CITY OF TORONTO

FIRE STATION NO. 243
SITE, VENTILATION AND FIRE ALARM SYSTEM UPGRADES

4560 SHEPPARD AVENUE EAST, TORONTO, ON

DECEMBER 2024

END

1.0 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 General Conditions

1.1.2 Ontario Building Code (OBC) current edition, including all amendments up to bid closing date.

1.1.3 Province of Ontario Occupational Health and Safety Act and Regulations for Construction Sites: All work shall be in accordance with the latest edition of the Province Of Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

1.1.4 CSA-0121, Douglas Fir Plywood

1.1.5 CAN/CSA-S269.2, Access Scaffolding for Construction Purposes.

1.1.6 CAN/CSA-Z321, Signs and Symbols for the Occupational Environment.

1.2 PROJECT CO-ORDINATION

1.2.1 Co-ordinate progress of the Work, progress schedules, submittals, use of site, temporary utilities and construction facilities.

1.2.2 Co-ordinate the work of all trades so work proceeds as planned and equipment functions properly.

1.2.3 Become aware of the site conditions described in the Designated Substances Survey (DSS) information available at the site and take all precautions for performing the Work as described therein.

1.2.4 Prepare plan indicating proposed location and dimensions of area to be fenced and used by Contractor, avenues of ingress/egress to fenced area and details of fence installation.

1.2.5 Prepare phasing and staging plans upon coordination with owner. Install and remove phasing and staging measures accordingly.

1.2.6 Prepare signage plans upon coordination with owner. Install and remove signage accordingly.

1.2.7 Indicate use of supplemental or other staging area.

1.2.8 Ensure adequate security measures are in place to guard hoarded areas and contents of hoarded areas after working hours and during holidays.

1.2.9 Provide construction facilities in order to execute work expeditiously.

1.2.10 Remove from site all such work after use.

1.3 CUTTING AND PATCHING

1.3.1 Submit written request in advance of cutting or alteration which affects:

.1 Structural integrity of any element of the Project.

.2 Integrity of weather exposed or moisture resistant elements.

.3 Efficiency, maintenance, or safety of any operational element.

.4 Visual qualities of sight exposed elements.

.5 Work of Owner or separate contractor.

1.4 **INSPECTION**

1.4.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

1.4.2 After uncovering, inspect conditions affecting performance of work.

1.4.3 Beginning of cutting or patching means acceptance of existing conditions.

1.5 **EXECUTION**

1.5.1 Perform cutting, fitting, patching and repairs to complete the Work.

1.5.2 Remove and replace defective and non-conforming work.

1.5.3 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical work.

1.5.4 Perform work to avoid damage to other work. Co-ordinate between all trades.

1.5.5 Prepare surfaces to receive patching and finishing.

1.5.6 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

1.5.7 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed.

1.5.8 Restore work with new products in accordance with Contract Documents.

1.5.9 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

1.5.10 At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire rated material full thickness of the construction element.

1.5.11 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

1.6 **PROJECT MEETINGS**

1.6.1 Contractor to Schedule and administer project progress meetings throughout the progress of the work.

1.6.2 Distribute written notice of each meeting 4 days in advance of meeting date to Consultant and Owner’s representatives.

1.6.3 Space will be provided on site for meetings. The Contractor to make arrangements for meetings.

1.6.4 Record the minutes. Include significant proceedings and decisions. Identify the "Action By" parties.

1.6.5 Reproduce and distribute copies of minutes within 3 days after each meeting and transmit to meeting participants and affected parties not in attendance.

1.7 REQUESTS FOR INFORMATION

1.7.1 All RFIs shall be submitted to the Consultant with copy to the Owner. Contractor shall submit Request for Information on form with Contractor company letterhead to Consultant and Owner wherever Contractor requires a clarification of the requirements of the Contract Documents or wherever work cannot proceed as indicated by the Contract Documents.

1.7.2 The Contractor shall await the Consultant's response to the RFI before proceeding with the work documented in the RFI. No delays to work or submissions of shop drawings not affected by the matter discussed in the RFI shall occur as a result of outstanding responses from Consultant.

1.8 SITE INSTRUCTIONS

1.8.1 The Consultant may provide specific instructions on how equipment is to be installed or change the layout arrangement of the arrangement to be installed prior the installation of said equipment. The Consultant will issue these instructions on a Site Instruction form with the Consultant’s company letterhead. Work described by Site Instructions shall not incur additional costs to the Owner.

1.9 CONTEMPLATED CHANGE NOTICES AND CHANGE ORDERS

1.9.1 Where equipment or service not indicated in the Contract Documents to be installed, the Consultant shall issue a Contemplated Change Notice to the Contractor to provide a quotation.

1.9.2 The Consultant and Owner will review the quotation and if deemed reasonable will produce a Change Order. The Contractor shall provide itemized breakdown of material, equipment, hourly labour rates, number of hours and number of workers for all scopes of work and the same breakdown for all sub-contractor quotations in their quotations.

1.9.3 The Contractor shall not proceed with any work described in a Contemplated Change Notice until a Change Order signed by the Consultant and Owner for the work is received or unless prior approval is provided by the Owner in writing.

1.10 AS-BUILT DRAWINGS

1.10.1 On completion of Work and prior to final inspection, submit record documents to Consultant. Refer to section 01770 – Closeout Documents, for submission format.

1.11 SCHEDULES

1.11.1 Submit the following schedules

.1 Construction Progress Schedule.

.2 Submittal Schedule for Shop Drawings, Product Data and Samples.

1.12 SCHEDULE FORMAT

1.12.1 Prepare schedule in the form of a horizontal bar chart.

1.12.2 Provide a separate bar for each trade or operation.

1.12.3 Provide horizontal time scale identifying the first work day of each week.

1.12.4 Format for listings: The chronological order of the start of each item of work.

1.13 **SCHEDULE SUBMISSION**

1.13.1 Submit initial schedules within 7 days after award of Contract.

1.13.2 Submit 2 opaque reproduction, plus 2 copies to be retained by the Consultant.

1.13.3 Consultant will review schedule and return reviewed copy within 5 days after receipt.

1.13.4 Resubmit finalized schedule within 7 days after return of reviewed copy.

1.14 **CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

1.14.1 Provide construction facilities and temporary controls in order to execute the work expeditiously.

1.14.2 Provide hoarding, scaffolding and dust-tight screens in accordance with the requirements laid out in Section 01005 Paragraphs 1.14.3, 1.14.4 and 1.14.5.

1.14.3 Scaffolding

.1 Scaffolding in accordance with CAN/CSA-S269.2.

