queue

2. Filter level draw-down
3. Low wash for an adjustable duration (traditionally 2 minutes) at an adjustable low wash rate (traditionally 1000 L/s – to be verified in final design) with surface sweeps for a duration which is also adjustable
4. High wash for an adjustable duration (traditionally 5 minutes) at an adjustable high wash rate (traditionally 2500 L/s – to be verified in final design)
5. Settling period of 15 minutes
6. The filter is assigned as out-of-service, available
7. The filter run-time is reset to zero
8. The filter idle time is reset to zero and begins incrementing until the filter is returned to service.

Temperature variations cause expansion/contraction of the GAC. To prevent overflow and loss of GAC during periods of low temperature, the process will have flexibility to adjust backwash flow rates based on the water temperature.

Once a filter has completed the backwash cycle, it is classified as an available filter. Backwashing will only be performed when power is available to maintain the facility power demand below a target criterion (refer to section Interlocks Contained in Software for more details).

Backwash flow rate set point is maintained by adjusting the backwash header valves for all filters except 19, 20, 21 and 22, where the flow rate set point is maintained by filter valve position. The backwash flow is monitored by the flow meters FHA-FLT-FIT-0101 and FHA-FLT-FIT-0201 for the west and east filters respectively. Based on the flow rate set point, a backwash header valve is modulated to achieve the desired flow rate.

The following outlines the valve operation sequence during an automatic backwash cycle:

1. Close filter inlet gate
2. Lower level in filter to trough level
3. Close filter effluent gate
4. Open filter drain valve
5. Open surface sweep valve
6. Open backwash valve to low setting
7. Close surface sweep valve
8. Adjust backwash valve to high setting
9. Close backwash valve
10. Close filter drain valve
11. Open filter inlet gate slowly (10% until filter full – this will need empirical verification to be done in final design)
12. Wait for Settling period

C.2 Fault Response

C.2.1 Filter Master Rate PLC Failure - Master Flow Rate Setpoint

A failure of the master PLC is detected through the absence of a 'heartbeat' signal from the SCADA system. Win 911 pages out the alarm indicating the failure. The master flow rate calculation is no longer available from the master filter PLC. The individual PLCs will maintain the last master flow rate set point provided prior to the network failure.

Using the Indicator/Manual set point device on the CBP the individual filters can still operate in SCADA/MASTER mode. The CBP/PLC selector switch will be switched to the CBP position. Using the level signal and flow signals which are displayed on the Indicator/Manual set point device, an Operator can calculate the desired master flow rate and enter it on the device. A 4-20mA signal is sent to all the individual filter PLCs and used to modulate the rate control valve.

C.2.2 Filter Master Rate PLC Failure - Backwashing

The individual filter PLCs can still run the automatic backwash sequencing while the master PLC is in failure however they will not automatically be put into a cue to perform a backwash. Each backwash would need to be triggered manually from the SCADA system and then the individual filter PLC will take over and perform the sequence.

C.2.3 Master Filter PLC Failure - Master Flow Rate Setpoint

The Master Filter PLCs are housed in RPU-1822 and RPU-1823. RPU-1822 also controls Filters 17-20 and *RPU*-1823 controls Filters 21-23. SCADA control of the associated filters will be lost in the event of a Master Filter PLC failure.

A failure of these master PLCs is detected through the absence of a 'heartbeat' signal from the SCADA system. Win 911 pages out the alarm indicating the failure. The master flow rate calculation is available from the filter master rate PLC.

During the failure of the Master Filter PLCs, Filters may not be brought into or taken out of service from the SCADA system.

C.2.4 Master Filter PLC Failure - Backwashing

The individual filter PLCs can still run the automatic backwash sequencing if the master PLC fails during the wash however they will not automatically be put into a cue to perform a backwash. During the failure of the Master Filter PLCs (RPU-1822 and RPU-1823) backwashing of a filter may only be completed by the operator manually (from SCADA (if not aforementioned filters in above section), ACP or Field) opening and closing associated backwash and filter valves and running the backwash pumps.

C.2.5 Individual Filter PLC Failure

A failure of an individual filter PLC is detected through the absence of a 'heartbeat' signal from the SCADA system. Win 911 pages out the alarm indicating the failure. The automated backwashing functions and filter rate control functions for the associated filters are no longer available. Backwashing becomes a manual process from the filter ACP and filter rate flow control becomes a manual process from the Indicator/Manual Setpoint device located on the ACP.

The ACP/PLC selector switch will be switched to ACP allowing a valve position set point to be entered into the Indicator/Manual Setpoint device. This set point will be sent via a 4-20mA signal to the rate control valve actuator.

Table 6: Filtration & Backwash Fault response

Equipment Name / Tag No	Fault Condition	Response
Filter Rate Control Valve(s) FHA-FLT-V-0101 (note 1)	Power failure	• Close Filter Rate Control Valve

Note(s):

1. Tag provided for Filter #1; typical of all other filters.

C.2.6 Software Interlocks

Table 7: Filtration & Backwash Software Interlocks

Equipment Name / Tag No	Type of Interlock	Description of Conditions
Backwash Valve(s) FHA-FLT-V-0102 (note 1)	NO OPEN	• Power demand above target criteria
Filter Inlet Valve(s)	Open 10%	• Filter not full, 100% open when full

Equipment Name / Tag No	Type of Interlock	Description of Conditions
FHA-FLT-G-0101 (note 1)		

Note(s):

1. Tag provided for Filter #1; typical of all other filters.

C.2.7 Hardwired Interlocks

Table 8: Filtration & Backwash Hardwired Interlocks

Equipment Name / Tag No	Type of Interlock	Description of Conditions
Backwash Valve(s) FHA-FLT-V-0102 (note 1)	NO OPEN	• FHA-FLT-V-0101 is open
Surface Sweep Valve(s) FHA-FLT-V-0103 (note 1)	NO OPEN	• FHA-FLT-V-0101 is open
Filter Drain Valve FHA-FLT-G-0102 (note 1)	NO OPEN	• FLT-G-0101 is open
Filter FHA-FLT-F-0101 (note 1)	Force Out of Service	• FHA-FLT-LSHL-0101 triggered low level
Backwash Pump FHA-BW-P-0501	NO START	• FHA-BW-V-0501 is closed • FHA-BW-V-0503 is open
	NO STOP	• FHA-BW-V-0503 is open
Backwash Pump FHA-BW-P-0601	NO START	• FHA-BW-V-0601 is closed • FHA-BW-V-0603 is open
	NO STOP	• FHA-BW-V-0603 is open
Backwash Pump FHA-BW-P-0701	NO START	• FHA-BW-V-0701 is closed • FHA-BW-V-0703 is open
	NO STOP	• BW-V-0703 is open

Note(s):

1. Tag provided for Filter #1; typical of all other filters

C.2.8 Power Supply Failure

The main 600VAC power at the MCC (THR-ELS-MCC-0440) is fed from two different sources, herein referred to as Source A and Source B. A Tie Breaker switches between the two sources of power supplying power to the main bus. Source A, Source B, and the Tie Breaker are monitored for proper operation by a hardwired relay system in the Filter CV Shutoff Control Panel (FLT-CP-0007). A fault in the system will close the filter rate control valves in the east and west galleries. The filter rate control valves are commanded to close under the following conditions:

1. Power failure of either Source A or Source B power and failure of the Tie Breaker to switchover
2. Power failure of both Source A and Source B power.

Upon restoration of power and normal operation the Filter rate control valves will resume operation based on PID setpoint from the PLC.

Table 9: Filtration & Backwash Power Failure Fault response

Equipment Name / Tag No	Fault Condition	Response
Filter CV Shutdown Control Panel FLT-CP-0007	Source A Power failure and Tie Breaker fail to switchover	• Close all Filter Rate Control Valves in east and west galleries
Filter CV Shutdown Control Panel FLT-CP-0007	Source B Power failure and Tie Breaker fail to switchover	• Close all Filter Rate Control Valves in east and west galleries
Filter CV Shutdown Control Panel FLT-CP-0007	Source A Power failure and Source B Power failure	• Close all Filter Rate Control Valves in east and west galleries

C.3 Process Set Points

The following table outlines process set points editable in SCADA for the Filtration & Backwashing Process:

Table 10: Filtration & Backwash Process Set Points

Signal Tag No	Description	Unit	Set Point
FHA-FLT-FTM-0000-SWCW	West Settled Water Conduit Level	m	1.69
FHA-FLT-FTM-0000-SWCE	East Settled Water Conduit Level	m	1.70
FHA-FLT-FTM-0000-MNFR	Minimum Filter Rate	L/s	65
FHA-FLT-FTM-0000-MXFR	Maximum Filter rate	L/s	100
FHA-FLT-MAST-0000-RES	Reservoir Level for Backwash	m	3.60
FHA-FLT-MAST-0000-PWR	Power Peak for Backwash		0.90
FHA-BW-TSL-0001-HMD-C	Backwash Tank Pump Start Level	m	0.40
FHA-BW-TSL-0001-HMB-C	Backwash Tank Pump Stop Level	m	1.40
	Filter #1 Leak Detection	%	5.0
	Filter #1 Low Flow	L/s	1000
	Filter #1 High Flow	L/s	2000
	Filter #1 Low Position	%	31
	Filter #1 High Position	%	65
	Filter #1 Surface Sweep Time	min	4
	Filter #1 Low Wash Time	min	3
	Filter #1 High Wash Time	min	5
	Filter #1 Settling Time	min	15
	Filter #1 Head Loss Limit	m	1.50
	Filter #1 Turbidity Limit	NTU	0.15
	Filter #1 Run Time Limit	hrs	96
	Filter #1 Idle Time	hrs	24
	Filter #2 Leak Detection	%	5.0
	Filter #2 Low Flow	L/s	1000
	Filter #2 High Flow	L/s	2000
	Filter #2 Low Position	%	31
	Filter #2 High Position	%	65
	Filter #2 Surface Sweep Time	min	3
	Filter #2 Low Wash Time	min	3
	Filter #2 High Wash Time	min	5
	Filter #2 Settling Time	min	15
	Filter #2 Head Loss Limit	m	1.50
	Filter #2 Turbidity Limit	NTU	0.15
	Filter #2 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #2 Idle Time	hrs	24
	Filter #3 Leak Detection	%	5.0
	Filter #3 Low Flow	L/s	1050
	Filter #3 High Flow	L/s	2000
	Filter #3 Low Position	%	31
	Filter #3 High Position	%	65
	Filter #3 Surface Sweep Time	min	3
	Filter #3 Low Wash Time	min	3
	Filter #3 High Wash Time	min	5
	Filter #3 Settling Time	min	15
	Filter #3 Head Loss Limit	m	1.50
	Filter #3 Turbidity Limit	NTU	0.15
	Filter #3 Run Time Limit	hrs	96
	Filter #3 Idle Time	hrs	24
	Filter #4 Leak Detection	%	5.0
	Filter #4 Low Flow	L/s	1050
	Filter #4 High Flow	L/s	2000
	Filter #4 Low Position	%	31
	Filter #4 High Position	%	65
	Filter #4 Surface Sweep Time	min	3
	Filter #4 Low Wash Time	min	3
	Filter #4 High Wash Time	min	5
	Filter #4 Settling Time	min	15
	Filter #4 Head Loss Limit	m	1.50
	Filter #4 Turbidity Limit	NTU	0.15
	Filter #4 Run Time Limit	hrs	96
	Filter #4 Idle Time	hrs	24
	Filter #5 Leak Detection	%	5.0
	Filter #5 Low Flow	L/s	1100
	Filter #5 High Flow	L/s	2400
	Filter #5 Low Position	%	31
	Filter #5 High Position	%	65
	Filter #5 Surface Sweep Time	min	3
	Filter #5 Low Wash Time	min	3
	Filter #5 High Wash Time	min	5
	Filter #5 Settling Time	min	15
	Filter #5 Head Loss Limit	m	1.50
	Filter #5 Turbidity Limit	NTU	0.15
	Filter #5 Run Time Limit	hrs	96
	Filter #5 Idle Time	hrs	24
	Filter #6 Leak Detection	%	5.0
	Filter #6 Low Flow	L/s	1100
	Filter #6 High Flow	L/s	2400
	Filter #6 Low Position	%	31
	Filter #6 High Position	%	70
	Filter #6 Surface Sweep Time	min	3
	Filter #6 Low Wash Time	min	3
	Filter #6 High Wash Time	min	5
	Filter #6 Settling Time	min	15
	Filter #6 Head Loss Limit	m	1.50
	Filter #6 Turbidity Limit	NTU	0.15
	Filter #6 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #6 Idle Time	hrs	24
	Filter #7 Leak Detection	%	5.0
	Filter #7 Low Flow	L/s	1100
	Filter #7 High Flow	L/s	2400
	Filter #7 Low Position	%	31
	Filter #7 High Position	%	70
	Filter #7 Surface Sweep Time	min	3
	Filter #7 Low Wash Time	min	3
	Filter #7 High Wash Time	min	5
	Filter #7 Settling Time	min	15
	Filter #7 Head Loss Limit	m	1.50
	Filter #7 Turbidity Limit	NTU	0.15
	Filter #7 Run Time Limit	hrs	96
	Filter #7 Idle Time	hrs	24
	Filter #8 Leak Detection	%	5.0
	Filter #8 Low Flow	L/s	1100
	Filter #8 High Flow	L/s	2400
	Filter #8 Low Position	%	31
	Filter #8 High Position	%	70
	Filter #8 Surface Sweep Time	min	3
	Filter #8 Low Wash Time	min	3
	Filter #8 High Wash Time	min	5
	Filter #8 Settling Time	min	15
	Filter #8 Head Loss Limit	m	1.50
	Filter #8 Turbidity Limit	NTU	0.15
	Filter #8 Run Time Limit	hrs	96
	Filter #8 Idle Time	hrs	24
	Filter #9 Leak Detection	%	5.0
	Filter #9 Low Flow	L/s	1000
	Filter #9 High Flow	L/s	2001
	Filter #9 Low Position	%	31
	Filter #9 High Position	%	65
	Filter #9 Surface Sweep Time	min	3
	Filter #9 Low Wash Time	min	3
	Filter #9 High Wash Time	min	5
	Filter #9 Settling Time	min	15
	Filter #9 Head Loss Limit	m	1.50
	Filter #9 Turbidity Limit	NTU	0.15
	Filter #9 Run Time Limit	hrs	96
	Filter #9 Idle Time	hrs	24
	Filter #10 Leak Detection	%	5.0
	Filter #10 Low Flow	L/s	1000
	Filter #10 High Flow	L/s	2000
	Filter #10 Low Position	%	31
	Filter #10 High Position	%	65
	Filter #10 Surface Sweep Time	min	3
	Filter #10 Low Wash Time	min	3
	Filter #10 High Wash Time	min	5
	Filter #10 Settling Time	min	15
	Filter #10 Head Loss Limit	m	1.50
	Filter #10 Turbidity Limit	NTU	0.15
	Filter #10 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #10Idle Time	hrs	24
	Filter #11 Leak Detection	%	5.0
	Filter #11 Low Flow	L/s	1000
	Filter #11 High Flow	L/s	2000
	Filter #11 Low Position	%	31
	Filter #11 High Position	%	65
	Filter #11 Surface Sweep Time	min	3
	Filter #11 Low Wash Time	min	3
	Filter #11 High Wash Time	min	5
	Filter #11 Settling Time	min	15
	Filter #11 Head Loss Limit	m	1.50
	Filter #11 Turbidity Limit	NTU	0.15
	Filter #11 Run Time Limit	hrs	96
	Filter #11 Idle Time	hrs	24
	Filter #12 Leak Detection	%	5.0
	Filter #12 Low Flow	L/s	1000
	Filter #12 High Flow	L/s	2000
	Filter #12 Low Position	%	31
	Filter #12 High Position	%	65
	Filter #12 Surface Sweep Time	min	3
	Filter #12 Low Wash Time	min	3
	Filter #12 High Wash Time	min	5
	Filter #12 Settling Time	min	15
	Filter #12 Head Loss Limit	m	1.50
	Filter #12 Turbidity Limit	NTU	0.15
	Filter #12 Run Time Limit	hrs	96
	Filter #12 Idle Time	hrs	24
	Filter #13 Leak Detection	%	5.0
	Filter #13 Low Flow	L/s	1000
	Filter #13 High Flow	L/s	2000
	Filter #13 Low Position	%	31
	Filter #13 High Position	%	65
	Filter #13 Surface Sweep Time	min	3
	Filter #13 Low Wash Time	min	3
	Filter #13 High Wash Time	min	5
	Filter #13 Settling Time	min	15
	Filter #13 Head Loss Limit	m	1.50
	Filter #13 Turbidity Limit	NTU	0.15
	Filter #13 Run Time Limit	hrs	96
	Filter #13 Idle Time	hrs	24
	Filter #14 Leak Detection	%	5.0
	Filter #14 Low Flow	L/s	1000
	Filter #14 High Flow	L/s	2000
	Filter #14 Low Position	%	31
	Filter #14 High Position	%	65
	Filter #14 Surface Sweep Time	min	3
	Filter #14 Low Wash Time	min	3
	Filter #14 High Wash Time	min	5
	Filter #14 Settling Time	min	15
	Filter #14 Head Loss Limit	m	1.50
	Filter #14 Turbidity Limit	NTU	0.15
	Filter #14 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #14 Idle Time	hrs	24
	Filter #15 Leak Detection	%	5.0
	Filter #15 Low Flow	L/s	1000
	Filter #15 High Flow	L/s	2000
	Filter #15 Low Position	%	31
	Filter #15 High Position	%	65
	Filter #15 Surface Sweep Time	min	3
	Filter #15 Low Wash Time	min	3
	Filter #15 High Wash Time	min	5
	Filter #15 Settling Time	min	15
	Filter #15 Head Loss Limit	m	1.50
	Filter #15 Turbidity Limit	NTU	0.15
	Filter #15 Run Time Limit	hrs	96
	Filter #15 Idle Time	hrs	24
	Filter #16 Leak Detection	%	5.0
	Filter #16 Low Flow	L/s	1000
	Filter #16 High Flow	L/s	2000
	Filter #16 Low Position	%	31
	Filter #16 High Position	%	65
	Filter #16 Surface Sweep Time	min	3
	Filter #16 Low Wash Time	min	3
	Filter #16 High Wash Time	min	5
	Filter #16 Settling Time	min	15
	Filter #16 Head Loss Limit	m	1.50
	Filter #16 Turbidity Limit	NTU	0.15
	Filter #16 Run Time Limit	hrs	96
	Filter #16 Idle Time	hrs	24
	Filter #17 Leak Detection	%	2.1
	Filter #17 Low Flow	L/s	1050
	Filter #17 High Flow	L/s	2000
	Filter #17 Low Position	%	31
	Filter #17 High Position	%	65
	Filter #17 Surface Sweep Time	min	3
	Filter #17 Low Wash Time	min	3
	Filter #17 High Wash Time	min	5
	Filter #17 Settling Time	min	15
	Filter #17 Head Loss Limit	m	1.50
	Filter #17 Turbidity Limit	NTU	0.15
	Filter #17 Run Time Limit	hrs	96
	Filter #17 Idle Time	hrs	24
	Filter #18 Leak Detection	%	1.5
	Filter #18 Low Flow	L/s	1000
	Filter #18 High Flow	L/s	2000
	Filter #18 Low Position	%	31
	Filter #18 High Position	%	65
	Filter #18 Surface Sweep Time	min	3
	Filter #18 Low Wash Time	min	3
	Filter #18 High Wash Time	min	5
	Filter #18 Settling Time	min	15
	Filter #18 Head Loss Limit	m	1.50
	Filter #18 Turbidity Limit	NTU	0.15
	Filter #18 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #18 Idle Time	hrs	24
	Filter #19 Leak Detection	%	1.2
	Filter #19 Low Flow	L/s	1000
	Filter #19 High Flow	L/s	2000
	Filter #19 Low Position	%	31
	Filter #19 High Position	%	65
	Filter #19 Surface Sweep Time	min	3
	Filter #19 Low Wash Time	min	3
	Filter #19 High Wash Time	min	5
	Filter #19 Settling Time	min	15
	Filter #19 Head Loss Limit	m	1.50
	Filter #19 Turbidity Limit	NTU	0.15
	Filter #19 Run Time Limit	hrs	96
	Filter #19 Idle Time	hrs	24
	Filter #20 Leak Detection	%	1.7
	Filter #20 Low Flow	L/s	1000
	Filter #20 High Flow	L/s	2200
	Filter #20 Low Position	%	31
	Filter #20 High Position	%	63
	Filter #20 Surface Sweep Time	min	3
	Filter #20 Low Wash Time	min	3
	Filter #20 High Wash Time	min	5
	Filter #20 Settling Time	min	15
	Filter #20 Head Loss Limit	m	1.50
	Filter #20 Turbidity Limit	NTU	0.15
	Filter #20 Run Time Limit	hrs	96
	Filter #20 Idle Time	hrs	24
	Filter #21 Leak Detection	%	5.0
	Filter #21 Low Flow	L/s	1000
	Filter #21 High Flow	L/s	2001
	Filter #21 Low Position	%	31
	Filter #21 High Position	%	65
	Filter #21 Surface Sweep Time	min	3
	Filter #21 Low Wash Time	min	3
	Filter #21 High Wash Time	min	5
	Filter #21 Settling Time	min	15
	Filter #21 Head Loss Limit	m	1.50
	Filter #21 Turbidity Limit	NTU	0.15
	Filter #21 Run Time Limit	hrs	96
	Filter #21 Idle Time	hrs	24
	Filter #22 Leak Detection	%	5.0
	Filter #22 Low Flow	L/s	1100
	Filter #22 High Flow	L/s	2400
	Filter #22 Low Position	%	31
	Filter #22 High Position	%	70
	Filter #22 Surface Sweep Time	min	3
	Filter #22 Low Wash Time	min	3
	Filter #22 High Wash Time	min	5
	Filter #22 Settling Time	min	15
	Filter #22 Head Loss Limit	m	1.50
	Filter #22 Turbidity Limit	NTU	0.15
	Filter #22 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #22 Idle Time	hrs	24
	Filter #23 Leak Detection	%	5.0
	Filter #23 Low Flow	L/s	1000
	Filter #23 High Flow	L/s	2001
	Filter #23 Low Position	%	31
	Filter #23 High Position	%	65
	Filter #23 Surface Sweep Time	min	3
	Filter #23 Low Wash Time	min	3
	Filter #23 High Wash Time	min	5
	Filter #23 Settling Time	min	15
	Filter #23 Head Loss Limit	m	1.50
	Filter #23 Turbidity Limit	NTU	0.15
	Filter #23 Run Time Limit	hrs	96
	Filter #23 Idle Time	hrs	24
	Filter #24 Leak Detection	%	5.0
	Filter #24 Low Flow	L/s	1100
	Filter #24 High Flow	L/s	2400
	Filter #24 Low Position	%	31
	Filter #24 High Position	%	70
	Filter #24 Surface Sweep Time	min	3
	Filter #24 Low Wash Time	min	3
	Filter #24 High Wash Time	min	5
	Filter #24 Settling Time	min	15
	Filter #24 Head Loss Limit	m	1.50
	Filter #24 Turbidity Limit	NTU	0.15
	Filter #24 Run Time Limit	hrs	96
	Filter #24 Idle Time	hrs	24
	Filter #25 Leak Detection	%	2.8
	Filter #25 Low Flow	L/s	1100
	Filter #25 High Flow	L/s	2400
	Filter #25 Low Position	%	31
	Filter #25 High Position	%	70
	Filter #25 Surface Sweep Time	min	3
	Filter #25 Low Wash Time	min	3
	Filter #25 High Wash Time	min	5
	Filter #25 Settling Time	min	15
	Filter #25 Head Loss Limit	m	1.50
	Filter #25 Turbidity Limit	NTU	0.15
	Filter #25 Run Time Limit	hrs	96
	Filter #25 Idle Time	hrs	24
	Filter #26 Leak Detection	%	1.2
	Filter #26 Low Flow	L/s	1100
	Filter #26 High Flow	L/s	2400
	Filter #26 Low Position	%	31
	Filter #26 High Position	%	70
	Filter #26 Surface Sweep Time	min	3
	Filter #26 Low Wash Time	min	3
	Filter #26 High Wash Time	min	5
	Filter #26 Settling Time	min	15
	Filter #26 Head Loss Limit	m	1.50
	Filter #26 Turbidity Limit	NTU	0.15
	Filter #26 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #26 Idle Time	hrs	24
	Filter #27 Leak Detection	%	3.1
	Filter #27 Low Flow	L/s	1100
	Filter #27 High Flow	L/s	2400
	Filter #27 Low Position	%	31
	Filter #27 High Position	%	70
	Filter #27 Surface Sweep Time	min	3
	Filter #27 Low Wash Time	min	3
	Filter #27 High Wash Time	min	5
	Filter #27 Settling Time	min	15
	Filter #27 Head Loss Limit	m	1.50
	Filter #27 Turbidity Limit	NTU	0.15
	Filter #27 Run Time Limit	hrs	96
	Filter #27 Idle Time	hrs	24
	Filter #28 Leak Detection	%	3.4
	Filter #28 Low Flow	L/s	1100
	Filter #28 High Flow	L/s	2400
	Filter #28 Low Position	%	31
	Filter #28 High Position	%	70
	Filter #28 Surface Sweep Time	min	3
	Filter #28 Low Wash Time	min	3
	Filter #28 High Wash Time	min	5
	Filter #28 Settling Time	min	15
	Filter #28 Head Loss Limit	m	1.50
	Filter #28 Turbidity Limit	NTU	0.15
	Filter #28 Run Time Limit	hrs	96
	Filter #28 Idle Time	hrs	24
	Filter #29 Leak Detection	%	5.0
	Filter #29 Low Flow	L/s	1000
	Filter #29 High Flow	L/s	2001
	Filter #29 Low Position	%	31
	Filter #29 High Position	%	65
	Filter #29 Surface Sweep Time	min	3
	Filter #29 Low Wash Time	min	3
	Filter #29 High Wash Time	min	5
	Filter #29 Settling Time	min	15
	Filter #29 Head Loss Limit	m	1.50
	Filter #29 Turbidity Limit	NTU	0.15
	Filter #29 Run Time Limit	hrs	96
	Filter #29 Idle Time	hrs	24
	Filter #30 Leak Detection	%	5.0
	Filter #30 Low Flow	L/s	1100
	Filter #30 High Flow	L/s	2400
	Filter #30 Low Position	%	31
	Filter #30 High Position	%	70
	Filter #30 Surface Sweep Time	min	3
	Filter #30 Low Wash Time	min	3
	Filter #30 High Wash Time	min	5
	Filter #30 Settling Time	min	15
	Filter #30 Head Loss Limit	m	1.50
	Filter #30 Turbidity Limit	NTU	0.15
	Filter #30 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #30 Idle Time	hrs	24
	Filter #30 Leak Detection	%	5.0
	Filter #31 Low Flow	L/s	1000
	Filter #31 High Flow	L/s	2001
	Filter #31 Low Position	%	31
	Filter #31 High Position	%	65
	Filter #31 Surface Sweep Time	min	3
	Filter #31 Low Wash Time	min	3
	Filter #31 High Wash Time	min	5
	Filter #31 Settling Time	min	15
	Filter #31 Head Loss Limit	m	1.50
	Filter #31 Turbidity Limit	NTU	0.15
	Filter #31 Run Time Limit	hrs	96
	Filter #31 Idle Time	hrs	24
	Filter #32 Leak Detection	%	5.0
	Filter #32 Low Flow	L/s	1100
	Filter #32 High Flow	L/s	2400
	Filter #32 Low Position	%	31
	Filter #32 High Position	%	70
	Filter #32 Surface Sweep Time	min	3
	Filter #32 Low Wash Time	min	3
	Filter #32 High Wash Time	min	5
	Filter #32 Settling Time	min	15
	Filter #32 Head Loss Limit	m	1.50
	Filter #32 Turbidity Limit	NTU	0.15
	Filter #32 Run Time Limit	hrs	96
	Filter #32 Idle Time	hrs	24
	Filter #33 Leak Detection	%	5.0
	Filter #33 Low Flow	L/s	1000
	Filter #33 High Flow	L/s	2001
	Filter #33 Low Position	%	31
	Filter #33 High Position	%	65
	Filter #33 Surface Sweep Time	min	3
	Filter #33 Low Wash Time	min	3
	Filter #33 High Wash Time	min	5
	Filter #33 Settling Time	min	15
	Filter #33 Head Loss Limit	m	1.50
	Filter #33 Turbidity Limit	NTU	0.15
	Filter #33 Run Time Limit	hrs	96
	Filter #33 Idle Time	hrs	24
	Filter #34 Leak Detection	%	5.0
	Filter #34 Low Flow	L/s	1100
	Filter #34 High Flow	L/s	2400
	Filter #34 Low Position	%	31
	Filter #34 High Position	%	70
	Filter #34 Surface Sweep Time	min	3
	Filter #34 Low Wash Time	min	3
	Filter #34 High Wash Time	min	5
	Filter #34 Settling Time	min	15
	Filter #34 Head Loss Limit	m	1.50
	Filter #34 Turbidity Limit	NTU	0.15
	Filter #34 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #34 Idle Time	hrs	24
	Filter #35 Leak Detection	%	5.0
	Filter #35 Low Flow	L/s	1000
	Filter #35 High Flow	L/s	2000
	Filter #35 Low Position	%	31
	Filter #35 High Position	%	65
	Filter #35 Surface Sweep Time	min	3
	Filter #35 Low Wash Time	min	3
	Filter #35 High Wash Time	min	5
	Filter #35 Settling Time	min	15
	Filter #35 Head Loss Limit	m	1.50
	Filter #35 Turbidity Limit	NTU	0.15
	Filter #35 Run Time Limit	hrs	96
	Filter #35 Idle Time	hrs	24
	Filter #36 Leak Detection	%	5.0
	Filter #36 Low Flow	L/s	1100
	Filter #36 High Flow	L/s	2400
	Filter #36 Low Position	%	31
	Filter #36 High Position	%	70
	Filter #36 Surface Sweep Time	min	3
	Filter #36 Low Wash Time	min	3
	Filter #36 High Wash Time	min	5
	Filter #36 Settling Time	min	15
	Filter #36 Head Loss Limit	m	1.50
	Filter #36 Turbidity Limit	NTU	0.15
	Filter #36 Run Time Limit	hrs	96
	Filter #36 Idle Time	hrs	24
	Filter #37 Leak Detection	%	5.0
	Filter #37 Low Flow	L/s	1100
	Filter #37 High Flow	L/s	2400
	Filter #37 Low Position	%	31
	Filter #37 High Position	%	70
	Filter #37 Surface Sweep Time	min	3
	Filter #37 Low Wash Time	min	3
	Filter #37 High Wash Time	min	5
	Filter #37 Settling Time	min	15
	Filter #37 Head Loss Limit	m	1.50
	Filter #37 Turbidity Limit	NTU	0.15
	Filter #37 Run Time Limit	hrs	96
	Filter #37 Idle Time	hrs	24
	Filter #38 Leak Detection	%	5.0
	Filter #38 Low Flow	L/s	1100
	Filter #38 High Flow	L/s	2400
	Filter #38 Low Position	%	31
	Filter #38 High Position	%	70
	Filter #38 Surface Sweep Time	min	3
	Filter #38 Low Wash Time	min	3
	Filter #38 High Wash Time	min	5
	Filter #38 Settling Time	min	15
	Filter #38 Head Loss Limit	m	1.50
	Filter #38 Turbidity Limit	NTU	0.15
	Filter #38 Run Time Limit	hrs	96

Signal Tag No	Description	Unit	Set Point
	Filter #38 Idle Time	hrs	24
	Filter #39 Leak Detection	%	5.0
	Filter #39 Low Flow	L/s	1100
	Filter #39 High Flow	L/s	2400
	Filter #39 Low Position	%	31
	Filter #39 High Position	%	70
	Filter #39 Surface Sweep Time	min	3
	Filter #39 Low Wash Time	min	3
	Filter #39 High Wash Time	min	5
	Filter #39 Settling Time	min	15
	Filter #39 Head Loss Limit	m	1.50
	Filter #39 Turbidity Limit	NTU	0.15
	Filter #39 Run Time Limit	hrs	96
	Filter #39 Idle Time	hrs	24
	Filter #40 Leak Detection	%	5.0
	Filter #40 Low Flow	L/s	1100
	Filter #40 High Flow	L/s	2400
	Filter #40 Low Position	%	31
	Filter #40 High Position	%	70
	Filter #40 Surface Sweep Time	min	3
	Filter #40 Low Wash Time	min	3
	Filter #40 High Wash Time	min	5
	Filter #40 Settling Time	min	15
	Filter #40 Head Loss Limit	m	1.50
	Filter #40 Turbidity Limit	NTU	0.15
	Filter #40 Run Time Limit	hrs	96
	Filter #40 Idle Time	hrs	24

C.4 Alarms

Alarms are generated by SCADA for specific events and their handling is as per Alarm Handling Standard. Virtual Alarms are monitored as available in the PCS software modules. For a complete alarm list, refer to "CSF RFI 030 Supplemental - FHA Alarm List.xlsx" contained in the Supplemental Documents folder.