.2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, temporary stairs, and similar means of construction access.

.3 Remove from site all such work after use.

1.14.4 Hoarding

.1 Erect temporary enclosures using 38 × 89 mm construction grade lumber framing at 600 mm centres and 1200 × 2400 × 13 mm exterior grade fir plywood to CSA O121.

.2 Apply plywood panels vertically as indicated flush and butt jointed.

.3 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.

.4 Paint public side of site enclosure in selected colours with one coat primer to CAN/CGSB 1.189 and one coat exterior paint to CGSB 1.59. Maintain public side of enclosure in clean condition.

.5 Provide lockable gates and doors at hoarding for access and egress from work zones.

1.14.5 Dust Tight Screens

.1 Provide dust tight screens or partitions to localize dust generating activities, and for the protection of workers, finished areas of Work and the public.

.2 Provide fastening of the screens from the floor or underside of the structure above as applicable to contain the dust within the work zones and prevent emission of the

dust outside the work zones. Repair floors after removal of the hoarding to match the existing surface conditions.

.3 Doors provided in dust-tight screens and hoarding shall open into the work zone.

.4 Provide tarps and sealing over furniture or other possessions of the Owner that Owner allows to remain inside the work zones.

.5 Provide protection for finished and partially finished work and equipment during performance of Work.

.6 Maintain and relocate protection until such Work is complete.

.7 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.8 Provide necessary screens, covers, and hoardings.

.9 Be responsible and pay for damage incurred due to lack of or improper protection.

1.15 **SITE STORAGE AND LOADING**

1.15.1 Confine the Work and the operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with Products.

1.15.2 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the Work.

1.16 **SANITARY FACILITIES**

1.16.1 Existing facilities as designated may be used during the construction period.

1.17 **WATER SUPPLY**

1.17.1 The Owner will provide a continuous supply of potable water for construction use.

1.18 **CONCEALMENT**

1.18.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

1.18.2 Before installation, inform the Consultant if there is a contradictory situation. Install as directed by Consultant.

1.19 **FINAL DOCUMENTS**

1.19.1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers.

1.19.2 Submit material prior to final Application for Payment.

1.19.3 Submit operation and maintenance data, record (as-built) drawings.

1.19.4 Provide warranties fully executed and notarized.

1.19.5 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining due.

1.19.6 Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.

1.19.7 Provide the Electrical Safety Authority Certificates of Inspection and Acceptance.

1.19.8 Provide fire alarm system verification report.

1.19.9 Provide vehicle exhaust extraction system testing, adjusting and balancing report.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

1.1.1 Administrative

1.1.2 Shop drawings and product data.

1.1.3 Samples.

1.1.4 Operating and Maintenance Manuals

1.2 ADMINISTRATIVE

1.2.1 Submit after contract award submittals within ten (10) business days of receipt of submittal information and in an orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of project completion schedule and no claim for extension by reason of such default will be allowed.

1.2.2 Work affected by submittal shall not proceed until review is complete.

1.2.3 Present shop drawings, product data, samples and mock-ups in both Imperial and SI Metric units.

1.2.4 Where items or information are not produced in SI Metric units, converted values are acceptable.

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

1.2.6 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

1.2.7 Verify field measurements and affected adjacent Work is coordinated.

1.2.8 Contractor’s responsibility for errors and omissions in submission is not relieved by Consultant’s review of submittals.

1.2.9 Contractor’s responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

1.2.10 Keep one (1) reviewed copy of each submission on site.

1.2.11 All payment submittals (i.e progress draws) are to be complete with valid copies of Statutory Declaration and WSIB and sent to the consultant for approval. Consultant to send payment submittal along with consultant’s payment certificate to Owner’s Representative.

1.3 SHOP DRAWING AND PRODUCT DATA

1.3.1 The term “shop drawings” means drawings, diagrams, illustrations, schedules, performance charts, specification sheets, equipment selection sheets, brochures and

other data which are to be provided by Contractor to illustrate details of a portion of Work.

1.3.2 Indicated materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of work. Where article or equipment attach or connect to other articles or equipment, indicate that such items will be supplied and installed. Indicate cross reference to design drawings and specifications.

1.3.3 Allow ten (10) working days for Consultant's review of each submission.

1.3.4 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with work.

1.3.5 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of any revision other than those requested.

1.3.6 Accompany submissions with transmittal letter, in duplicate, containing:

.1 Date.

.2 Project title and number.

.3 Contractors name and address.

.4 Identification and quantity of each shop drawing, product data and sample.

.5 Other pertinent data.

1.3.7 Submission shall include:

.1 Date and revision dates

.2 Project title and number.

.3 Name and address of :

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor's stamp, signed by Contractors authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Dimensions

.3 Weights

.4 Layout,

.5 Setting or erection details

.6 Capacities.

.7 Performance characteristics.

.8 Standards.

.9 Relationship to adjacent work.

1.3.8 After Consultant's review, distribute copies.

1.3.9 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as consultant may reasonably request.

1.3.10 Submit one electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.

1.3.11 Delete information not applicable to project.

1.3.12 Supplement standard information to provide details applicable to project.

1.3.13 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.4 **SAMPLES**

1.4.1 Submit for review, samples in duplicate as requested in respective specification sections.

1.4.2 Deliver samples prepaid to site.

1.5 **OPERATING AND MAINTENANCE MANUALS**

1.5.1 Two weeks prior to Substantial Performance of the Work, submit to the Consultant digital copies of the operating and maintenance manuals. Refer to section 01770 – Project Closeout for requirements.

1.5.2 After receiving comments from Consultant, produce three (3) hard copies of operating and maintenance manuals in three-ring binders and three (3) digital copies addressing all Consultant comments that include warranties and all other materials reviewed by the Consultant. Deliver all copies of the manuals to the Owner’s Representative.

1.5.3 Manuals to contain operational information on equipment, cleaning, filter and lubrication schedules, wiring diagrams, schematic diagrams, control sequences, overhaul and adjustment schedules and similar maintenance information. Provide separate tabbed section for Contractor and equipment warranties (file directory folder for digital copies). Provide separate tabbed section for equipment start-up reports (file directory folder for digital copies).

1.5.4 Bind contents in a three-ring, D ring style hard covered, plastic jacketed binder. Organize contents into applicable categories of work, parallel to specifications Sections.

1.5.5 Save the digital copies on USB Key and deliver to Owner addressed to the attention of the City of Toronto Project Manager.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

1.1.1 Inspection and testing, administrative and enforcement requirements.

1.2 RELATED SECTIONS

1.2.1 Section 01330 - Submittal Requirements.

1.3 INSPECTION

1.3.1 Allow Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

1.3.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultants.

1.3.3 Consultant may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

1.3.4 If the Contractor covers of permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such work, have the inspections or tests satisfactorily completed and make good such Work.

1.4 INDEPENDENT INSPECTION AGENCIES

1.4.1 Independent Inspection/Testing Agencies will be engaged by Consultant for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Consultant.

1.4.2 Provide equipment required for executing inspection and testing by appointed agencies.

1.4.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

1.4.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to Consultant. Pay costs for retesting and re-inspection.

1.5 ACCESS TO WORK

1.5.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

1.5.2 Co-operate to provide reasonable facilities for such access.

1.6 **PROCEDURES**

1.6.1 Notify appropriate agency and Consultant in advance of requirement for tests, in order that attendance arrangements can be made.

1.6.2 Submit after Tender award samples and/or materials required for testing, as specifically requested in specifications. Submit within ten (10) business days of receipt of material and in an orderly sequence so as not to cause delay in Work.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

1.1.1 Product quality, availability, storage, handling, protection, and transportation.

1.1.2 Manufacturer's instructions.

1.1.3 Quality of Work, coordination and fastenings.

1.1.4 Existing facilities.

1.2 RELATED SECTIONS

1.2.1 Section 01450 - Quality Control.

1.3 REFERENCE STANDARDS

1.3.1 Within text of specifications, reference may be made to various reference standards.

1.3.2 Conform to these standards, in whole or in part as specifically requested in specifications.

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

1.3.4 The cost for such testing will be borne by Consultant in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.3.5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

1.4 QUALITY

1.4.1 All products shall be CSA-approved or ULC-approved and labeled as such.

1.4.2 All products shall be CSA-approved or ULC-approved for the application for which they are to be installed and used on this project and labeled as such.

1.4.3 Products shall be labeled with seals of the Electrical Safety Authority (ESA), Technical Standards and Safety Authority (TSSA) or other authorities having jurisdiction as required by the relevant authorities having jurisdiction.

1.4.4 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

1.4.5 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

1.4.6 Should any dispute arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.

1.4.7 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item through out building.

1.4.8 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions.

1.5 AVAILABILITY

1.5.1 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 Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

1.5.2 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.6 STORAGE, HANDLING AND PROTECTION

1.6.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

1.6.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

1.6.3 No loose products or equipment shall be stored on the roof under any circumstances. Include all costs to provide storage container of products and equipment at location on site agreeable to Owner.

1.6.4 Store products subject to damage from weather in weatherproof enclosures.

1.6.5 Remove and replace damaged products at own expense and to satisfaction of Consultant.

1.6.6 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.7 TRANSPORTATION AND DELIVERY

1.7.1 Pay costs of transportation and delivery of products required for performance of Work.

1.7.2 Be present at the site for deliveries of all equipment. The Owner will not accept deliveries. Deliveries will be turned away if Contractor is not present at the site during delivery and the Contractor shall pay additional costs for deliveries at no expense to the Owner.

1.8 MANUFACTURER'S INSTRUCTIONS

1.8.1 Unless otherwise indicated in 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.

1.8.2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.

1.8.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

1.9 QUALITY OF WORK

1.9.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.

1.9.2 Do not employ anyone unskilled in their required duties. Consultant reserves right to require dismissal from site, workers deemed incompetent or careless.

1.9.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

1.10 CO-ORDINANCE

1.10.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

1.11 REMEDIAL WORK

1.11.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

1.11.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.12 FASTENINGS

1.12.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

1.12.2 Prevent electrolytic action between dissimilar metals and materials.

1.12.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

1.12.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

1.12.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

1.12.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 PROTECTION OF WORK IN PROGRESS

1.13.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by Consultant, at no increase in Contract Price or Contract Time.

1.13.2 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Consultant.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

1.1.1 Progressive cleaning.

1.1.2 Final cleaning.

1.2 PROJECT CLEANLINESS

1.2.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

1.2.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site.

1.2.3 Remove equipment and product on roof not fastened to roof and dispose of.

1.2.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

1.2.5 Provide on-site dump containers for collection of waste materials and debris.

1.2.6 Remove waste material and debris from site and deposit in waste container at the end of each working day.

1.2.7 Dispose of waste materials and debris off site in an environmentally responsible manner in accordance with applicable regulations at a waste site designated for the material which will be disposed of there.

1.2.8 Building must be kept dust free. Contractor will be charged costs for any additional cleaning required as decided by the Owner.

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

1.2.10 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

1.2.11 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

1.2.12 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.2.13 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

1.3.1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

1.3.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

1.3.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

1.3.4 Remove waste products and debris.

1.3.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant.

1.3.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

1.3.7 Clean and polish glass, hardware, baked enamel finishes. Replace broken, scratched or disfigured glass.

1.3.8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture, fitments, walls, and floors.

1.3.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

END OF SECTION

1.0 GENERAL

1.1 REFERENCE STANDARD

1.1.1 Comply with provisions of OAA, OGCA Document No. 100, "Take-Over Procedures", latest edition, except as modified in these Specifications.

1.2 OPERATING AND MAINTENANCE MANUALS

1.2.1 Provide operation and maintenance manuals.

1.2.2 Provide operating and maintenance data, prepared on 8 1/2" X 11" sheets in printed or typewritten form and also the digital files on a USB.

1.2.3 Provide the following material as applicable to work of this Contract in hard copy and digital form on USB:

.1 Complete list of products used in the work showing product name, part number or code and manufacturer for each listing; follow specification format. Provide the specification sheets of the equipment.

.2 Final copies of brochures and cut sheets of all equipment with Consultant shop drawing review comment sheet and review stamps visible.

.3 Operating and maintenance instructions for all equipment.

.4 Wiring diagrams.

.5 Controls schematics.

.6 Operation sequences.

.7 Extended warranties.

.8 Certificates of Inspection and Acceptance from the Inspection Branch of the Electrical Safety Authority of Ontario

.9 Indication building permits have been closed out with the City of Toronto

.10 Other data required elsewhere in Contract Documents or deemed necessary by Consultant.

.11 Fire Alarm System Verification Report

.12 Vehicle Exhaust Extraction System Testing, Adjusting and Balancing Report

1.3 EXTENDED WARRANTIES

1.3.1 Definition: Warranty = guarantee.

1.3.2 Submission Requirements:

.1 Submit extended warranties as part of "Operating and Maintenance Manuals".