The following table outlines the set points for analog alarms generated by the system for specific events detected through analog signals connected to the RPU:

Table 11: Filtration & Backwash Analog Alarms

Signal Tag No	Unit	Alarm set points				Alarm Description
		LL	L	H	HH	
Backwash Flow FHA-BW-FIT-0001-XALLC-C FHA-BW-FIT-0001-XALC-C FHA-BW-FIT-0001-XAHC-C FHA-BW-FIT-0001-XAHHC-C	L/s	98.19	194.45	1247.2	1276.6	Backwash flow low low/ low/ high/ high high
Backwash Flow West FHA-BW-FIT-0101-XALLC-C FHA-BW-FIT-0101-XALC-C FHA-BW-FIT-0101-XAHC-C FHA-BW-FIT-0101-XAHHC-C	L/s	250	500	2500	3200	Backwash flow west low low/ low/ high/ high high
Backwash Flow East FHA-BW-FIT-0201-XALLC-C	L/s	250	500	2500	3200	Backwash flow west low low/ low/ high/ high high

Signal Tag No	Unit	Alarm set points				Alarm Description
		LL	L	H	HH	
FHA-BW-FIT-0201-XALC-C FHA-BW-FIT-0201-XAHC-C FHA-BW-FIT-0201-XAHHC-C						
Backwash Tank South Level FHA-BW-LIT-0101-XALLC-C FHA-BW-LIT-0101-XALC-C FHA-BW-LIT-0101-XAHC-C FHA-BW-LIT-0101-XAHHC-C	m	0.00	0.00	1.80	2.00	South backwash tank level low low/ low/ high/ high high
Backwash Tank North Level FHA-BW-LIT-0201-XALLC-C FHA-BW-LIT-0201-XALC-C FHA-BW-LIT-0201-XAHC-C FHA-BW-LIT-0201-XAHHC-C	m	0.00	0.00	1.80	2.00	North backwash tank level low low/ low/ high/ high high
West Total Filter Flow FHA-FLT-FIT-0001-XALLC-C FHA-FLT-FIT-0001-XALC-C FHA-FLT-FIT-0001-XAHC-C FHA-FLT-FIT-0001-XAHHC-C	m^3/s	0.30	0.60	5.50	6.50	West total filter flow low low/ low/ high/ high high
East Total Filter Flow FHA-FLT-FIT-0002-XALLC-C FHA-FLT-FIT-0002-XALC-C FHA-FLT-FIT-0002-XAHC-C FHA-FLT-FIT-0002-XAHHC-C	m^3/s	0.30	1.20	5.50	6.50	East total filter flow low low/ low/ high/ high high
West Settled Water Level FHA-LIT-0101-XALLC-C FHA-LIT-0101-XALC-C FHA-LIT-0101-XAHC-C FHA-LIT-0101-XAHHC-C	m	1.20	1.30	1.85	1.95	West settled water conduit level low low/ low/ high/ high high
East Settled Water Level FHA-LIT-0101-XALLC-C FHA-LIT-0101-XALC-C FHA-LIT-0101-XAHC-C FHA-LIT-0101-XAHHC-C	m	1.20	1.30	1.85	1.95	East settled water conduit level low low/ low/ high/ high high
Filter Turbidity (Note 1)	NTU	0.01	-	0.15	0.2	Filter turbidity low low/ high/ high high
Filter Flow (Note 1)	L/s	0	50	450	500	Filter flow low low/ low/ high/ high high
Filter Head Differential (Note 1)	m	0.00	-	1.50	2.00	Filter head difference low low/ high/ high high

Note(s):

1. These set points are editable in SCADA for each individual filter. All set points are

Appendix O

Section 16014A – RC Harris Water Treatment Plant, Toronto, Ontario - Installation of Standby Generator Short Circuit Analysis Protection Device Coordination ARC Flash Study

RC Harris Water Treatment Plant, Toronto, Ontario - Installation of Standby Generator

Short Circuit Analysis

Protection Device Coordination

ARC Flash Study

Prepared for RC Harris Water Treatment Plant
by ARCADIS May 24, 2024

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REVIEWER:	Sadaqat Chaudhary
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Table of Contents

1 INTRODUCTION

In this Short Circuit Protection Coordination Study, we intend to set the protective devices and settings to ensure a coordinated response during faults.

This enhances the reliability of our systems and reduces downtime by selectively isolating faults while safeguarding personnel and equipment.

2 EXECUTIVE SUMMARY

The project involves the modification of the existing electrical system. This ensures that the system is not only compliant with safety standards but also optimized for efficient and reliable operation.

This report includes the short circuit fault levels for the new 300kW standby generator, two automatic transfer switches and the downstream Power Distribution Panels (PDP), panels and equipment for the new and existing devices.

In this study we have calculated current fault levels and provided the settings for the protective devices and indicates Arc Flash Incident Energy and the related information.

3 BACKGROUND INFORMATION

This project is being conducted in response to the evolving needs of additional emergency power backup of critical loads including new server room. Following is a breakdown of the relevant background information:

1. **Existing Electrical System**: Existing electrical system in the plant is to be upgraded to accommodate a new Standby Generator System for critical loads/essential equipment in the plant.
2. **Safety Concerns**: Safety is a paramount concern in any industrial or commercial environment. In recent years, there has been a growing emphasis on ensuring the safety of personnel working with or near electrical equipment. Arc flash hazards, in particular, have garnered increased attention.
3. **Regulatory Compliance**: The regulatory landscape for electrical safety has evolved, with a focus on compliance with standards such as the National Fire Protection Association (NFPA) 70E and IEEE 1584. Adhering to these standards is not only a matter of legal obligation but also a commitment to ensuring the well-being of our workforce.
4. **Operational Efficiency:** The efficient operation of our electrical systems is essential for maintaining productivity and avoiding costly downtime. Optimizing the coordination of protective devices ensures that electrical faults are isolated with minimal disruption to operations.
5. **Previous Studies:** The facility has previously undergone short circuit protection coordination studies and arc flash assessments. This modification project aims to build upon

the findings of these earlier studies, taking into account system changes and advances in technology.

6. **Commitment to Safety**: The project reflects the organization's unwavering commitment to the safety of its personnel and the reliability of its electrical infrastructure. It recognizes that safety and efficiency go hand in hand.

4 SHORT CIRCUIT ANALYSIS

In the ever-evolving landscape of electrical systems and safety, ongoing modifications and improvements are paramount to ensure the reliability and safety of operations. The "Short Circuit Protection Coordination Study and Arc Flash Calculations is a vital undertaking in the optimizing electrical infrastructure.

4.1 Calculations

Using Actual Present Fault Short Circuit Currents

4.2 Purpose

The primary purpose of a short circuit analysis is to determine the maximum fault current that can flow in the electrical system when a short circuit occurs. A short circuit is an unintended electrical connection between two or more conductors, typically resulting from equipment failure or wiring errors.

4.3 Assumptions

Calculations are based on:

- Information from the site and bill of material
- Typical bus duct, and cable Z1, Z2 and Z0 impedances
- Nameplate transformer Z and typical ANSI X and R
- Motor contribution was not included

4.4 Summary of Calculations

The results of the calculations are presented in Tables 1 , 2, 3 and 4.

ID	Nominal kV	Bracing Symm. kA	Bracing Asymm. kA	Symm. kA	Asymm. kA	X/R Ratio
TS-0300-EMER	0.6	50	62.3	1.349064	1.87682	8.268628
TS-0300-LOAD	0.6	50	62.3	19.50975	22.38054	3.404898
TS-0300-NOR	0.6	50	62.3	19.50975	22.38054	3.404898
TS-0400-EMER	0.6	50	62.3	1.400013	2.090124	12.89989
TS-0400-LOAD	0.6	50	62.3	19.59338	22.53999	3.448449
TS-0400-NOR	0.6	50	62.3	19.59338	22.53999	3.448449
Bus1	0.6	50	62.3	1.398036	2.184778	19.21518
Bus2	0.6	50	62.3	22.472	29.60327	6.280001

Bus6	0.6	50	62.3	22.472	29.60327	6.280001
PDP-0100GEN	0.6	50	62.3	1.442222	2.305543	25
GEN BUS	0.6	50	62.3	1.442222	2.305543	25
GEN TERMINALS	0.6	50	62.3	1.442222	2.305543	25
PDP-0200E	0.6	50	62.3	7.889071	8.572355	2.613716
PDP-0300A	0.6	50	62.3	22.472	29.60327	6.280001
PDP-0300E	0.6	42	52.4	19.30283	21.99388	3.301835
MCC-0400B	0.6	50	62.3	22.472	29.60327	6.280001
PDP-0400E	0.6	50	62.3	19.38523	22.14653	3.342102

Table 1 Short Circuit Bus Withstand ratings - TS Normal

ID	kV	Rated Int. Adj. kA	Rated Int. kA	Int. Adj. Symm. kA	Int. X/R Ratio
CB GEN MAIN	0.6	35	35	1.84908	25
CB LOAD BANK	0.6	42	42	1.674491	25
CB-0300A	0.6	65	65	22.472	6.280001
CB-0401B	0.6	65	65	22.472	6.280001
CB-1701	0.6	25	25	19.30283	3.301835
CB-TS-0300-EMER	0.6	35	35	1.84908	25
CB-TS-0300-NOR	0.6	42	42	22.472	6.280001
CB-TS-0400-EMER	0.6	35	35	1.84908	25
CB-TS-0400-NOR	0.6	42	42	22.472	6.280001
CB-CP-1101	0.6	25	25	19.30283	3.301835
CB-CP-6230	0.6	25	25	7.889071	2.613716
CB-CP-6240	0.6	25	25	7.889071	2.613716
CB-PDP-0200E	0.6	25	25	19.30283	3.301835
CB-SERV.RM2	0.6	25	25	19.30283	3.301835
CB-SERV.RM3	0.6	25	25	19.30283	3.301835
CB-SPARE1	0.6	25	25	19.30283	3.301835
CB-SPARE2	0.6	25	25	7.889071	2.613716
CB-SPARE3	0.6	25	25	19.38523	3.342102
CB-TR-G1	0.6	25	25	19.38523	3.342102
CB-TR1-LP-2	0.6	25	25	7.889071	2.613716
CB-UPS-0004	0.6	25	25	19.38523	3.342102
CB11	0.6	25	25	19.38523	3.342102
CB12	0.6	25	25	19.38523	3.342102
SERV.RM1	0.6	25	25	19.30283	3.301835

Table 2 Short Circuit Breakers Interrupting ratings - TS Normal

ID	Nominal kV	Bracing Symm. kA	Bracing Asymm. kA	Symm. kA	Asymm. kA	X/R Ratio
TS-0300-EMER	0.6	50	62.3	1.349064	1.87682	8.268628
TS-0300-LOAD	0.6	50	62.3	1.349064	1.87682	8.268628
TS-0300-NOR	0.6	50	62.3	19.50975	22.38054	3.404898
TS-0400-EMER	0.6	50	62.3	1.400013	2.090124	12.89989
TS-0400-LOAD	0.6	50	62.3	1.400013	2.090124	12.89989
TS-0400-NOR	0.6	50	62.3	19.59338	22.53999	3.448449
Bus1	0.6	50	62.3	1.398036	2.184778	19.21518
Bus2	0.6	50	62.3	22.472	29.60327	6.280001
Bus6	0.6	50	62.3	22.472	29.60327	6.280001
PDP-0100GEN	0.6	50	62.3	1.442222	2.305543	25
GEN BUS	0.6	50	62.3	1.442222	2.305543	25
GEN TERMINALS	0.6	50	62.3	1.442222	2.305543	25
PDP-0200E	0.6	50	62.3	1.228541	1.641338	6.717603
PDP-0300A	0.6	50	62.3	22.472	29.60327	6.280001
PDP-0300E	0.6	42	52.4	1.348211	1.87361	8.220248
MCC-0400B	0.6	50	62.3	22.472	29.60327	6.280001
PDP-0400E	0.6	50	62.3	1.39914	2.086075	12.77465

Table 3 Short Circuit Bus Withstand ratings - TS Emergency

ID	kV	Rated Int. Adj. kA	Int. Adj. Symm. kA	Int. Symm. kA	Int. X/R Ratio
CB GEN MAIN	0.6	35	1.84908	1.442222	25
CB LOAD BANK	0.6	42	1.674491	1.442222	25
CB-0300A	0.6	65	22.472	22.472	6.280001
CB-0401B	0.6	65	22.472	22.472	6.280001
CB-1701	0.6	25	1.502664	1.348211	8.220248
CB-TS-0300-EMER	0.6	35	1.84908	1.442222	25
CB-TS-0300-NOR	0.6	42	22.472	22.472	6.280001
CB-TS-0400-EMER	0.6	35	1.84908	1.442222	25
CB-TS-0400-NOR	0.6	42	22.472	22.472	6.280001
CB-CP-1101	0.6	25	1.502664	1.348211	8.220248
CB-CP-6230	0.6	25	1.316378	1.228541	6.717603
CB-CP-6240	0.6	25	1.316378	1.228541	6.717603
CB-PDP-0200E	0.6	25	1.502664	1.348211	8.220248
CB-SERV.RM2	0.6	25	1.502664	1.348211	8.220248
CB-SERV.RM3	0.6	25	1.502664	1.348211	8.220248
CB-SPARE1	0.6	25	1.502664	1.348211	8.220248
CB-SPARE2	0.6	25	1.316378	1.228541	6.717603
CB-SPARE3	0.6	25	1.673063	1.39914	12.77465
CB-TR-G1	0.6	25	1.673063	1.39914	12.77465
CB-TR1-LP-2	0.6	25	1.316378	1.228541	6.717603

CB-UPS-0004	0.6	25	1.673063	1.39914	12.77465
CB11	0.6	25	1.673063	1.39914	12.77465
CB12	0.6	25	1.673063	1.39914	12.77465
SERV.RM1	0.6	25	1.502664	1.348211	8.220248

Table 4 Short Circuit Breakers Interrupting ratings - TS Emergency

5 PROTECTIVE DEVICE CO-ORDINATION ANALYSIS

5.1 Assumptions

Time current curves are based on:

- The existing “Short Circuit Protection Co-ordination Study" Dated May 2012 Revision 5.0
- Information from the site and bill of material.
- All conductors are copper unless noted otherwise.

5.2 Protective Devices

Protective devices results of the calculations are presented on Time Current Curves (TCC) in the Appendix.

5.3 Time Current Curves

Three sets of protective devices settings are included in the Appendix of this report:

1. TS in normal position "NORMAL POWER TO PDP-0200E - PHASE"
2. TS in normal position "NORMAL POWER TO PDP-0200E - GND"
3. TS in emergency position "GEN TO PDP-0200E - PHASE"
4. TS in emergency position "GEN TO PDP-0200E - GND"

Time current curves show the following information:

- The protective device settings
- Three phase and line to ground fault symmetrical values.

5.4 Analysis of coordination between devices

1. TS in normal position:

   NORMAL POWER TO PDP-0200E

   - CB-TS-0300-NOR and upstream CB-0300A is excellent.
   - **CB-TS-0300-NOR and downstream devices is poor during the high short circuit faults.**
   - Remedy would be to install circuit breakers with no Instantaneous or very high instantaneous setting on CB-TS-0300-NOR and CB-DP-0200E. Please

note that such a breakers might not exist or are too expensive to provide this solution.

2. TS in emergency position:

   GEN TO PDP-0200E

   - Full coordination exist for all circuit breakers - total fault current is limited by the standby generator to deliver the short circuit (decrement curve).

6 ARC FLASH CALCULATIONS

Arc flash calculations are essential for assessing the potential hazard and specifying the appropriate Personal Protective Equipment (PPE) for workers. Preformed with an aid of the latest ETAP engineering software that calculates Incident Energy (IE) according to the latest IEEE 1584 standard and CSA Z462 guidelines. These calculations involve detailed equations that consider various factors such as fault duration and distance from the arc. Two scenarios were considered:

1. TS in normal position
2. TS in emergency position

6.1 Summary of Calculations

IE values are shown in the Table 5 and Table 6.

6.2 Recommendations and Mitigations

Based on the results of the coordination study and arc flash calculations, changes to the protective device settings or system design to improve safety is not required.

ID	kV	Total Energy (cal/cm²)	AFB (m)	Final FCT (sec)	% Ia Variation
TS-0300-EMER	0.6	0.826655	0.362	0.4	
TS-0300-LOAD	0.6	2.46	0.717	0.065	
TS-0300-NOR	0.6	2.46	0.717	0.065	
TS-0400-EMER	0.6	0.860824	0.371	0.4	
TS-0400-LOAD	0.6	2.48	0.719	0.065	
TS-0400-NOR	0.6	2.48	0.719	0.065	
Bus1	0.6	1.07	0.426	0.5	
PDP-0100GEN	0.6	1.11	0.436	0.5	
GEN TERMINALS	0.6	4.45	1.037	2	
PDP-0200E	0.6	0.337961	0.207	0.024	
PDP-0300A	0.6	6.15	1.694	0.21	
PDP-0300E	0.6	2.44	0.712	0.065	
MCC-0400B	0.6	6.15	1.694	0.21	
PDP-0400E	0.6	2.45	0.714	0.065	

Table 5 - TS in NORMAL

ID	kV	Total Energy (cal/cm²)	AFB (m)	Final FCT (sec)	% Ia Variation
TS-0300-EMER	0.6	0.826655	0.362	0.4	
TS-0300-LOAD	0.6	0.826655	0.362	0.4	
TS-0300-NOR	0.6	2.46	0.717	0.065	
TS-0400-EMER	0.6	0.860824	0.371	0.4	
TS-0400-LOAD	0.6	0.860824	0.371	0.4	
TS-0400-NOR	0.6	2.48	0.719	0.065	
Bus1	0.6	1.07	0.426	0.5	
PDP-0100GEN	0.6	1.11	0.436	0.5	
GEN TERMINALS	0.6	4.45	1.037	2	
PDP-0200E	0.6	0.548556	0.28	0.294	
PDP-0300A	0.6	6.15	1.694	0.21	
PDP-0300E	0.6	0.826084	0.362	0.4	
MCC-0400B	0.6	6.15	1.694	0.21	
PDP-0400E	0.6	0.860238	0.371	0.4	

Table 6 TS in EMERGENCY

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions:

Short Circuit Currents: The short circuit current calculations have determined the worst-case fault scenarios and identified the available fault currents at various points in your electrical system.

Coordination Study: The protective devices in your system have been analyzed to ensure they operate in a coordinated manner. The time-current curves of these devices have been examined to establish selective coordination and minimize downtime during fault conditions.

Arc Flash Calculations: Arc flash incident energy levels have been calculated for different fault scenarios. These calculations are essential for assessing the potential hazard to workers in the event of an arc flash.

7.2 Recommendations:

Safety Procedures: Develop and implement comprehensive safety procedures and policies for personnel working on your electrical system. These procedures should include guidelines for arc flash hazard prevention, incident energy mitigation, and the use of appropriate Personal Protective Equipment (PPE).