.2 Each warranty must show:

.1 Name and address of Project

.2 Name of the Owner

.3 Section Number and Title

.4 Start and end date of the warranty and a specific written policy on how deficiencies will be handled by the warrantor complete with response times and lead times for parts

.3 All extended warranties shall be presented under Contractor's letterhead, seal and signature and shall bear similar wording to that specified in Contract Documents.

.4 Submit manufacturers' Product warranties.

1.4 **AS-BUILT DRAWINGS**

1.4.1 Prior to Substantial Performance obtain a CAD file of all Contract Drawings from Consultant and transfer changes, revisions, deletions and additions made throughout the execution of the Work, from the set of prints kept on site to the CAD file.

1.4.2 Clearly and prominently mark each drawing "AS-BUILT DRAWING prepared by _____ _____ (name of Contractor).

1.5 **CERTIFICATES OF COMPLIANCE**

1.5.1 Submit Certificates of Compliance, prior to the application for Substantial Performance, for each of the following items:

.1 Products for which Material Safety Data Sheets have been submitted and accepted.

.2 Other Work / Products identified in the Contract Documents as requiring a Certificate of Compliance.

1.5.2 Each Certificate of Compliance shall indicate names and addresses of the project, the Owner, the date of issue, product description including name, number, manufacturer, with a statement verifying that the Work / Product installed meets specified requirements and, if applicable, complies with the submitted and accepted Material Safety Data Sheets.

1.5.3 Each Certificate of Compliance shall be issued on the subcontractor's letterhead, properly executed, under whose work the respective Work / Product has been provided.

1.5.4 Each Certificate of Compliance shall be endorsed by the Contractor with his authorized stamp / signature. Ensure that submissions are made to allow sufficient time for review without delaying progress of scheduled completion.

1.5.5 The Completion Security Account will not be paid to the Contractor without submission of all required affidavits and requested material and safety data sheets.

1.6 **OPERATING AND MAINTENANCE INSTRUCTIONS**

1.6.1 Prior to requesting Substantial Performance, at a time acceptable to the Owner and Consultant, but not before operating and maintenance data has been reviewed and accepted by Consultant, instruct designated Owner’s representatives in the operation and maintenance of all systems and equipment.

1.6.2 Arrange training sessions for each type of operating system and equipment. Sessions shall be conducted by instructors employed by the equipment manufacturer or the equipment manufacturer's representative and who have experience operating the provided equipment at the provided settings. The training sessions shall be of sufficient duration and depth to adequately instruct participants. The training sessions shall be digitally recorded on video and copies of the video shall be provided to the Owner on USB.

1.6.3 Make reference to reviewed operation and maintenance manuals throughout the training sessions to familiarize participants with the data provided.

1.6.4 Prepare an attendance record for each training session, to be signed by each participant upon conclusion of session. Show date and time of session, subject of session and name, title and organization of each participant. Submit a copy of each record to Owner and Consultant.

1.6.5 Subcontractor whose work is subject of training session and Contractor shall be represented during training session by employees who performed the installation or their designated representatives who are similarly experienced with the subject systems.

1.7 SYSTEMS DEMONSTRATION

1.7.1 Prior to final inspection, demonstrate operation of each system to Owner and Consultant.

1.7.2 Instruct personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.

1.7.3 Include specific system demonstration instructions in all sections of the specifications.

1.7.4 The training sessions shall be digitally recorded on video and copies of the video shall be provided to the Owner on USB.

1.8 INSPECTION AND ACCEPTANCE OF WORK

1.8.1 Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete, defects are corrected and the building is clean and in condition for occupancy. Notify the Consultant in writing, of satisfactory completion of the Work. If Consultant agrees that this stage has been reached, prepare a complete list of deficiencies as submitted by the Consultant and the Owner's representatives and actions taken to remedy them. Submit this list to Consultant and Owner.

1.8.2 On receipt of the above deficiency list in a satisfactory form, the Consultant, accompanied by Sub-consultants, the Contractor and the Owner, if deemed necessary, will carry out an inspection of the Project.

1.8.3 Add to the deficiency list, in accordance with Consultant's directions, any additional deficiencies which are identified during inspection and reissue updated deficiency list. Add remedies for deficiencies to list and apply remedies to eliminate deficiencies.

1.8.4 When the Consultant considers deficiencies and defects corrected and it appears requirements of the Contract have been performed and all required documents requested by Owner or Consultant such as maintenance manuals, inspection

certificates, acceptance certificates, etc., have been submitted and accepted, make application for certificate of Substantial Performance.

1.9 **FINAL SUBMISSION**

1.9.1 Prior to claiming Final Payment do the following:

.1 Submit as-built drawings in AutoCAD dwg and Adobe pdf format as well as full-size paper copies to be included in the manuals.

.2 Submit one complete set of reviewed shop drawings, folded to 8-1/2" x 11" size, contained in heavy duty manila envelopes, numbered and labelled. The set of shop drawings shall be the final reviewed set with Consultant review comment sheet and review stamp.

.3 Submit three hard copies of the maintenance manuals in heavy-duty binders complete with record drawings and all instructions suitably labelled with project name and locations. Submit three copies on USB key with all of the same contents as the hard copies of the maintenance manuals at project close-out.

.4 Submit a final accounting of all approved changes to the Contractor Price.

END OF SECTION

1.0 **GENERAL**

1.1 **SECTION INCLUDES**

1.1.1 Excavation for trenching.

1.2 **RELATED SECTIONS**

1.2.1 Section 02323 - Backfilling.

1.3 **PROTECTION**

1.3.1 Protect trees, shrubs, and lawns, remaining as a portion of final landscaping.

1.3.2 Protect trees in accordance with the requirements of the City of Toronto Tree Protection Policy. Provide protection in accordance with City of Toronto standard requirements as set out in Appendix A of the Specifications.

1.3.3 Obtain all locates of public and private utilities and services at the excavation area. Perform tests and tracing to verify exact locations of services prior excavation.

1.3.4 Protect above and below grade utilities which are to remain.

1.3.5 Protect excavations by a method required to prevent cave-in and excessive water from building up in the excavation.

1.3.6 Protect bottom of excavations and soil adjacent to and beneath foundation from frost.

1.3.7 Grade excavation top perimeter to prevent surface water run-off into excavation.

2.0 **PRODUCTS**

2.1.1 Not Used.

3.0 **EXECUTION**

3.1 **PREPARATION**

3.1.1 Identify required lines, levels, contours, and datum.

3.1.2 Identify known underground, above ground, and aerial utilities. Stake and flag locations.

3.1.3 Protect above and below grade utilities which are to remain. Expose utilities and services to daylight, maintain required clearances, provide hand-digging and provide structural support of utilities and services in place during the Work.

3.1.4 Protect plant life, lawns, and other features remaining as a portion of final landscaping.

3.1.5 Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

3.2 **EXCAVATION**

3.2.1 Excavate subsoil required to accommodate trenching construction operations.

3.2.2 Machine slope banks.

3.2.3 Excavation cut not to interfere with normal 45 degree bearing splay of foundation.

3.2.4 Grade top perimeter of excavation to prevent surface water from draining into excavation.

3.2.5 Hand trim excavation. Remove loose matter.

3.2.6 Remove lumped subsoil, boulders, and rock.

3.2.7 Correct areas over excavated by error.

3.2.8 Stockpile excavated material in area designated on site and remove excess material not being reused, from site.

3.3 **PROTECTION**

3.3.1 Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

3.3.2 Protect bottom of excavations and soil adjacent to and beneath foundation, from freezing.

3.3.3 Protect roots of trees from excavation. Protect trees in accordance with the requirements of the City of Toronto Tree Protection Policy. Provide protection in accordance with City of Toronto standard requirements as set out in Appendix A of the Specifications.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

1.1.1 Fill under slabs-on-grade and paving.

1.2 RELATED SECTIONS

1.2.1 Section 02316 - Excavation.

1.3 PROTECTION

1.3.1 Protect trees, shrubs, and lawns, remaining as a portion of final landscaping.

1.3.2 Protect trees in accordance with the requirements of the City of Toronto Tree Protection Policy. Provide protection in accordance with City of Toronto standard requirements as set out in Appendix A of the Specifications.

1.3.3 Protect above and below grade utilities which are to remain.

1.3.4 Protect excavations by a method required to prevent cave-in and excessive water from building up in the excavation.

1.3.5 Protect bottom of excavations and soil adjacent to and beneath foundation from frost.

1.3.6 Grade excavation top perimeter to prevent surface water run-off into excavation.

1.4 TESTING

1.4.1 Test and analysis of fill materials will be performed in accordance with ASTM D698 and D1557.

1.4.2 Provide tests and analysis reports of fill materials in Operations and Maintenance Manuals.

2.0 PRODUCTS

2.1 FILL MATERIALS

2.1.1 Type A – Crushed Gravel: Pit run, washed natural stone; free of shale, clay, friable material, sand, debris.

2.1.2 Type B - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; graded as follows:

.1 Minimum Size: 6 mm. Maximum Size: 16 mm

.2 Type C - Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, or organic matter.

2.1.3 Subsoil: Reused, free of gravel larger than 75 mm size, and debris.

2.2 ACCESSORIES

2.2.1 Geotextile Fabric:

3.0 EXECUTION

3.1 EXAMINATION

3.1.1 Verify foundation perimeter drainage installation has been inspected.

3.2 PREPARATION

3.2.1 Generally, compact subgrade to density requirements for subsequent fill materials.

3.2.2 Cut out soft areas of subgrade not capable of compaction and compact.

3.2.3 Remove water, ice or soggy material from excavated area before backfilling.

3.3 BACKFILLING

3.3.1 Backfill areas to contours and elevations with unfrozen materials.

3.3.2 Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

3.3.3 Granular Fill: Place and compact materials in continuous layers not exceeding 150 mm compacted depth.

3.3.4 Soil Fill: Place and compact material in continuous layers not exceeding 200 mm compacted depth.

3.3.5 Employ a placement method that does not disturb or damage foundation perimeter drainage, foundation dampproofing, foundation waterproofing and protective cover and utilities in trenches.

3.3.6 Slope grade away from building minimum 150 mm in 3 m, unless noted otherwise.

3.3.7 Make grade changes gradual. Blend slope into level areas.

3.4 FIELD QUALITY CONTROL

3.4.1 Field inspection and testing will be performed under provisions of Section 01005.

3.4.2 Tests and analysis of fill material will be performed in accordance with ASTM D698.D1557.

3.4.3 If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

1.0 **GENERAL**

1.1 **SCOPE OF WORK**

1.1.1 The work under this section shall comprise the supply of labour, materials and equipment for mixing, hauling, spreading, jointing and compaction of hot mix, hot laid asphaltic concrete to the lines and levels as indicated on the drawings.

1.1.2 Coordinate work in this section with work in all other sections.

2.0 **PRODUCTS**

2.1 **MATERIALS**

2.1.1 Asphalt used on this project shall consist of the following types:

2.1.2 HL3 Surface Course - Asphalt Cement 5.0% to 7.0% by weight to be used on asphalt pathway and as top coat layer on parking area.

2.1.3 HL8 Base Course - Asphalt Cement 4.5% to 6.5% by weight to be used as base course on parking area.

2.1.4 Asphalt Emulsion - SS-1 Emulsion to OPSS 1103.

2.1.5 The various materials for these types of asphalt shall be selected to conform to the latest Ontario Provincial Standards Specifications (OPSS) Forms 1001, 1003, 1101 and 1150.

2.1.6 The contractor shall forward to the Owner in writing, his proposed job mix formula for the specific type of asphalt to be used indicating:

2.1.7 Source and location of all materials;

2.1.8 The proportions of all materials;

2.1.9 The single definite percentage for each sieve fraction.

2.1.10 The job mix formula, as noted above, must be corroborated by the contractor, by supplying to the Owner representative at least a three-point Marshall Mix Design proposed by an accredited testing firm acceptable to the Consultant / Owner. The mix design shall have been carried out during the calendar year of the submission of the job mix formula. Adequate samples of the materials proposed to be used shall be made available for acceptance tests upon request by the Consultant / Owner. No mix shall be supplied until the proposed job mix formula has been approved by the Consultant / Owner. The contractor shall accept full responsibility for the supply of a uniform product.

2.1.11 The submission of the job mix formula shall, upon approval, bind the contractor to supply a mixture not only within the limiting requirements of the specification, but as a further requirement, also meeting the exact formula established, subject to the following tolerances:

Permissible Tolerances	
Aggregates	**Passing Nos.**
26.5 mm to 4.75 mm	± 5%
2.36 mm	± 4%
1.18 mm	± 4%
600 µm	± 4%

Permissible Tolerances	
Aggregates	**Passing Nos.**
300 µm	± 4%
150 µm	± 2%
75 µm	± 2%
Asphalt Cement Content	± 0.3%

2.1.12 Failure of test samples to meet the job mix formula shall be sufficient cause for the Owner representative to prohibit shipment of any material from the plant until such time as the contractor has satisfactorily demonstrated the ability to consistently supply an approved product.