Review Protective Device Settings: Periodically review and validate the settings of protective devices in your system to ensure that they remain in accordance with your coordination goals. Adjust settings as necessary to maintain selective coordination and enhance system safety.

Training: Provide training for your personnel on electrical safety, arc flash awareness, and the proper use of PPE. Ensure that they are aware of the Arc Flash Boundary (AFB) distances and the associated PPE requirements.

Documentation: Maintain detailed records of all calculations, studies, and any changes made to the system. Accurate and up-to-date documentation is crucial for compliance and safety.

Regular System Audits: Conduct regular audits of your electrical system to verify that it continues to meet safety standards. Make adjustments or improvements as needed based on the results of these audits.

Compliance: Ensure that your electrical system complies with relevant industry standards and codes, such as the latest CSA Z462 for arc flash safety.

8 DEFINITIONS

1. Bus ID - Bus Identification.
2. Equipment Name - Name field.
3. Bus Nominal kV - Voltage in kV
4. Equipment Type, MCC, Switchgear, etc.
5. Total Bus Bolted - Total 3-phase short-circuit (SC) current for a fault at the bus in kA.
6. Total Bus Arcing - Calculated arcing current at the faulted bus in kA.
7. PD – Protective Device

9 APPENDIX

9.1 Single Line Diagram (SLD)

9.2 Time Current Curve - TCC NORMAL TO 0200E - PHASE

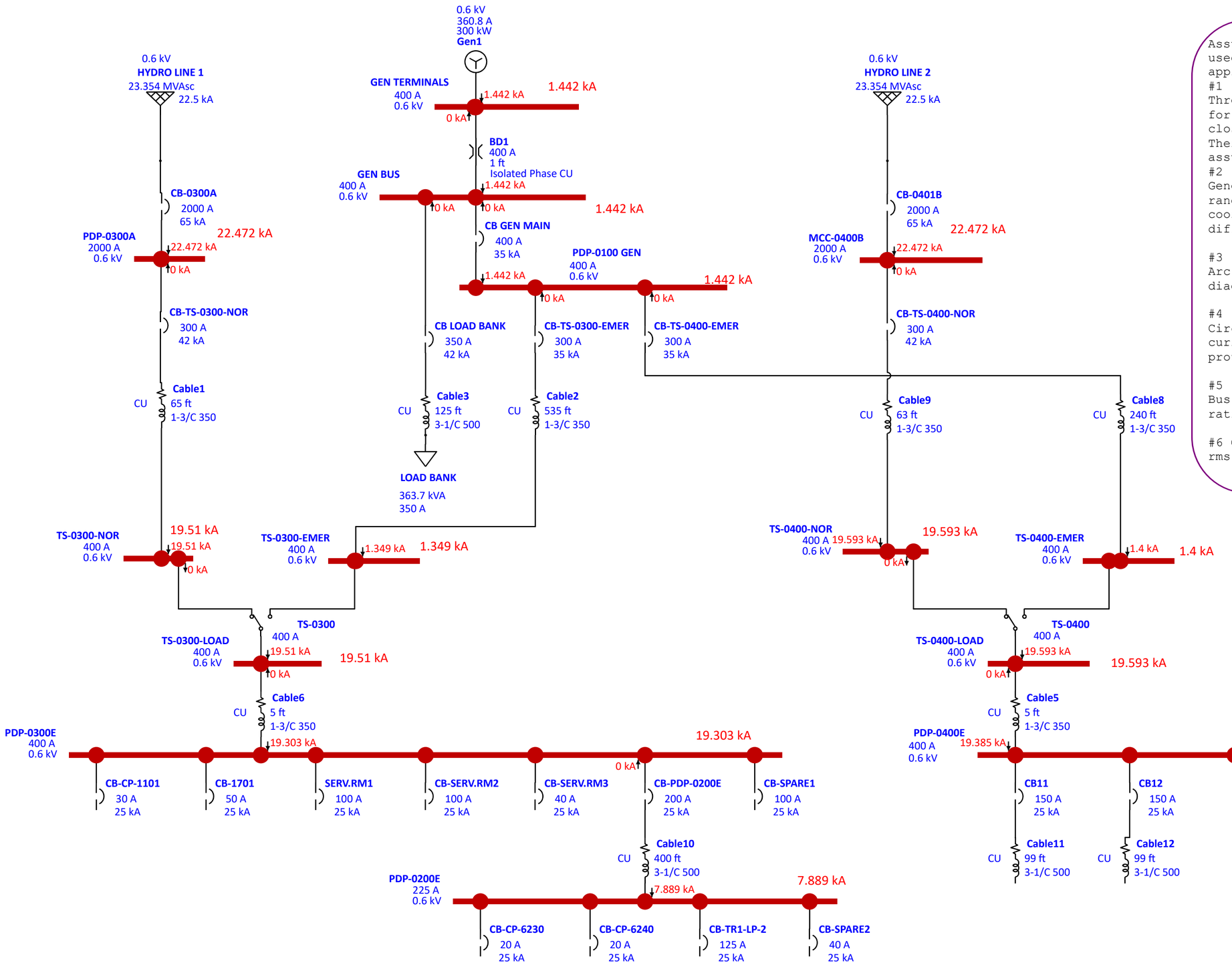
9.3 Time Current Curve - TCC NORMAL TO 0200E - GND

9.4 Time Current Curve - GEN TO 0200E - PHASE

9.5 Time Current Curve - GEN TO 0200E - GND

APPENDIX 9.1

SINGLE LINE DIAGRAM (SLD)



Assumption for the preliminary calculations (NOT to be used to produce arc flash labels and NOT to be used to apply for the protection devices settings).
#1
Three phase fault levels used for the May 2012 study for all three sources A31MN, A21MN and A20MN are very close to each other the difference is less than 70A. Therefore at the PDP-0300A or the MCC-0400B we can assume the same fault current of 22.5kA.
#2
Generator characteristics and circuit breakers were randomly selected from one manufacturer - The final coordination study and arc flash calculations will have different results.

#3
Arc flash results are indicated on the single line diagram only and NOT to be used for Arc Flash labels.

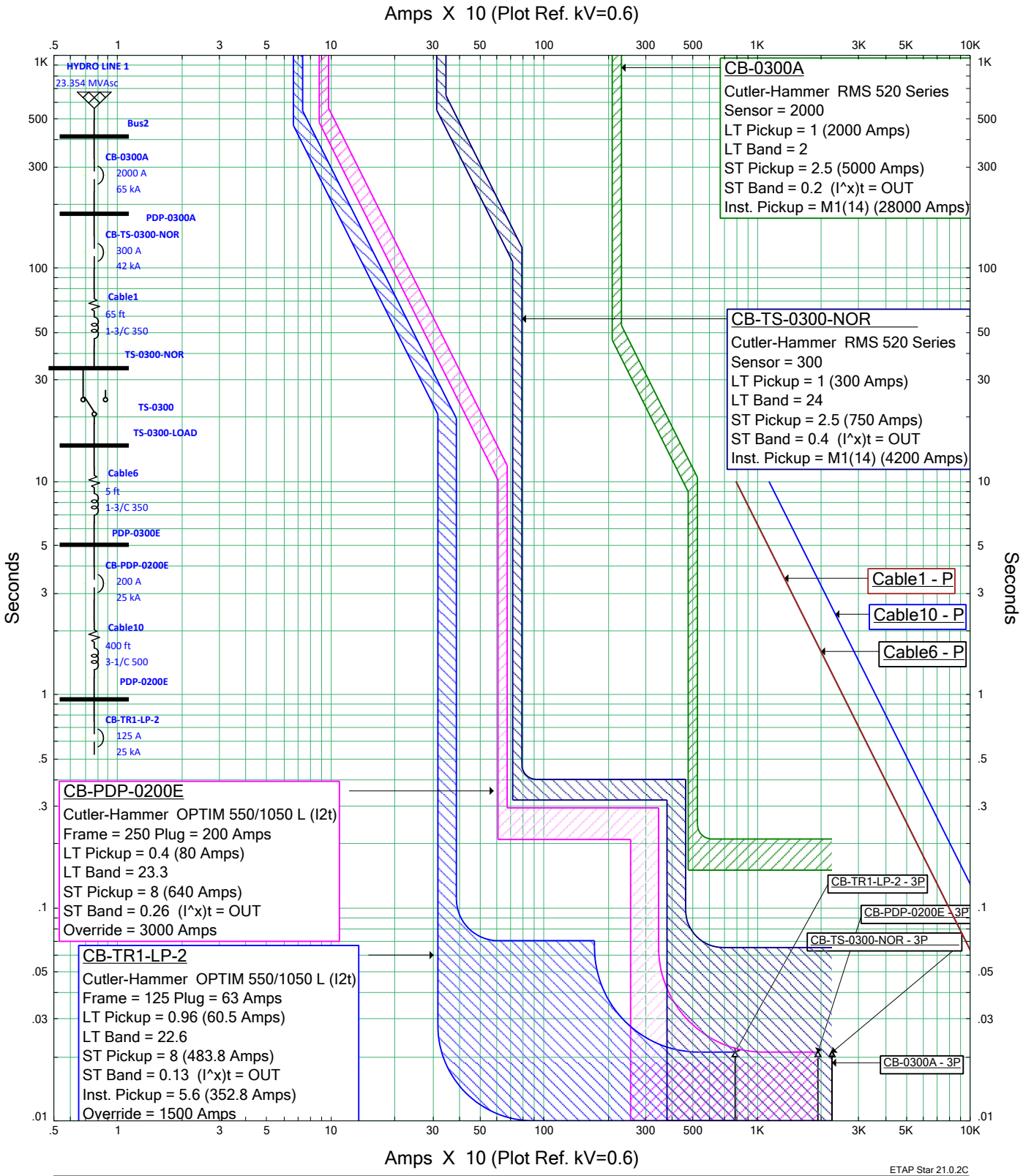
#4
Circuit breakers setting are indicated on the time current curves only and NOT to be used for setting the protective devices.

#5
Bus bracing rating is shown in assymetrical rms amps rating.

#6 Circuit braker interrupting rating is in symmetrical rms amps.

APPENDIX 9.2

TIME CURRENT CURVE – TCC NORMAL TO 0200E - PHASE



ETAP Star 21.0.2C

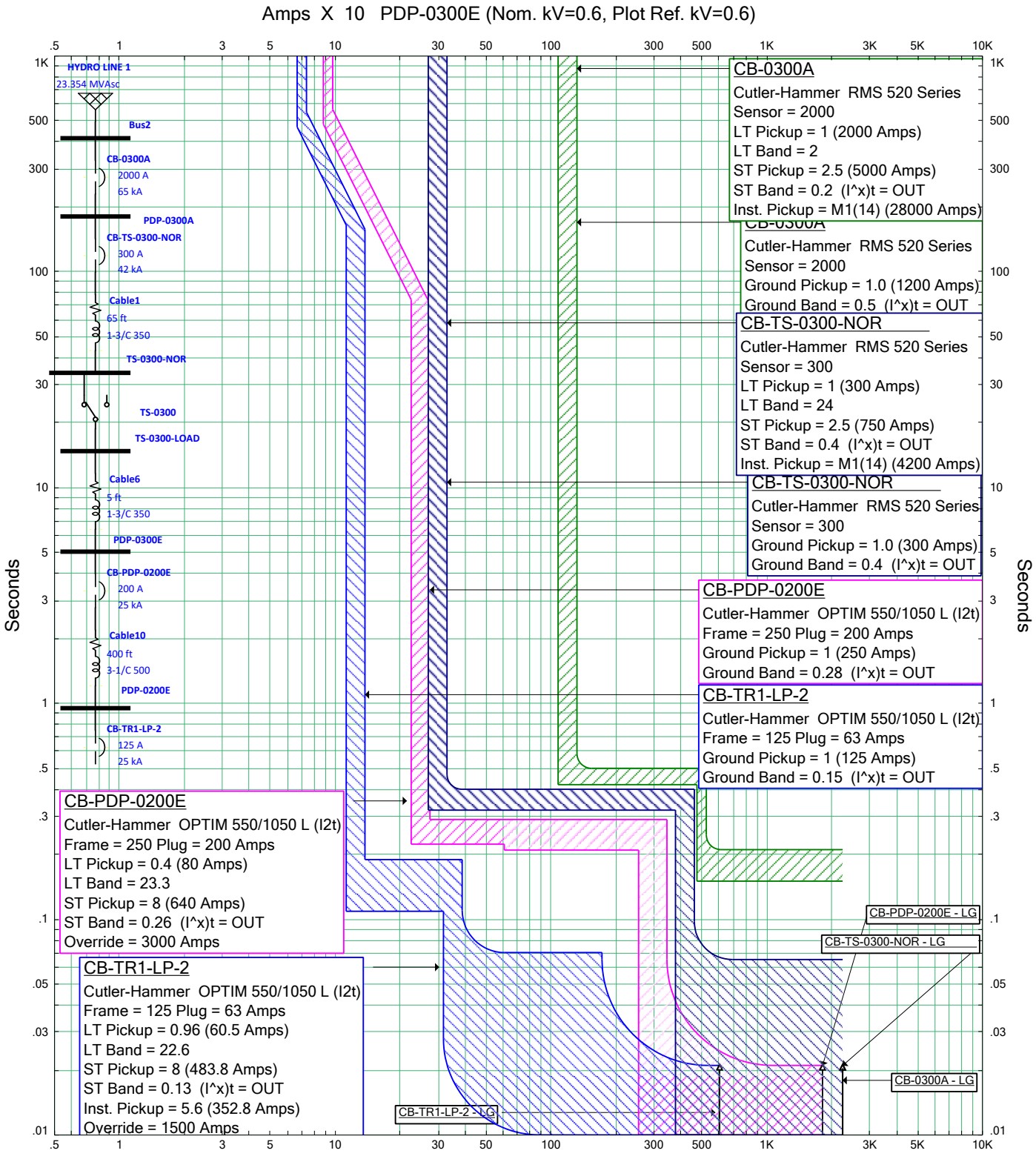
NORMAL TO PDP-0200E

Project: R.C. HARRIS WTP-INST STDBY GEN
Location: TORONTO, ONTARIO
Contract:

Date: 11-05-2023
Rev: Base
Fault: Phase
Circuit:

APPENDIX 9.3

TIME CURRENT CURVE – TCC NORMAL TO 0200E - GND



ETAP Star 21.0.2C

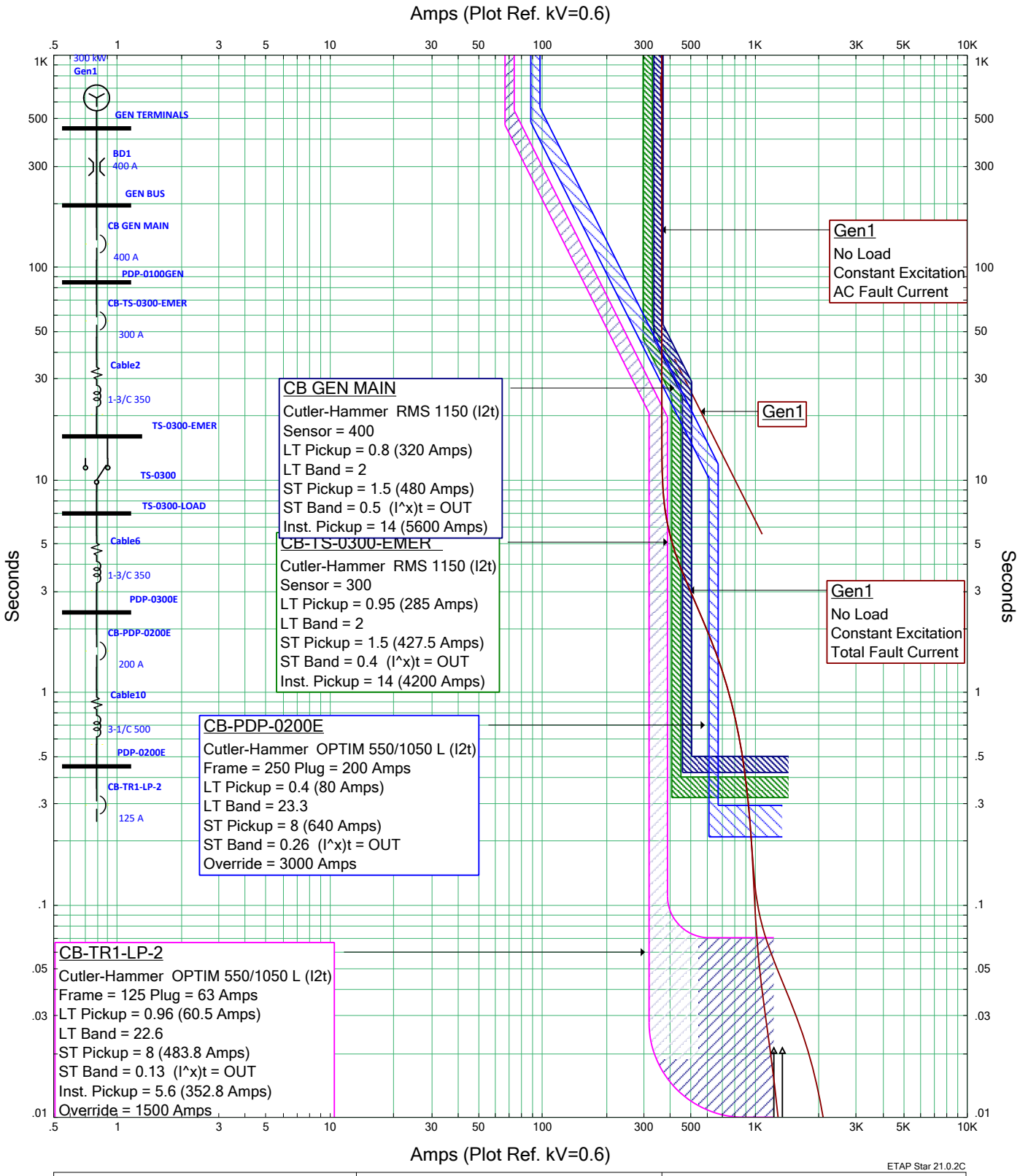
NORMAL TO PDP-0200E

Project: R.C. HARRIS WTP-INST STDBY GEN
Location: TORONTO, ONTARIO
Contract:

Date: 11-05-2023
Rev: Base
Fault: Ground
Circuit:

APPENDIX 9.4

TIME CURRENT CURVE – GEN TO 0200E - PHASE



ETAP Star 21.0.2C

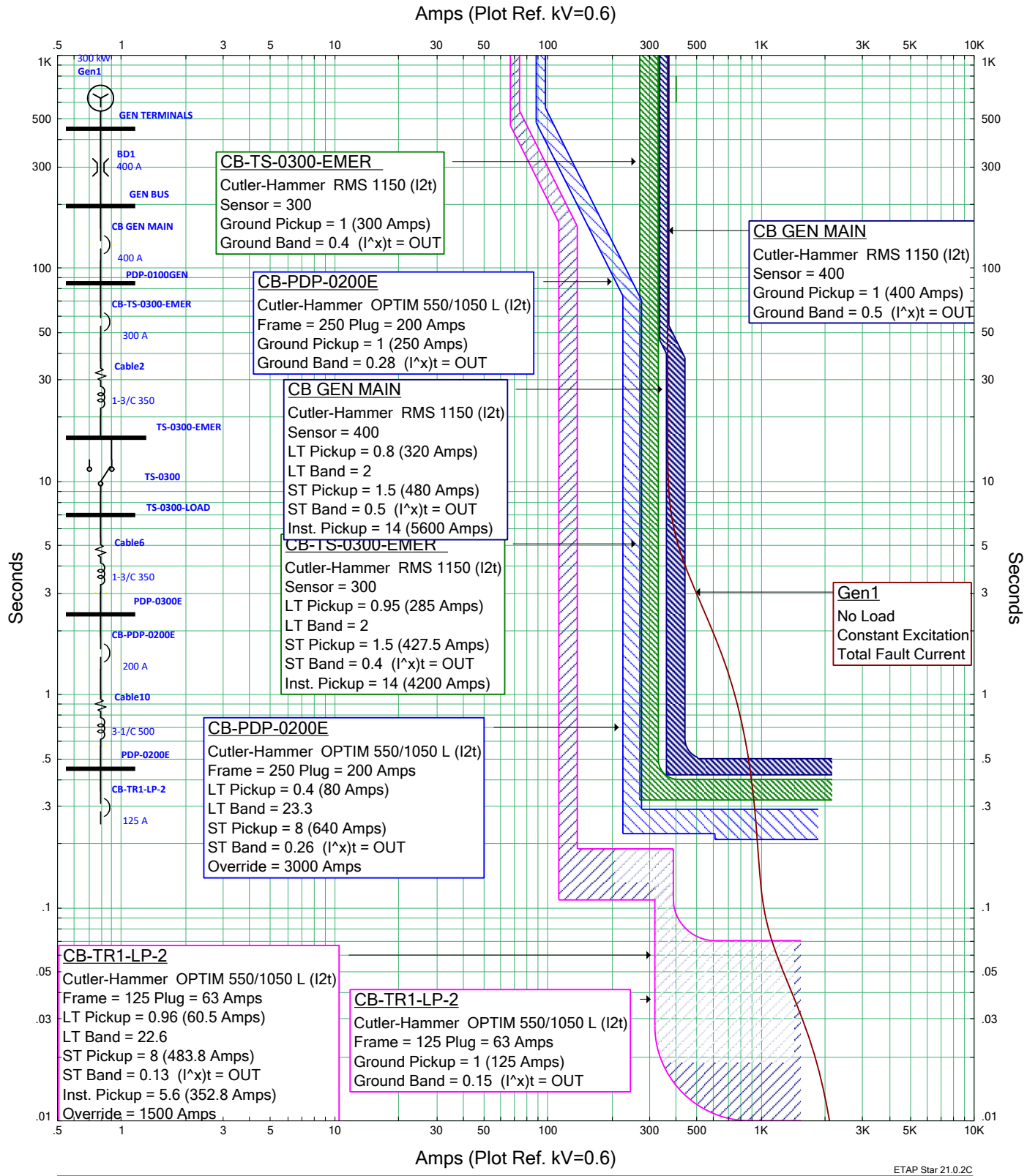
GEN TO PDP-0200E

Project: R.C. HARRIS WTP-INST STDBY GEN
Location: TORONTO, ONTARIO
Contract:

Date: 10-31-2023
Rev: Base
Fault: Phase
Circuit:

APPENDIX 9.5

TIME CURRENT CURVE – GEN TO 0200E - GND



ETAP Star 21.0.2C

GEN TO PDP-0200E

Project: R.C. HARRIS WTP-INST STDBY GEN
Location: TORONTO, ONTARIO
Contract:

Date: 10-31-2023
Rev: Base
Fault: Ground
Circuit:

Appendix P
14B2802-R4 MCC 4 ASB - Shop Drawings

EATON | Cutler-Hammer

POW-R-LINE C
Switchboard/Sous-Station

CUSTOMER DATA

DISTRIBUTOR : WESCO MARKHAM
CUSTOMER : : SUTHERLAND AND SCHULTZ
ORDER No. : 2810-306201
PROJECT TITLE : RC HARRIS WATER FILTRATION PLANT
TORONTO, ON.
SWBD. TAG : MCC-4

NOTES

- BUILT TO : CSA STANDARD C22.2 No. 31.
- C.S.A. FILE LL47168
- GROUND FAULT PROTECTION, WHERE SUPPLIED, TO BE FACTORY SET AT 20% OF RATING AND 10 CYCLE TIME DELAY.
- COORDINATION OF PROTECTIVE DEVICES IS NOT DONE BY THE FACTORY, THE PROTECTIVE DEVICES NEED TO BE SET TO APPROPRIATE VALUES BY THE CUSTOMER AT THE TIME OF COMMISSIONING PRIOR TO ENERGIZATION TO MEET THE SITE REQUIREMENTS AND LOCAL CODES.
- DOORS, HINGED AT LEFT HAND SIDE UNLESS NOTED IN THE DRAWINGS.
- LIFTING LUGS ARE SUPPLIED AS STANDARD.
- FACTORY RESERVES THE RIGHT TO SUBSTITUTE PRODUCTS OF EQUAL OR HIGHER PERFORMANCE, BASED ON AVAILABILITY.
- ALL FACTORY SUPPLIED BREAKER LUGS ARE SIZED FOR TRIP UNIT RATINGS AS SHOWN ON DISTRIBUTION SECTION PAGE(S).
- SWBD c/w NAMEPLATE (BLACK LAMACOID w/ WHITE ENGRAVING) SCREWED ON
- OVERHEAD LIFTING DEVICE AND PORTABLE LIFTING TRUCK SHALL BE PROVIDED
- BUS BARS SHALL BE FULLY INSULATED AND BOOTS ON JOINTS.
- SWBD SHALL BE c/w BARRIERS BETWEEN CABLE AND BUS COMPARTMENT
- **SPARE PARTS TO BE SHIPPED LOOSE:**
  (1)500VA CONTROL TRANSFORMER 600:120V
  (1)POTENTIAL TRANFORMER 600:120V (#467-600)
  (1)120VAC MAGNUM BREAKER SHUNT TRIP (MST1)
  (1)120VAC MAGNUM BREAKER SPRING RELEASE (MSRA)
  (1)MAGNUM BREAKER AUX. SWITCH 2a/b (MAUX2)
  (1)MDS TEST SET (MTST1), (1) MAGNUM LIFTING DEVICE

SPECIFICATIONS

MAIN BUS RATING : 2000 AMP. 600 VOLTS 60 HZ.
SYSTEM : 3 PHASE 3 WIRE
SWBD SHORT CCT. RATING : 50 KA SYM.
BUS BAR : ☐ TIN PLATED ALUMINUM ☒ TIN PLATED COPPER
BUS BRACING : 50 KA SYM.
ACCESS REQUIRED FOR SWITCHBOARD INSTALLATION TO BE FROM :
FRONT AND REAR
ENCLOSURE TYPE : CSA II SPRINKLERPROOF
PAINT FINISH - INTERIOR : ASA 61 LIGHT GREY(CTRL PAN SHALL BE WHITE)
EXTERIOR : ASA 61 LIGHT GREY
SUITABLE FOR SERVICE USE : NO
BASE CHANNELS : YES

MAIN DEVICE : CUTLER-HAMMER TYPE "MDS"
FRAME : MDS620 (2000AF) FUSE PROVISION : N/A
TRIP UNIT : 1150 LSIG RATING PLUG : 2000A
GROUND FAULT PROTECTION : YES
GROUND FAULT SENSING : RESIDUAL GROUND

MAIN INCOMING
ENTRY BY : TOP
ENTRY WITH : TRANSFORMER COORDINATION

IMPORTANT: IT IS THE PURCHASERS RESPONSIBILITY TO OBTAIN ANY NECESSARY LOCAL UTILITY AND/OR PROVINCIAL INSPECTION AUTHORITY APPROVAL. WHEN RETURNING APPROVED DRAWINGS THE PURCHASER SHOULD CONFIRM THAT SUCH APPROVAL HAS BEEN OBTAINED OR IS NOT REQUIRED.

- Info
-
-
-
-

REVISION			
4	02	09/27/05 MR.	GENERAL REVISION AS PER CUSTOMER CHANGES.
	03	03/30/06 ANDY	GENERAL REVISION AS PER CUSTOMER CHANGES.
4	-AS BUILT	YP	08/27/07

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

DFTR	DATE
MR	02/07/05
APPD	DATE
.	.
FILENAME	WPAGE

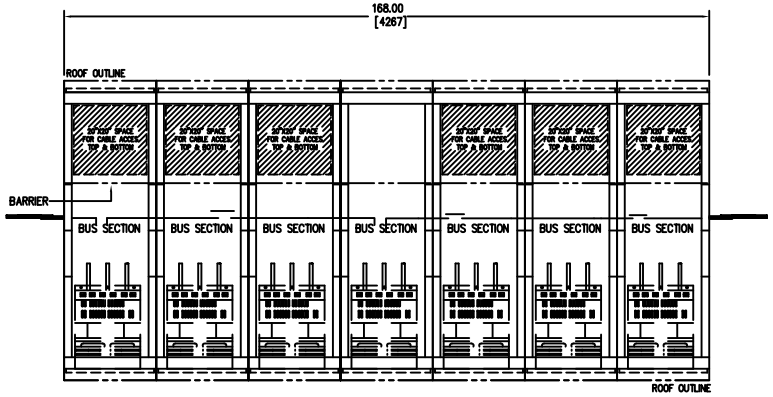
EATON | Cutler-Hammer MILTON, ON

TITLE SWITCHBOARD SPECIFICATION
RC HARRIS WATER FILTRATION PLANT

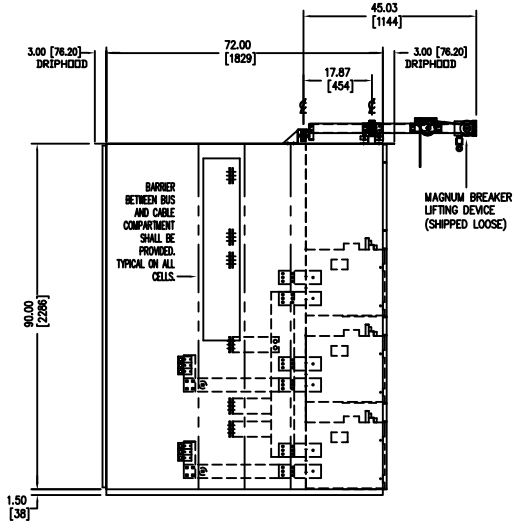
TYPE CUSTOM SWBD — MAIN SWBD.

FEDERAL ID NO.	PRODUCT CODE	REVISION	DWG SIZE	G.O.	DWG	SHEET
	PG 140	4	A	CMBI0023	14B2802	1 OF 12

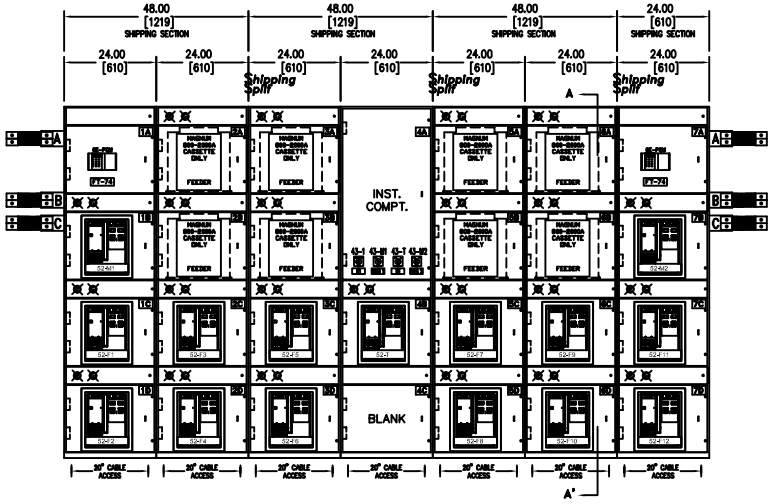
SWITCHBOARD SHIPPED IN __4__ SECTIONS.



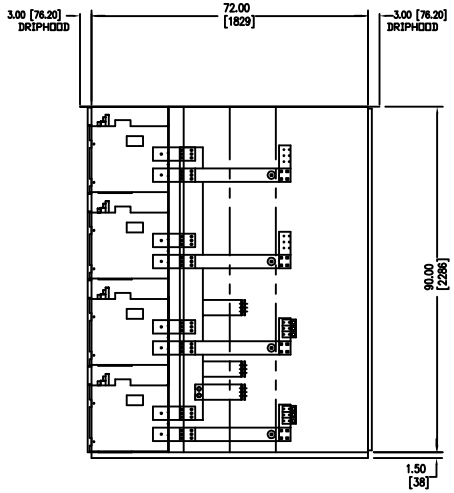
PLAN VIEW



L-H SIDE VIEW



FRONT VIEW



SECTION VIEW (A-A')

Dimensions in Inches [Metric]

REVISION			
01			
02	09/27/05	MR	GENERAL REVISION AS PER CUSTOMER CHANGES.
03	03/30/06	ANDY	GENERAL REVISION AS PER CUSTOMER CHANGES.
4	-AS BUILT	YP	08/27/07

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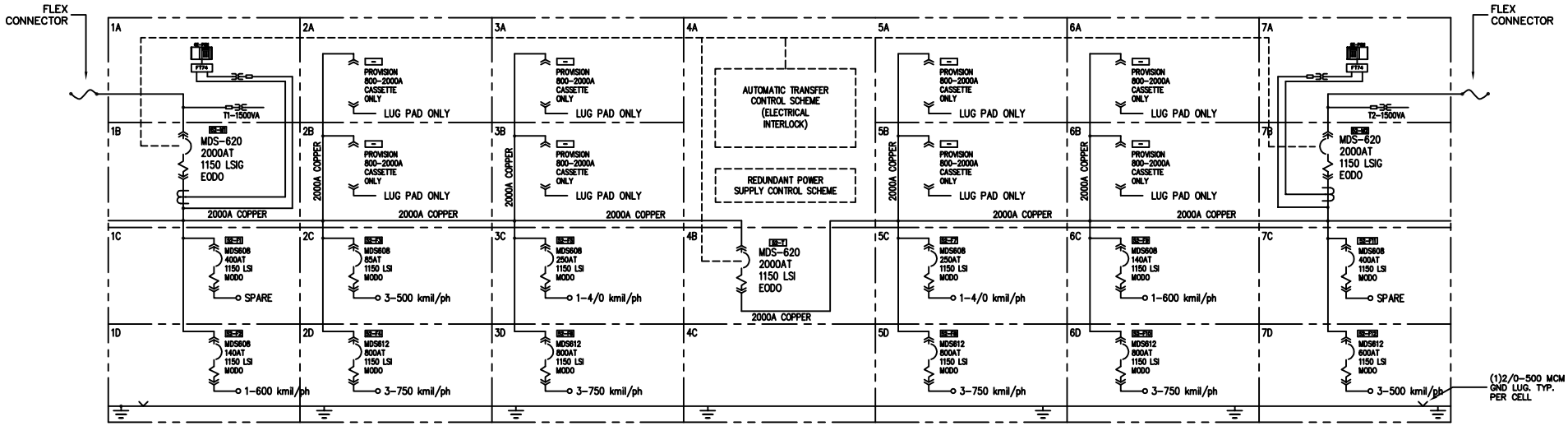
DFTR	MR	DATE	02/07/05
APPD	.	DATE	.
FILENAME	ELEV		
FEDERAL ID NO.	PRODUCT CODE	REVISION	DWG SIZE
	PG 140	4	B