2.1.13 Granular Base: sound, hard, durable 19 mm and 50 mm crusher run limestone, free from clay or organic matter meeting OPSS Standards 1001, 1004 and 1010; installed to the compacted depths indicated on the drawings.

2.1.14 Line Paint: yellow lines and yellow handicapped, regular dry traffic paint meeting OPSS 1710 Standard.

3.0 EXECUTION

3.1 PLACEMENT

3.1.1 The equipment, methods of heating materials, hauling, spreading, jointing and compaction procedures shall conform to the latest OPSS Form 310 for HL3 and HL8. The granular base on which hot mix is placed shall be firm and stable, and shaped to proper contour and grade, compacted to 98% Standard Proctor Maximum Dry Density. Receive approval of granular base from the Owner representative prior to placement of asphalt.

3.1.2 Class "R1" or Class "S1" roller (as defined in OPSS Form 310, Table V) as an intermediate roller for compaction shall be used at the discretion of the Owner’s representative. The rolling sequence shall be as follows:

3.1.3 Breakdown roller: 9-11 mg Steel Tandem - 5-7 passes

3.1.4 Intermediate roller: Pneumatic Tire - 13 passes

3.1.5 Finishing roller: 7-9 mg Steel Tandem - 3 passes

3.1.6 The roller shall be operated by competent and experienced operators. To prevent adhesion of asphalt mixture to the roller, it shall be kept moistened, but excess water shall not be permitted. The mixture shall be compacted to a density not less than 98% of the density of the laboratory compacted mixture, and after compaction shall not contain more than 6% voids.

3.1.7 The surface of the finished pavement shall be free from depressions exceeding 3 mm as measured with a 3 metre straight-edge paralleling the centerline of the roadway or walkway. Any finished pavement not meeting these requirements will be removed and replaced to the satisfaction of the Consultant / Owner. Patching will not be acceptable.

3.2 JOINTS

3.2.1 All joints shall be cleaned of dirt or other foreign material and shall be painted with a thin, uniform and continuous coating of SS-1 asphalt emulsion which complies with OPSS Form Number 1103. The joints shall be carefully made and in such a manner as to ensure a thorough and continuous band, and to provide a smooth riding surface.

3.2.2 Requirements for Longitudinal Joints:

3.2.3 Where the existing pavement comprises a single course, it shall be cut back to a straight vertical face.

3.2.4 Where the existing pavement comprises two or more courses, it shall be cut back approximately 100 mm to a straight vertical face, and to its full depth. The existing surface course shall then be cut back a further 150 mm to a straight vertical face and the 150 mm width of surface course removed by burning, if necessary, to form a stepped joint.

3.2.5 Requirements for Transverse Joints:

3.2.6 Except when a board is used to form transverse joints, the edge of previously laid course shall be cut back to its full depth to a straight vertical face. All joints between the surface course and existing bituminous pavement shall be butt joints. These joints shall be prepared by cutting the existing surface course to a straight vertical face. Where the existing pavement comprises two or more courses, the new surface course shall overlap the existing binder course across the full width of the pavement for a longitudinal distance of not less than 1.0 m and that at no point shall the depth of the new surface course be less than 25 mm.

3.3 TEMPERATURE

3.3.1 No surface asphalt shall be placed unless the air temperature at the surface of the parking lot is a minimum of 7°C.

3.3.2 Hot mix asphalt can be placed when the minimum temperature is greater than 2°C when:

3.3.3 Any frost or moisture from previous inclement weather has evaporated to leave a dry surface;

3.3.4 Base asphalt is laid on a granular grade;

3.3.5 Compacted lifts are greater than 75 mm in thickness;

3.3.6 A single course pavement is laid on a granular grade.

3.3.7 The temperature of the mixture immediately after spreading and prior to rolling shall not be less than 120°C and not more than 160°C.

3.4 FIELD QUALITY CONTROL

3.4.1 At edges of curb and interfaces with concrete surfaces ensure that asphalt is flush and smooth. Remove spilled or soiled areas to leave tidy appearance.

3.4.2 Edges of asphalt paths must be hand tamped at 45° to ensure a clean angled edge. Ensure that width and depth of path remains consistent as indicated on the drawings.

3.5 LINE PAINTING

3.5.1 Apply line paint 100 mm wide to dimensions shown on the drawings.

3.5.2 Paint is to be applied on a smooth, clean, dust free, dry surface with an approved spray applicator.

3.5.3 Paint shall be applied according to manufacturer's recommendations.

3.5.4 Use template to the dimensions as detailed on drawings for the handicapped symbols.

3.6 PROTECTION AND TESTING

3.6.1 Protect and maintain completed paving from time of installation until acceptance of work.

3.6.2 Keep areas clean and neat at all times. Mud tracking and cleaning of roads and walkways both on and off the site shall be the responsibility of the contractor.

3.6.3 Inspection and compaction tests of subbase, granular and asphalt as well as finished thickness and composition tests of asphalt, in accordance with item 2.1.5 of this section, shall be carried out by an independent testing laboratory. Costs of tests shall be paid for by the Contractor. Subbase tests shall be submitted to the Consultant / Owner for approval prior to the installation of the granular material. Granular compaction tests will be submitted to the Consultant / Owner for approval prior to the installation of asphalt.

End of Section

1.0 **GENERAL**

1.1 **WASTE MANAGEMENT AND DISPOSAL**

1.1.1 Divert unused soil amendments from landfill to official hazardous material collections site.

1.1.2 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

2.0 **PRODUCTS**

2.1 **TOPSOIL**

2.1.1 Topsoil for seeded areas: mixture of particulates, microorganisms and organic matter that provides suitable medium for supporting intended plant growth.

2.1.2 Soil texture based on “The Canadian System of Soil Classification”, to consist of 20 to 70% sand, minimum 7% clay, and contain 2 to 10% organic matter by weight.

2.1.3 Contain no toxic elements or growth inhibiting materials.

2.1.4 Finished surface free from:

2.1.5 Debris and stones over 50 mm diameter

2.1.6 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.

2.1.7 Consistency: Friable when moist

2.1.8 Site Excavated Topsoil:

2.1.9 Topsoil excavated from site, screened to remove debris and stones over 50 mm diameter.

2.2 **SOURCE QUALITY CONTROL**

2.2.1 Advise Owner's Representative / Consultant of sources of topsoil to be utilized.

2.2.2 Contractor is responsible for amendments to supply topsoil as specified.

3.0 **EXECUTION**

3.1 **PREPARATION OF EXISTING GRADE**

3.1.1 Verify that grades are correct. If discrepancies occur, notify Consultant and do not commence work until instructed by the Consultant.