EATON | Cutler-Hammer — MILTON, ON

TITLE: ELEVATION
RC HARRIS WATER FILTRATION PLANT

TYPE: CUSTOM SWBD — MAIN SWBD

G.O.: CMBI0023 — DWG: 14B2802 — SHEET: 2 OF 12



LUGS:

- ALL LUGS SHALL BE COMPRESSION TYPE LUGS
- (TBA) CUSTOMER TO ADVISE LUGS SIZES
-

NOTES:

1. FOR GE-PQM CONNECTION DIAGRAM SEE PAGE 5 .

REVISION		
01		
02	09/27/05 MR	GENERAL REVISION AS PER CUSTOMER CHANGES.
03	03/30/06 ANDY	GENERAL REVISION AS PER CUSTOMER CHANGES.
4	-AS BUILT YP 08/27/07	

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DFTR MR	DATE 02/07/05	EATON Cutler-Hammer	MILTON, ON
APPD .	DATE .	TITLE ELEVATION RC HARRIS WATER FILTRATION PLANT	
FILENAME ELEV		TYPE CUSTOM SWBD	MAIN SWBD
FEDERAL ID NO.	PRODUCT CODE PG 140	REVISION 4	DWG SIZE B
G.O. CMBI0023	DWG 14B2802	SHEET 3 OF 12	

CIRCUIT BREAKER, LUGGING AND CONDUIT ENTRY SCHEDULE

DEVICE	LOCATION	MANUFACTURE TYPE | TRIP UNIT	FRAME (A)	TRIP SETTING (A)	RATING PLUG (A)	INTERRUPT CAPACITY (kA)	TRIP FUNCTIONS	OPERATION	MOUNTING	CHARGE	SHUNT CLOSE	SHUNT TRIP	ACCESSORIES							COMPRESSION LUGS			NAMEPLATE DESCRIPTION	CONDUIT ENTRY	
													a/b CONTACTS	BELL ALARM	CELL SWITCH	CLOSE COVER	KIRK KEY	OP CTR	SHUTTERS	LUGS PER PHASE	NEUTRAL LUGS	GROUND LUGS		TOP	BOTTOM
52–M1	1B	CUTLER–HAMMER MDS–620 / DT–1150	2000	2000	2000	65	LSIG	E.O.	D.O.	120VAC	120VAC	120VAC	8	2	8	X			X	N/A	N/A	TBD	MAIN BREAKER 1		
52–T	4B	CUTLER–HAMMER MDS–620 / DT–1150	2000	2000	2000	65	LSIG	E.O.	D.O.	120VAC	120VAC	120VAC	8	2	8	X			X	N/A	N/A	N/A	TIE BREAKER		
52–M2	7B	CUTLER–HAMMER MDS–620 / DT–1150	2000	2000	2000	65	LSIG	E.O.	D.O.	120VAC	120VAC	120VAC	8	2	8	X			X	N/A	N/A	N/A	MAIN BREAKER 2		
52–F1	1C	CUTLER–HAMMER MDS–608 / DT–1150	800	140	300	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	TBD	N/A	TBD	SPARE		
52–F2	1D	CUTLER–HAMMER MDS–608 / DT–1150	800	85	200	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	1–600 kmil	N/A	TBD	T13		
52–F3	2C	CUTLER–HAMMER MDS–608 / DT–1150	800	600	600	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	3–500 kmil	N/A	TBD	DWP1		
52–F4	2D	CUTLER–HAMMER MDS–612 / DT–1150	1200	800	800	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	3–750kmil	N/A	TBD	HF1		
52–F5	3C	CUTLER–HAMMER MDS–608 / DT–1150	800	225	250@.9	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	1–4/0 kmil	N/A	TBD	PF1		
52–F6	3D	CUTLER–HAMMER MDS–612 / DT–1150	1200	800	800	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	3–750 kmil	N/A	TBD	MCC–6		
52–F7	5C	CUTLER–HAMMER MDS–608 / DT–1150	800	225	250@.9	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	1– 4/0 kmil	N/A	TBD	PF2		
52–F8	5D	CUTLER–HAMMER MDS–612 / DT–1150	1200	800	800	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	3– 750 kmil	N/A	TBD	MCC–6		
52–F9	6C	CUTLER–HAMMER MDS–608 / DT–1150	800	140	300	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	1–600 kmil	N/A	TBD	T14		
52–F10	6D	CUTLER–HAMMER MDS–612 / DT–1150	1200	800	800	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	3– 750 kmil	N/A	TBD	HF2		
52–F11	7C	CUTLER–HAMMER MDS–608 / DT–1150	800	400	400	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	TBD	N/A	TBD	SPARE		
52–F12	7D	CUTLER–HAMMER MDS–612 / DT–1150	1200	600	600	65	LSI	M.O.	D.O.	N/A	N/A	N/A	8	2	8	X			X	3– 500 kmil	N/A	TBD	DF1		

LEGEND:

E.O.D.O. - ELECTRICAL OPERATED DRAWOUT
T.B.D. - TO BE DETERMINED

REVISION	
02	09/27/05 MR. GENERAL REVISION AS PER CUSTOMER CHANGES.
03	03/30/06 andy GENERAL REVISION AS PER CUSTOMER CHANGES.
4	-AS BUILT YP 08/27/07

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DFTR	MR
DATE	02/07/05
APPD	.
DATE	.
FILENAME	BREAKER TABLE
FEDERAL ID NO.	
PRODUCT CODE	PG 140
REVISION	4
DWG SIZE	A

EATON | Cutler-Hammer — MILTON, ON

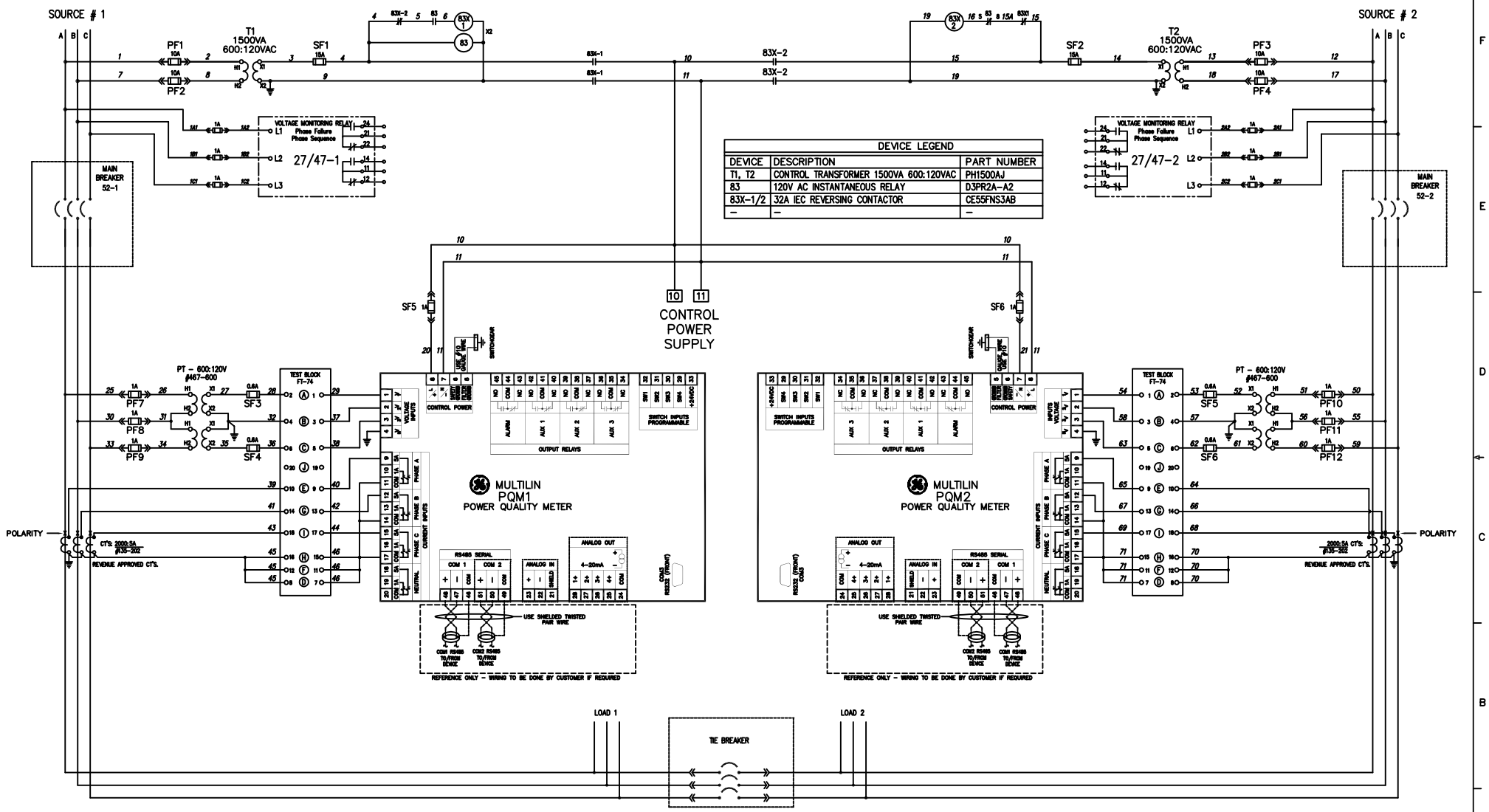
TITLE: SWITCHBOARD LAYOUT
RC HARRIS WATER FILTRATION PLANT

TYPE: CUSTOM SWBD — –

G.O.: CMBI0023

DWG: 14B2802

SHEET 4 OF 12



REVISION			
4			
02	09/27/05	MR	GENERAL REVISION AS PER CUSTOMER CHANGES.
03	03/30/06	ANDY	GENERAL REVISION AS PER CUSTOMER CHANGES.
4	-AS BUILT	YP	08/27/07

NOTES
1. WIRE MARKERS INCLUDED.
2. ALL CONTROL WIRING WILL BE No. 14 SIS
3. GROUND WIRING WILL BE No. 12 SIS
4. COMPONENTS SHALL BE LABELED AS PER THE DWG.

Certified As-Built
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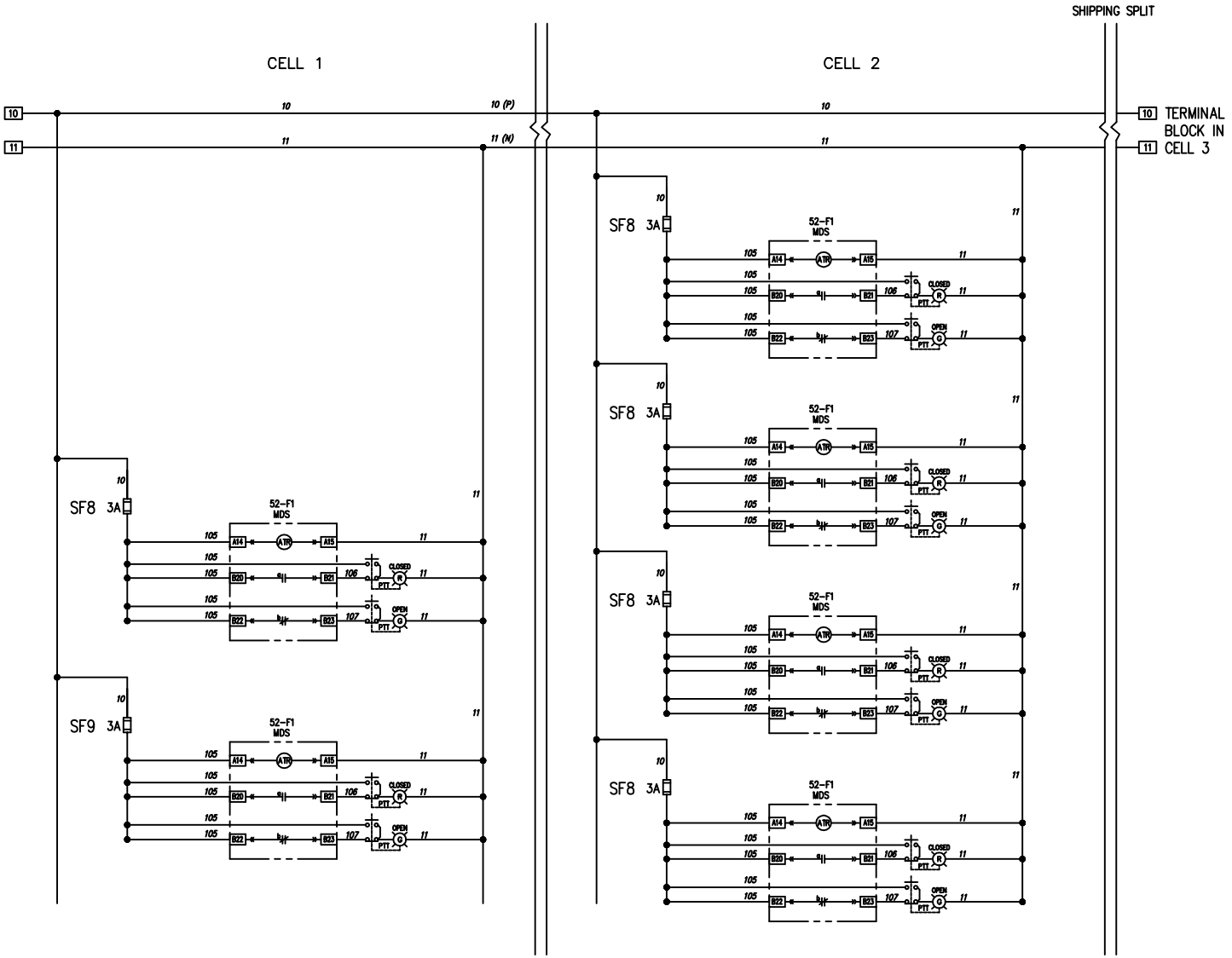
DFTR	MR	DATE	02/07/05
APPD	.	DATE	.
FILENAME	GEPQM		
FEDERAL ID NO.	PRODUCT CODE	REVISION	DWG SIZE
	PG 140	4	B

EATON | Cutler-Hammer — MILTON, ON

TITLE: 3-LINE WIRING DIAGRAM
RC HARRIS WATER FILTRATION PLANT

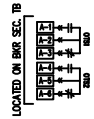
TYPE: CUSTOM SWBD — MAIN SWBD

G.O.: CMBI0023 — DWG: 14B2802 — SHEET: 5 OF 12



TYPICAL BREAKER AUX. CONTACTS

TYPICAL OVERCURRENT TRIP SWITCH



TYPICAL INCOM

LEGEND:

ATR – AUTOMATIC TRIP RELAY
PTT – PUSH TO TEST PILOT LIGHTS
OTS – OVER CURRENT TRIP SWITCH
ST – SHUNT TRIP
SR – SPRING RELEASE
M – MOTOR OPERATOR

NOTES
1. WIRE MARKERS INCLUDED.
2. ALL CONTROL WIRING WILL BE No. 14 SIS
3. GROUND WIRING WILL BE No. 12 SIS
4. COMPONENTS SHALL BE LABELED AS PER THE DWG.