3.1.2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage

3.1.3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris that protrudes more than 75 mm above surface. Dispose of removed material off site.

3.1.4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.2 **PLACING AND SPREADING OF TOPSOIL**

3.2.1 Place topsoil after Departmental Representative has accepted sub grade.

3.2.2 Spread topsoil as indicated to following minimum depths after settlement.

3.2.3 150 mm for seeded areas

3.2.4 150 mm for sodded areas

3.3 **FINISH GRADING**

3.3.1 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

3.3.2 Consolidate topsoil to required bulk density using equipment approved by Owner's Representative / Consultant. Leave surfaces smooth, uniform and firm against deep foot printing.

3.4 **ACCEPTANCE**

3.4.1 Departmental Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.5 **SURPLUS MATERIAL**

3.5.1 Dispose of materials except topsoil not required off-site

3.6 **CLEANING**

3.6.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers

END OF SECTION

1.0 **GENERAL**

1.1 **RELATED SECTIONS**

1.1.1 Section 02910 – Topsoil

1.2 **REFERENCE**

1.2.1 Department of Justice Fertilizer Act (R.S., 1985, c. F-10) and Fertilizer Regulation (C.R.C., c666)

1.3 **SCHEDULING**

1.3.1 Schedule sod-laying to coincide with preparation of soil surface.

1.3.2 Schedule sod installation when frost is not present in ground.

2.0 **PRODUCTS**

2.1 **MATERIALS**

2.1.1 Number One Turf Grass Nursery Sod: Sod that has been especially sown and cultivated in nursery fields as turf grass crop.

2.1.2 Turf Grass Nursery Sod types:

2.1.3 Number One Kentucky Bluegrass Sod: Nursery Sod grown solely from seed of cultivars of Kentucky Bluegrass, containing not less than 50% Kentucky Bluegrass cultivars.

2.1.4 Turf Grass Nursery Sod quality:

.1 Not more than two (2) broadleaf weeds or ten (10) other weeds per 40 square metres.

.2 Density of sod sufficient so that no soil is visible from height of 1,500 mm when mown to height of 50 mm

.3 Mowing height limit: 35 to 65 mm

2.1.5 Soil portion of sod: 6 to 15 mm in thickness

2.1.6 Water:

.1 Supplied by contractor free of contamination and impurities

2.1.7 Fertilizer:

.1 To Canada "Fertilizers Act" and "Fertilizers Regulations”

2.2 **SOURCE QUALITY CONTROL**

2.2.1 Obtain approval from Owner's Representative / Consultant of sod at source.

2.2.2 When proposed source of sod is approved, use no other source without written authorization.

3.0 **EXECUTION**

3.1 **PREPARATION**

3.1.1 Verify that grades are correct and prepared in accordance with Section 02910 – Topsoil. If discrepancies occur, notify Owner's Representative / Consultant Representative and do not commence work until instructed by Departmental Representative.

3.1.2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.

3.1.3 Fine grade surface free of humps and hollows to smooth, even grade to match existing grades; ±8 mm, surface to drain naturally.

3.1.4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site as directed by Owner's Representative / Consultant.

3.2 **SOD PLACEMENT**

3.2.1 Lay sod within 24 hours of being lifted if air temperature exceeds 20°C.

3.2.2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.

3.2.3 Roll sod as directed by Owner's Representative / Consultant. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.3 **MAINTENANCE DURING ESTABLISHMENT PERIOD**

3.3.1 Perform following operations from time of installation until acceptance.

3.3.2 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.

3.3.3 Cut grass to 50 mm when or prior to it reaching height of 75 mm. Remove clippings which will smother grassed areas as directed by Owner's Representative / Consultant.

3.3.4 Maintain sodded areas weed free.

3.3.5 Fertilize areas as required to ensure establishment of sod. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.

3.4 **ACCEPTANCE**

3.4.1 Turfgrass Nursery Sod areas will be accepted by Owner's Representative / Consultant provided that: Sodded areas are properly established.

3.4.2 Sodded areas are properly established

3.4.3 Sod is free of bare and dead spots

3.4.4 No surface soil is visible from height of 1,500 mm when grass has been cut to height of 50 mm.

3.4.5 Sodded areas have been cut minimum 2 times prior to acceptance.

3.4.6 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 Comply with the City of Toronto General Conditions, Division 01, Tender Documents and Division 16.

1.2 APPLICATION

1.2.1 This Section applies to and is an integral part of all succeeding Sections of this Division of the specification.

1.3 DEFINITIONS

1.3.1 The following are definitions of words found in Sections of this Specification and on associated drawings:

1.3.2 "Concealed" - hidden from normal sight in furred spaces, shafts, crawl spaces, ceiling spaces, walls and partitions;

1.3.3 "Exposed" - all work normally visible to building occupants;

1.3.4 "Provide" (and tenses of "Provide") - supply, install and connect complete.

1.3.5 "Install" (and tenses of "install") - install, and connect complete;

1.3.6 "Supply" - Supply only.

1.3.7 "Work" - all equipment, permits, materials and labour to provide a complete electrical installation as required and detailed in Drawings and Specification.

1.3.8 "Authorities" or "Authorities Having Jurisdiction" - any and all current laws and/or by-laws of any federal, provincial or local authorized agencies having jurisdiction over the sum total or parts of the work including, but not restricted to the Municipal Planning and Building Department, Municipal Fire Department, Labour Canada, The Provincial Fire Marshall, The Local Hydro Supply Authority, The Ontario Building Code, The Construction Safety Act, Municipal Public Works Department, the Canadian Electrical Code with Ontario Supplement, hereinafter referred to as the "Code", the Electrical Safety Authority and all Inspection Bulletins.

1.3.9 "Drawings and Specifications" - "the Tender Drawings and Specifications".

1.3.10 "Consultant" shall mean the firm of Moon Matz Ltd., or other person authorized to act on their behalf.

1.4 WORK INCLUDED

1.4.1 The work shall include all labour, materials, equipment, permits, inspections and tools required for a complete supply and installation of power distribution, communications and security including but not limited to all equipment and accessories as indicated on drawings and otherwise required for complete working operational systems as described but not necessarily limited to items, in the following sections:

.1 Section 16010 Electrical General Provisions

.2 Section 16100 Electrical Basic Materials and Methods

.3 Section 16400 Electrical Distribution

.4 Section 16700 Fire Detection and Alarm

1.5 **SCHEDULING OF PRODUCT DELIVERY**

1.5.1 Every effort must be made to ensure delivery of all materials and products in the Tender Documents on time. At commencement of Tender, prepare schedule of order dates for items requiring long delivery periods.