Certified As-Built
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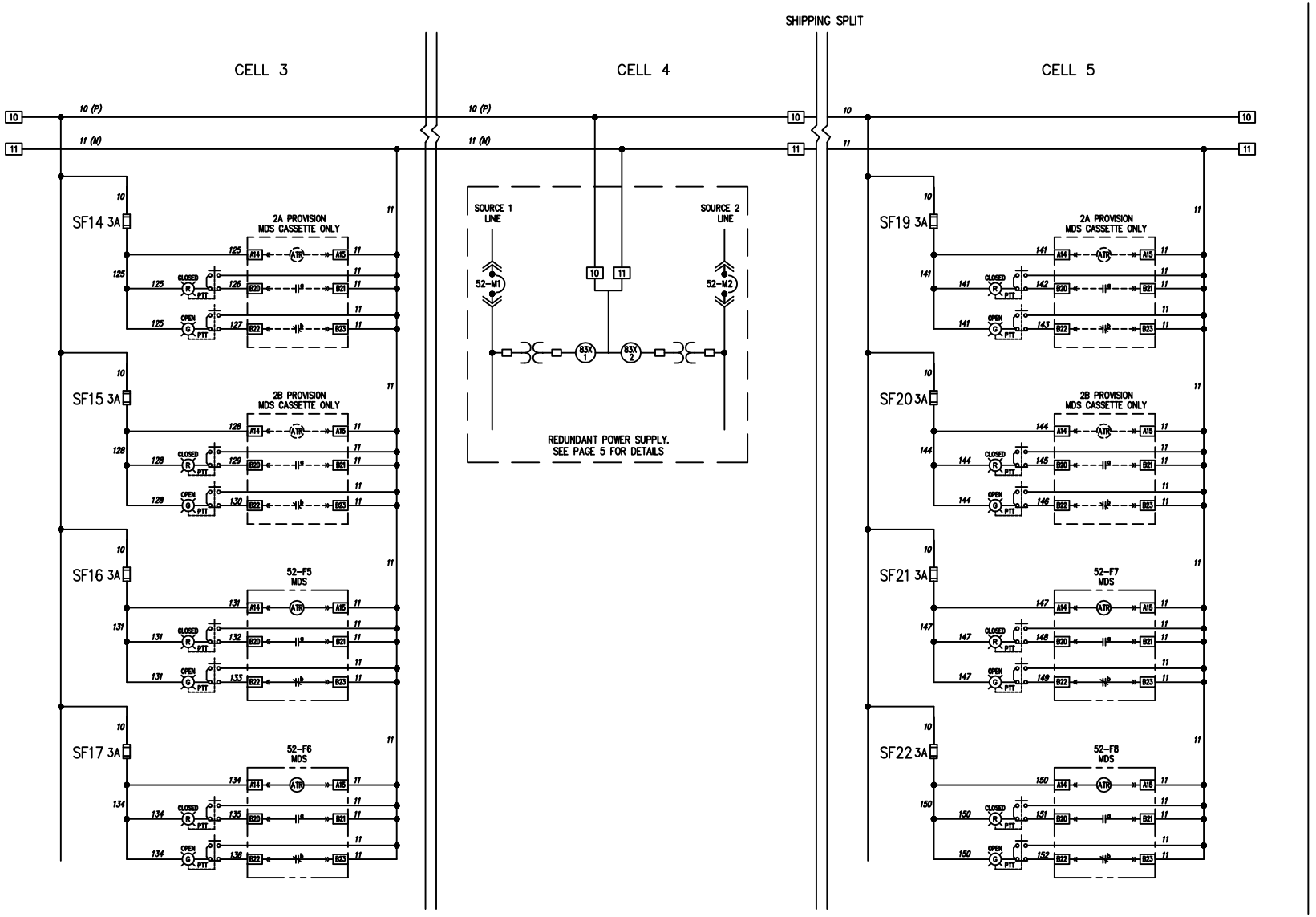
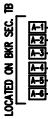
REVISION	DESCRIPTION	
4		
02	09/27/05 MR GENERAL REVISION AS PER CUSTOMER CHANGES.	
03	03/30/06 ANDY GENERAL REVISION AS PER CUSTOMER CHANGES.	
4	-AS BUILT YP	09/21/07

DFTR MR	DATE 02/07/05	EATON | Cutler-Hammer	MILTON, ON
APPD .	DATE .	TITLE BREAKER CONTROL CIRCUIT RC HARRIS WATER FILTRATION PLANT	
FILENAME MDSWIRING		TYPE CUSTOM SWBD	MAIN SWBD
FEDERAL ID NO.	PRODUCT CODE PG 140	REVISION 4	DWG SIZE B
G.O. CMBI0023	DWG 14B2802	SHEET 6 OF 12	



TYPICAL BREAKER AUX. CONTACTS

TYPICAL OVERCURRENT TRIP SWITCH



TYPICAL INCOM

LEGEND:

ATR – AUTOMATIC TRIP RELAY
PTT – PUSH TO TEST PILOT LIGHTS
OTS – OVER CURRENT TRIP SWITCH
ST – SHUNT TRIP
SR – SPRING RELEASE
M – MOTOR OPERATOR

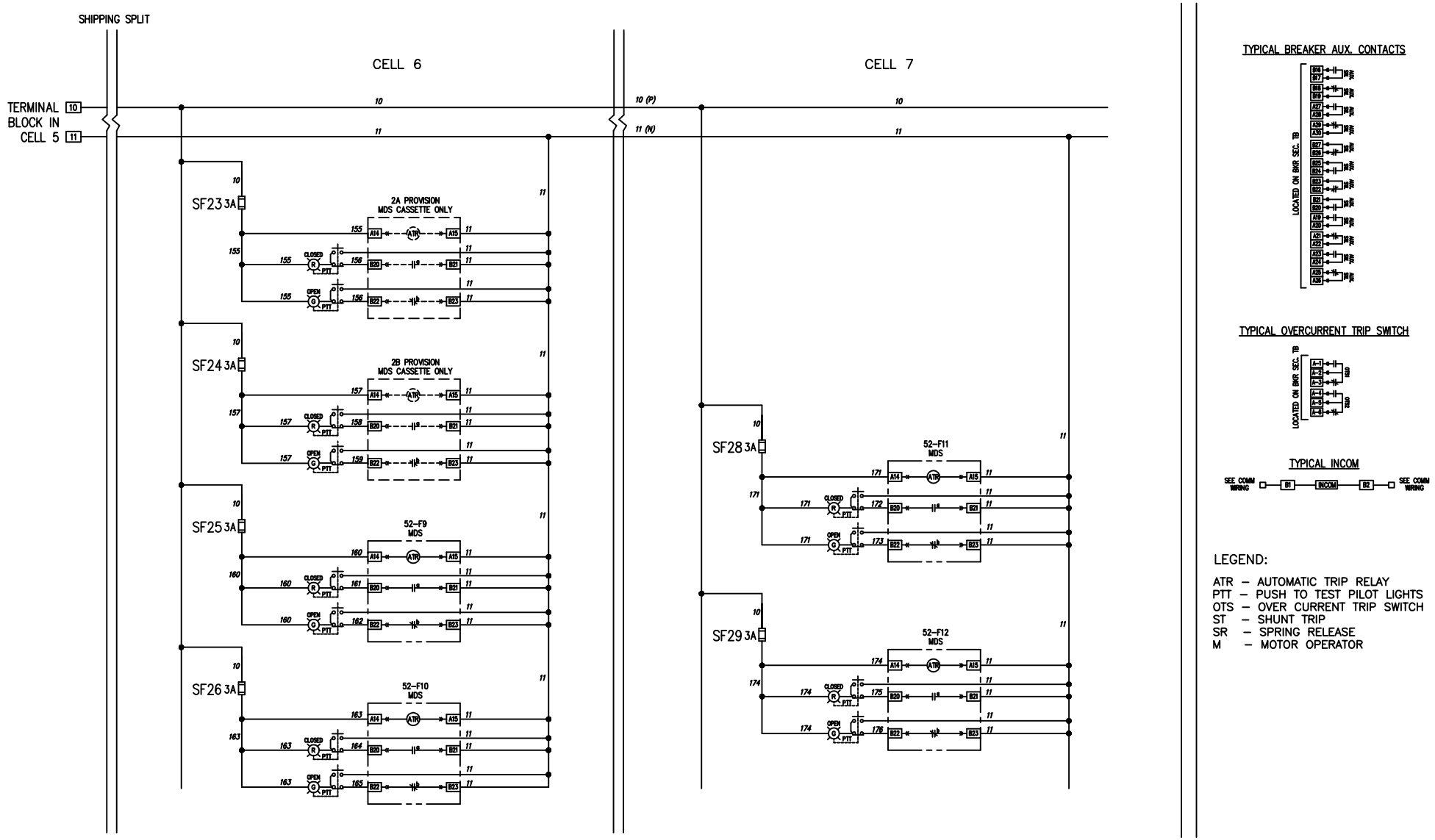
NOTES
1. WIRE MARKERS INCLUDED.
2. ALL CONTROL WIRING WILL BE No. 14 SIS
3. GROUND WIRING WILL BE No. 12 SIS
4. COMPONENTS SHALL BE LABELED AS PER THE DWG.

REVISION		
4	-AS BUILT YP	08/27/07
03	03/30/06 ANDY. GENERAL REVISION AS PER CUSTOMER CHANGES.	
02	09/27/05 MR. GENERAL REVISION AS PER CUSTOMER CHANGES.	

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED. LES RENSEIGNEMENTS CI-DESSUS ONT ÉTÉ ÉLABORÉS PAR CUTLER-HAMMER. ILS VOUS SONT DIVULGUÉS EN TOUTE CONFIANCE ET LEUR UTILISATION SE LIMITE AUX SEULES FINS POUR.

DFTR MR	DATE 02/07/05	EATON | Cutler-Hammer	MILTON, ON
APPD .	DATE .	TITLE BREAKER CONTROL CIRCUIT RC HARRIS WATER FILTRATION PLANT	
FILENAME MDSWIRING		TYPE CUSTOM SWBD	MAIN SWBD
FEDERAL ID NO.	PRODUCT CODE PG 140	REVISION 4	DWG SIZE B
G.O. MCBI0023	DWG 14B2802	SHEET 7 OF 12	



TYPICAL BREAKER AUX. CONTACTS

TYPICAL OVERCURRENT TRIP SWITCH

TYPICAL INCOM

LEGEND:

ATR – AUTOMATIC TRIP RELAY
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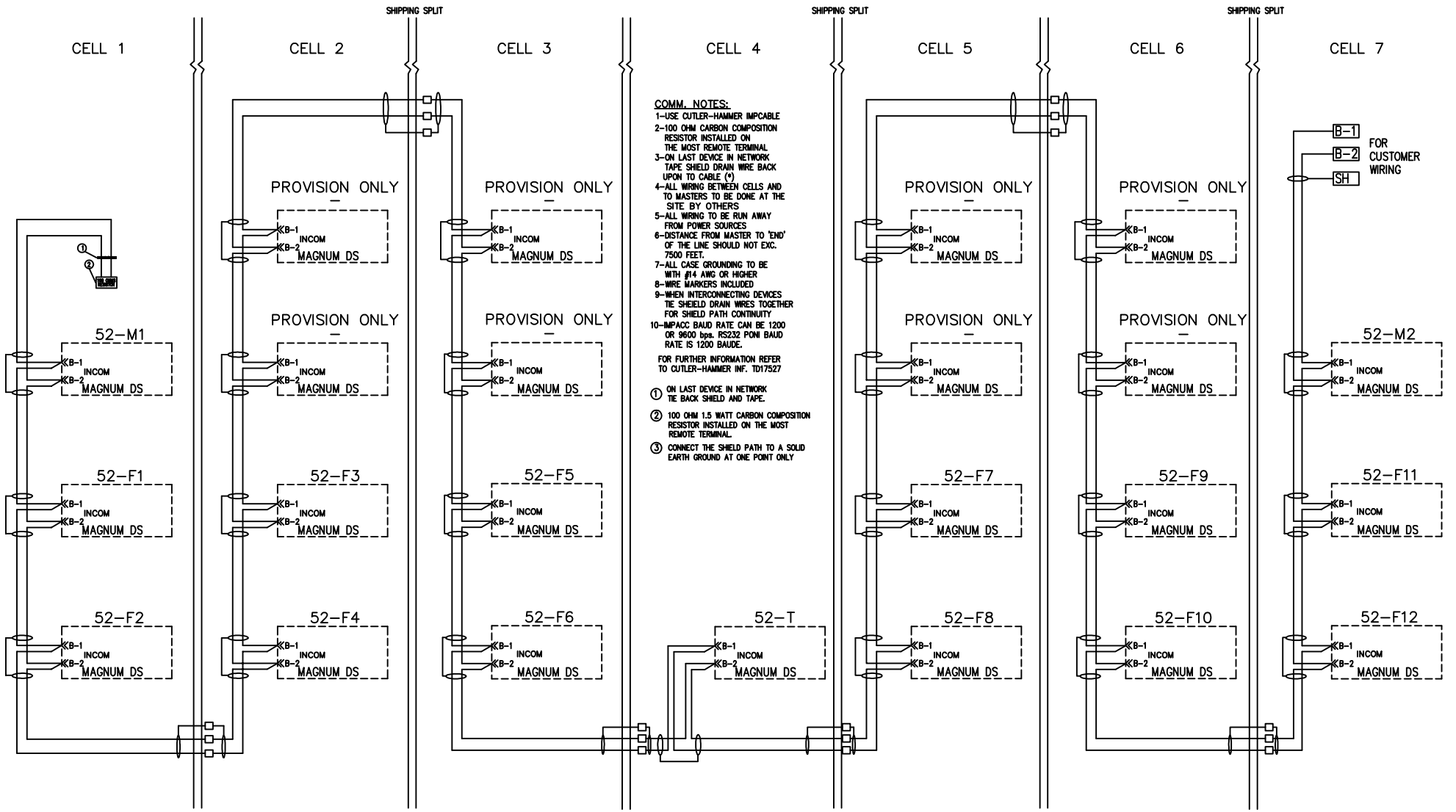
REVISION			
4			
02	09/27/05 MR GENERAL REVISION AS PER CUSTOMER CHANGES.		
03	03/30/06 ANDY. GENERAL REVISION AS PER CUSTOMER CHANGES.		
4	-AS BUILT	YP	06/27/07

DFTR MR	DATE 02/07/05	EATON Cutler-Hammer	MILTON, ON
APPD .	DATE .	TITLE BREAKER CONTROL CIRCUIT RC HARRIS WATER FILTRATION PLANT	
FILENAME MDSWIRING		TYPE CUSTOM SWBD	MAIN SWBD
FEDERAL ID NO.	PRODUCT CODE PG 140	REVISION 4	DWG SIZE B
G.O. CMBI0023	DWG 14B2802	SHEET 8 OF 12	



COMM. NOTES:
1-USE CUTLER-HAMMER IMPCABLE
2-100 OHM CARBON COMPOSITION RESISTOR INSTALLED ON THE MOST REMOTE TERMINAL
3-ON LAST DEVICE IN NETWORK TAPE SHIELD DRAIN WIRE BACK UPON TO CABLE (*)
4-ALL WIRING BETWEEN CELLS AND TO MASTERS TO BE DONE AT THE SITE BY OTHERS
5-ALL WIRING TO BE RUN AWAY FROM POWER SOURCES
6-DISTANCE FROM MASTER TO 'END' OF THE LINE SHOULD NOT EXC. 7500 FEET.
7-ALL CASE GROUNDING TO BE WITH #14 AWG OR HIGHER
8-WIRE MARKERS INCLUDED
9-WHEN INTERCONNECTING DEVICES TIE SHEIELD DRAIN WIRES TOGETHER FOR SHIELD PATH CONTINUITY
10-IMPACC BAUD RATE CAN BE 1200 OR 9600 bps. RS232 PONI BAUD RATE IS 1200 BAUDE.

FOR FURTHER INFORMATION REFER TO CUTLER-HAMMER INF. TD17527

① ON LAST DEVICE IN NETWORK TIE BACK SHIELD AND TAPE.

② 100 OHM 1.5 WATT CARBON COMPOSITION RESISTOR INSTALLED ON THE MOST REMOTE TERMINAL.

③ CONNECT THE SHIELD PATH TO A SOLID EARTH GROUND AT ONE POINT ONLY

REVISION			
4			
02	09/27/05	MR	GENERAL REVISION AS PER CUSTOMER CHANGES.
03	03/30/06	ANDY.	GENERAL REVISION AS PER CUSTOMER CHANGES.
4	-AS BUILT	YP	06/27/07

NOTES
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DFTR: MR	DATE: 02/11/05	EATON Cutler-Hammer	MILTON, ON
APPD: .	DATE: .	TITLE: COMMUNICATION WIRING RC HARRIS WATER FILTRATION	
FILENAME: BKR_COMM		TYPE: CUSTOM SWBD	MAIN SWBD
FEDERAL ID NO.	PRODUCT CODE: PG 140	REVISION: 4	DWG SIZE: B
G.O.: CMBI0023	DWG: 14B2802	SHEET: 9 OF 12	

NORMAL CONDITION
1. MAIN BREAKERS (52-1, 52-2) ARE CLOSED
2. TIE BREAKER (52-T) IS OPEN

INTERLOCKING
1. MAIN AND TIE BREAKERS ARE ELECTRICALLY INTERLOCKED TO PREVENT PARALLELING OF SOURCES AT ALL TIMES.

2. CLOSING OF MAIN AND TIE BREAKERS VIA SELECTOR WITCH IS PERMITTED ONLY WHEN THE AUTO/OFF/MANUAL SELECTOR SWITCH (43-1) IS IN THE MANUAL OR OFF POSITION.

3. TRIPPING OF MAIN AND TIE BREAKERS VIA SELECTOR SWITCH IS PERMITTED UNDER ALL CIRCUMSTANCES.

LOCKOUT
1. OVERCURRENT TRIP SWITCHES (OTS) ON MAIN AND TIE BREAKERS ARE INCORPORATED IN THE CONTROL SCHEME TO PREVENT CLOSURE OF TIE & FAULTED MAIN BREAKER AFTER A FAULT. THE FAULT MUST BE CLEARED AND THE CORRESPONDING BREAKER MANUALLY RESET TO RETURN TO NORMAL OPERATION.

4. ONLY TWO BREAKERS CAN BE CLOSED AT ONE TIME WHEN SELECTOR SWITCH (43-1) IS EITHER IN AUTO, OFF OR MANUAL POSITION AND BKRS ARE IN FULLY CONNECTED POSITION. **INTERLOCKING IS DEFEATED WHEN BREAKERS ARE IN TEST POSITION. SELECTOR SWITCH (43-1) MUST BE IN OFF POSITION WHEN TESTING THE BREAKERS.**

INITIAL START-UP
1. VERIFY SELECTOR SWITCH (43-1) IS IN "MANUAL" POSITION.

2. VERIFY ALL 3 BREAKERS ARE IN THE FULLY CONNECTED POSITION IN THEIR RESPECTIVE CELLS.

3. TURN SELECTOR SWITCH (43-M1/2) TO CLOSE POSITION.
   -MAIN BREAKERS CLOSES.

4. PLACE SELECTOR SWITCH (43-1) IN THE "AUTO" POSITION.

SEQUENCE OF AUTOMATIC OPERATION
A. LOSS OF UTILITY POWER AT EITHER MAIN
1. DEVICE 47 DETECTS LOSS OF NORMAL VOLTAGE (BUILT IN TIME DELAY SET TO MINIMUM).
2. DEVICE 62-1/2 TIMES OUT FOR 5s(ADJUSTABLE 0.0s - 10sec.)
3. MAIN BREAKER OPENS
4. DEVICE 62-3/4 TIMES OUT FOR 1s(ADJUSTABLE 0.5s - 10s)
5. TIE BREAKER CLOSES

B. POWER RESTORED AT EITHER MAIN
1. DEVICE 47 DETECTS NORMAL VOLTAGE (AUTOMATICALLY RESETS CONTACT)
2. DEVICE 62-5/6 TIMES OUT FOR 5min. (ADJUSTABLE 0min - 10min)
3. TIE BREAKER OPENS
4. DEVICE 62-3/4 TIMES OUT FOR 1s(ADJUSTABLE 0.5s - 10s)
5. MAIN BREAKER CLOSES

C. LOSS OF UTILITY POWER AT BOTH MAINS.
1. NO ACTIVITY UNTIL AT LEAST ONE SOURCE IS AVAILABLE.

MANUAL MODE SEQUENCE
1. PLACE SELECTOR SWITCH (43-1) IN "MANUAL" POSITION.

2. USING SELECTOR SWITCH(43-M1/M2/T) IN EACH MAIN BREAKERS WILL ALLOW MANUAL TRANSFER CONTROL OF THE ASSOCIATED BREAKER. OPERATION OF THE BREAKER SELECTOR SWITCH IN TRIP POSITION WILL TRIP THE ASSOCIATED BREAKER.

3. OPERATION OF MAIN BREAKERS SELECTOR SWITCH (43-M1/M2) IN CLOSE POSITION WILL TRIP THE TIE BREAKER. TIE BREAKER CANNOT BE CLOSED UNLESS ONE OF THE MAIN BREAKERS IS OPEN. ONLY TWO BREAKERS CAN BE CLOSED AT ANY GIVEN TIME.

4. MAIN BREAKER WILL CLOSE ONLY IF SOURCE POWER IS AVAILABLE.

5. SELECTOR SWITCH (43-1) MAY BE RETURNED TO "AUTO" TO REACT TO NEXT POWER FAILURE.

LEGEND:
- OTC OVERCURRENT TRIP SWITCH (BELL ALARM)
- TOC TRUCK OPERATED CELL SWITCH
- 120V AC COIL
- 120V AC PILOT LIGHT
- FUSE
- MOT SPRING CHARGE OPERATOR
- SR SPRING RELEASE (CLOSE)
- 27/47 VOLTAGE MONITORING RELAY-D65VMLS600-B1
- TC TRIP COIL
- VENDOR WIRING
- FIELD WIRING
- TERMINAL BLOCK

DEVICE LEGEND		
DEVICE	DESCRIPTION	PART NUMBER
43-1	AUTO/OFF/MANUAL SELECTOR SWITCH - 3 POS. SELECTOR SWITCH	LVDAJB404
43-M1/T/M2	CLOSE/OFF/OPEN SELECTOR SWITCH - 3 POS. MOMENTARY	10250T3043
62-1,62-2	OMRON OFF-DELAY (3s-10min) 120V AC RELAY - 8 PIN (H3CR)	3A16882H01
62-1,62-2	RELAY SOCKET - 8 PIN	D3PA2-A2
62-3,62-4	OMRON ON-DELAY (0.5-60s) 120V AC RELAY - 8 PIN (H3CR)	LVDAJ7617
62-3,62-4	RELAY SOCKET - 11 PIN	D3PA3-A2
62-5,62-6	OMRON ON-DELAY (2min-120min) 120V AC RELAY - 8 PIN (H3CR)	LVDAJ7617
62-5,62-6	RELAY SOCKET - 11 PIN	D3PA3-A2
62-1,62-2	RELAY SOCKET - 8 PIN	D3PA2-A2
LIGHTS	120V AC PUSH-TO-TEST TRANSFORMER TYPE PILOT LIGHTS	10250T221N
G	GREEN PILOT LIGHT LENS	10250TC22
R	RED PILOT LIGHT LENS	10250TC21
CR-1,CR-7	CONTROL RELAY 120VAC / 8 PIN SOCKET	D3PR2A / D3PA2-A2
CR-4,CR-5,CR-6	CONTROL RELAY 120VAC / 11 PIN SOCKET	D3PR3A / D3PA3-A2

DEVICE 43-1
AUTO/MANUAL SELECTOR SWITCH

CONTACT	AUTO	OFF	MAN
1-4	X		
5-6	X		
7-8			X
9-10	X		
11-12			X
13-14	X		
15-16			X
17-18	X		
19-20			X
21-22	X		
23-24			X
25-26	X		

"X" = CONTACT CLOSED

DEVICE (43-M1) MOMENTARY
CLOSE/OFF/TRIP SELECTOR SWITCH

CONTACT	CLOSE	OFF	TRIP
1-2	X		
3-4			X
5-6	X		
7-8			X
9-10	X		
11-12			X

"X" = CONTACT CLOSED

DEVICE (43-M2) MOMENTARY
CLOSE/OFF/TRIP SELECTOR SWITCH

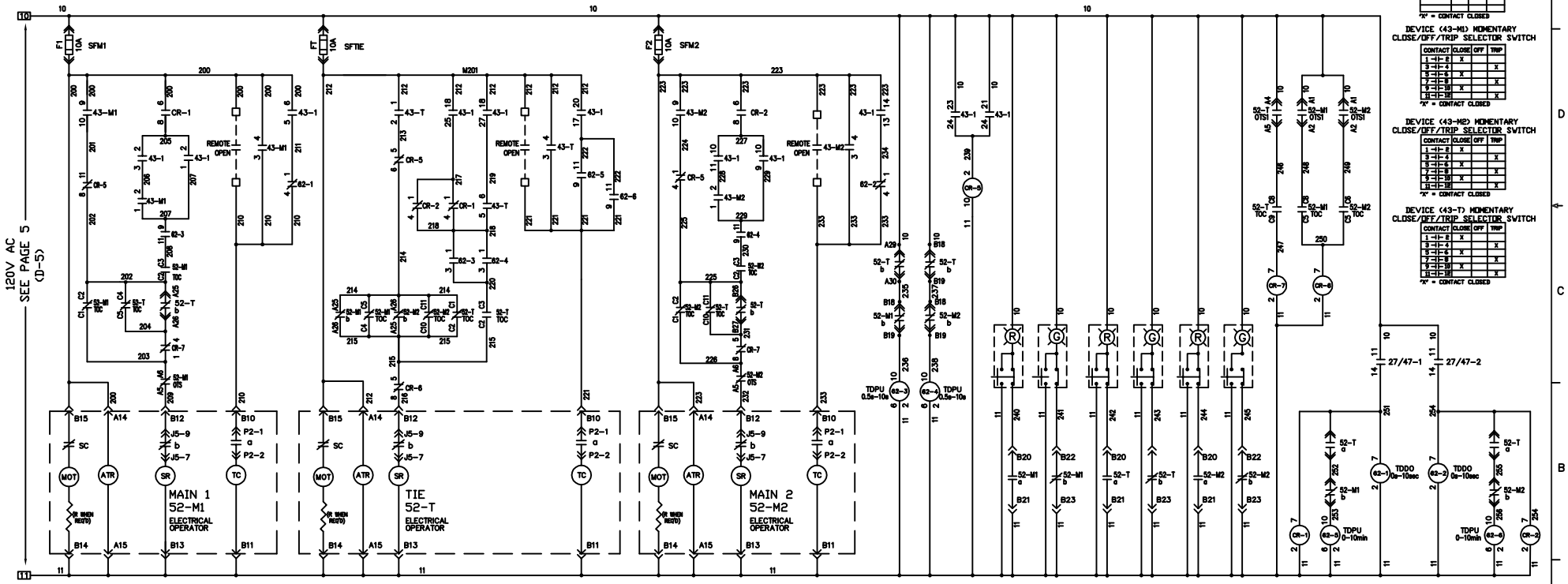
CONTACT	CLOSE	OFF	TRIP
1-2	X		
3-4			X
5-6	X		
7-8			X
9-10	X		
11-12			X

"X" = CONTACT CLOSED

DEVICE (43-T) MOMENTARY
CLOSE/OFF/TRIP SELECTOR SWITCH

CONTACT	CLOSE	OFF	TRIP
1-2	X		
3-4			X
5-6	X		
7-8			X
9-10	X		
11-12			X

"X" = CONTACT CLOSED



NOTES
1. WIRE MARKERS INCLUDED.
2. ALL CONTROL WIRING WILL BE No. 14 SIS
3. GROUND WIRING WILL BE No. 12 SIS
4. COMPONENTS SHALL BE LABELED AS PER THE DWG.
5. WIRING SHALL BE LOCATED IN CELL 4A

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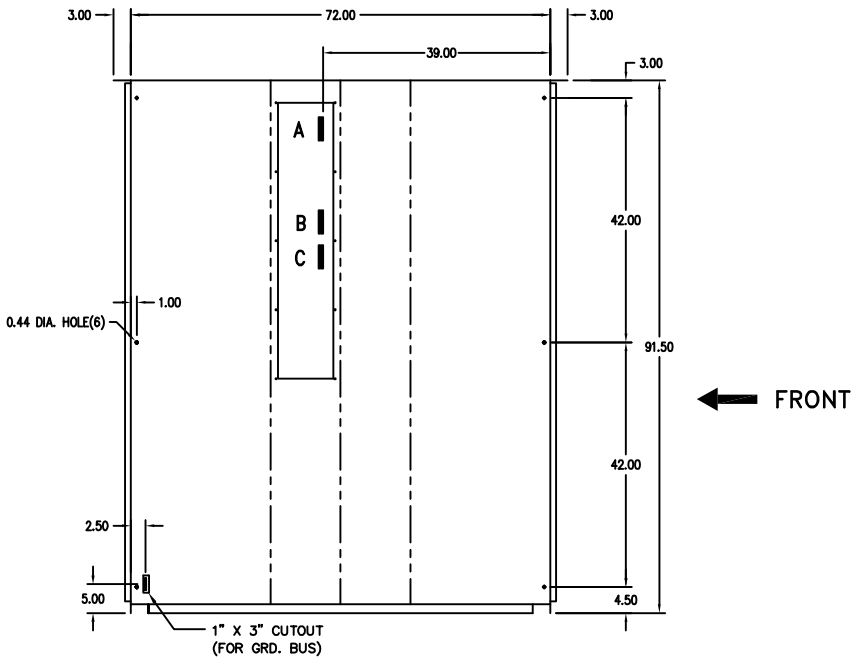
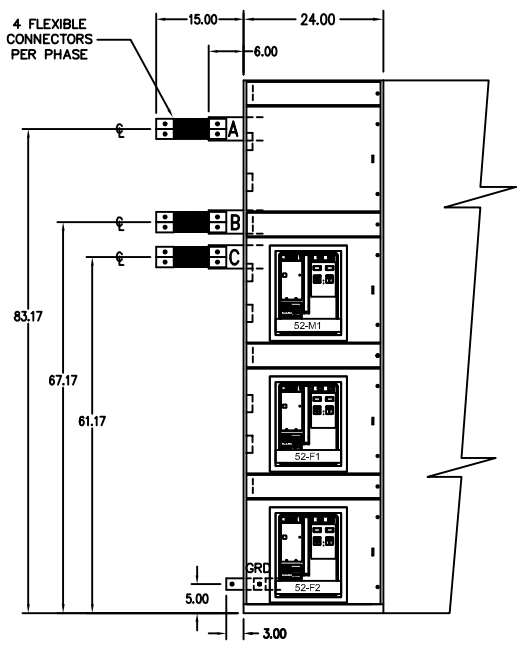
REVISION		
02	09/27/05	MR. GENERAL REVISION AS PER CUSTOMER CHANGES.
03	03/30/06	ANDY. GENERAL REVISION AS PER CUSTOMER CHANGES.
3	-AS BUILT	YP 06/27/07

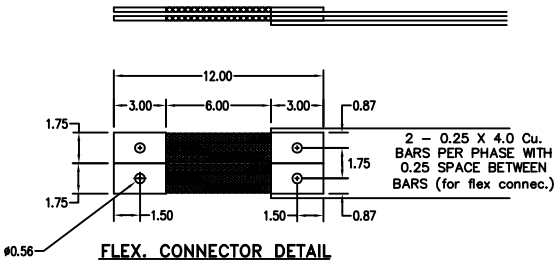
DFTR MR	DATE 02/07/05	EATON Cutler-Hammer	MILTON, ON
APPD .	DATE .	TITLE MAIN-TIE-MAIN AUTOMATIC TRANSFER SCHEME RC HARRIS WATER FILTRATION	
FILENAME AUTO TRANSFER		TYPE CUSTOM SWBD	-
FEDERAL ID NO.	PRODUCT CODE PG 140	REVISION 4	DWG SIZE B
G.O. CMBI0023	DWG 14B2802	SHEET 10 OF 12	



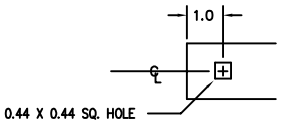
LEFTHAND SIDE VIEW OF LOW VOLTAGE CELL



FRONT VIEW



FLEX. CONNECTOR DETAIL



GRD. BUS DRILLING DETAIL
(1 – 2"X 1/4" COPPER)

Dimensions in Inches [Metric]

REVISION			
4	02	09/27/05 MR.	GENERAL REVISION AS PER CUSTOMER CHANGES.
	03	03/30/06 ANDY	GENERAL REVISION AS PER CUSTOMER CHANGES.
4		-AS BUILT YP	08/27/07

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DFTR	DATE
MR	02/10/05
APPD	DATE
.	.

FILENAME: TXLVMDS4HI-LHSide

FEDERAL ID NO.	PRODUCT CODE	REVISION	DWG SIZE
	PG 140	4	A

EATON | Cutler-Hammer — MILTON, ON

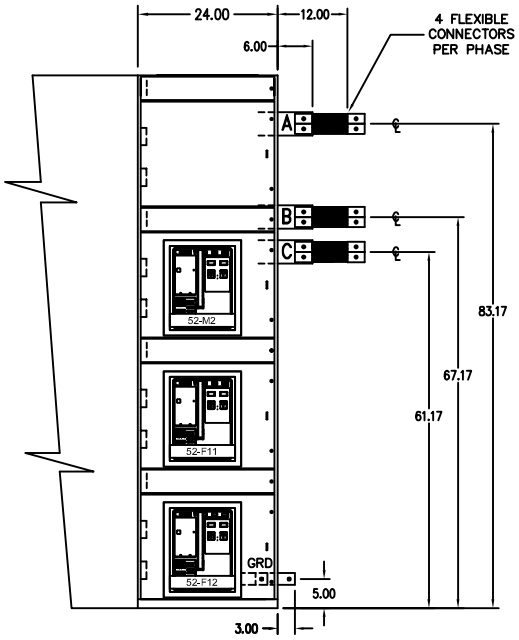
TITLE: TRANSFORMER COORDINATION LAYOUT
RC HARRIS WATER FILTRATION PLANT

TYPE: CUSTOM SWBD — –

G.O.: CMBI0023

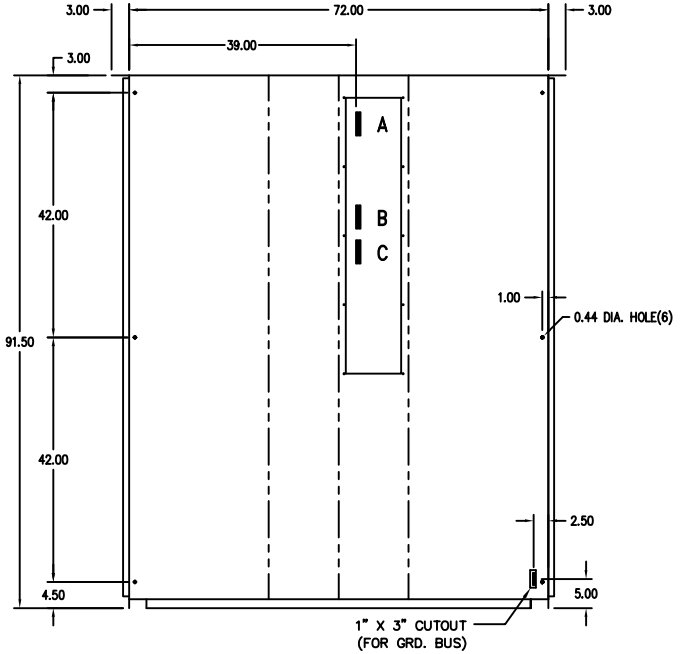
DWG: 14B2802

SHEET 11 OF 12

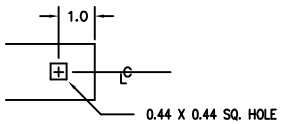


FRONT VIEW

FRONT



RIGHTHAND SIDE VIEW OF LOW VOLTAGE CELL



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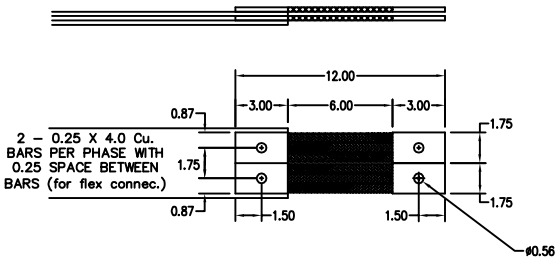

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4		-AS BUILT YP 08/27/07	

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DFTR	DATE
MR	02/10/05
APPD	DATE
.	.

FILENAME: TXLVMDS4HI-RHSide

FEDERAL ID NO.	PRODUCT CODE	REVISION	DWG SIZE
	PG 140	4	A

EATON | Cutler-Hammer — MILTON, ON

TITLE: TRANSFORMER COORDINATION LAYOUT
RC HARRIS WATER FILTRATION PLANT

TYPE: CUSTOM SWBD — –

G.O.: CMBI0023

DWG: 14B2802

SHEET: 12 OF 12