1.6 **EXAMINATION OF SITE**

1.6.1 Prior to submitting a bid carefully examine conditions at the site, which may or will affect the work. Refer to and examine all Tender documents, including room finish schedules to determine finished, partially finished and unfinished areas of the building.

1.6.2 Ensure that materials and equipment are delivered to the site at the proper time and in such assemblies and sizes so as to enter into the building and to be moved into the spaces where they are to be located without difficulty. Be responsible for any cutting and patching involved in getting assemblies into place.

1.7 **QUALITY ASSURANCE:**

1.7.1 General Codes and Standards:

.1 Comply with the Ontario Building Code and Canada Labour Code, Part 4.

.2 Where provisions of pertinent codes or local by-laws conflict with these Specifications and Drawings or each other, comply with the more stringent provisions.

.3 Operating voltages shall comply with CAN3-C235-83 (R2015).

.4 Ground system shall comply with CSA Standard C22.1.

.5 Abbreviations for electrical terms: to CSA Z85-1983

1.7.2 Provide new materials bearing certification marks or labels acceptable under Ontario Electrical Safety Code.

.1 Equipment must bear, on manufacturer's label, certification mark or label acceptable under Electrical Safety Authority for the application it is being used.

1.7.3 Provide units of same manufacture where two or more units of same class or type of equipment are required.

1.7.4 Manufacturer's names are stated in this Specification to establish a definite basis for bid submission and to clearly describe the quality of product that is desired for the work.

1.7.5 Standard Specifications

.1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with latest issue of applicable Standard Specifications issued by authorities having jurisdiction, but such Standard Specifications shall not be applied to decrease the quality of workmanship, products and services required by the Tender Documents.

1.7.6 Electrical Codes and Permits:

.1 The work shall be bid on and shall be carried out in accordance with these Drawings and Specifications and shall comply with the essential requirements of the latest editions of the Canadian Electrical Code C. 22.1 and the Electrical Safety Code (together with applicable bulletins issued by the Inspection Department of Electrical Safety Authority). In no instance, however, shall the standards established by the Drawings and Specifications be reduced by any of the codes referred to above. In the event of conflicting requirements, the codes shall take precedence over these Tender Documents and the Consultant's decision shall be final.

.2 Arrange for and obtain all necessary permits, inspection and approvals from authorities having jurisdiction, and also pay all applicable fees. The Contractor shall conform with all Municipal Codes and By-laws which affect the work.

.3 Applicable Codes
- .1 Ontario Electrical Safety Code and Bulletins issued by the Inspection Department of Electrical Safety Authority
- .2 Canadian Electrical Code with applicable regional amendments
- .3 Ontario Building Code
- .4 CSA C282 (latest edition) Emergency Power Supply for Buildings
- .5 Technical Standards and Safety Authority
- .6 National Building Code
- .7 Ontario Fire Code
- .8 National Fire Code

.4 Before starting any work, submit the required number of copies of Drawings and Specifications to the Electrical Safety Authority and the local authority for approval and comments. Comply with any changes requested as part of the Tender, but notify the Consultant immediately of such changes for proper processing of these requirements. Prepare and furnish any additional Drawings, details or information as may be required by the Consultant.

.5 On or before the completion of this Tender, obtain at own expense, the necessary certificates of inspection and acceptance from the Inspection Branch of the Electrical Safety Authority of Ontario and forward same to the Consultant.

.6 Equipment and material shall be acceptable to Electrical Safety Authority.

.7 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the co-operation of the material supplier.

.8 Supply and install warning signs and nameplates as required by the Electrical Safety Authority.

.9 Submit required Documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Tender Drawings and Specifications may be used for this purpose.

1.8 **REQUIREMENTS OF DRAWINGS:**

1.8.1 Tender:

.1 The Drawings for electrical work are essentially performance drawings, partly schematic, intended to convey the scope of work and extent of work. They only indicate general arrangement and approximate location of apparatus, fixtures and general typical sizes and locations of equipment and connections. The Drawings do not intend to show architectural, structural or mechanical details.

.2 Do not scale Drawings, but obtain information involving accurate dimensions to structure from those shown on Architectural and Structural Drawings, or by site measurements of existing areas. Follow the Electrical Drawings in laying out the work but consult general Construction Drawings as well as detail Drawings to become familiar with all conditions affecting the work, and verify spaces in which the work will be installed and structures to which it will be attached.

.3 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.). Alter, at no additional cost, the location of materials and/or equipment up to 3m, or as directed, provided that the changes are made before installation and do not necessitate additional material or labour.

.4 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 all equipment sizes in relation to space allowed and check all clearances.

.5 Confirm on the site, the exact location and mounting elevation of equipment and fixtures as related to Architectural or Structural details. Confirm location of outlets and/or connection points for equipment supplied by other trades.

1.9 **SHOP DRAWINGS:**

1.9.1 Pay careful attention to all shop drawings and review comments and ensure that all requirements are fully complied with.

1.9.2 Submit manufacturer's or vendor's drawings for all products being furnished except cable (up to 1000V), wire and conduit for review prior to commencement of work. Include rating, performance, specification sheets, descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assembly. Ensure submissions contain adequate data to easily confirm equipment meets the requirements of these Specifications.

1.9.3 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.

1.9.4 Submit prior to commencement of work for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.

1.9.5 Obtain and comply with the manufacturer's installation instructions.

1.9.6 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with contractor company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.

1.9.7 The Consultant will stamp shop drawings as follows:

.1 Drawing: Reviewed ( )

.2 Reviewed as Modified ( )

.3 Revise and Resubmit ( )

.4 Rejected ( )

1.9.8 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory provided requirements of remarks put on shop drawing copies are met. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing and equipment selection must be revised in accordance with comments written on shop drawing copies and resubmitted. If "REJECTED" is checked-off, the shop drawing is in error of submission and the equipment described therein shall not be used for this project.

1.9.9 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Tender documents. Contractor shall 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 co- ordination of the work as well as compliance with codes and inspection authorities such as C.S.A., etc.

1.9.10 Co-ordinate Work of this Division such that items will properly interface with Work of other Divisions.

1.9.11 Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.

1.10 **SUBSTITUTIONS**

1.10.1 When only one manufacturer's catalogued trade name is specified, provide only that catalogued trade name, material or product.

1.10.2 When more than one manufacturer's trade name is specified for a material or product, the choice is the bidder’s.

1.10.3 If an alternate product is desired to be used (for equipment and material other than specified equipment or system), a written RFI (Request For information) shall be submitted for review by the Consultant. Acceptance of alternates will be at the sole discretion of the Owner and Consultant. A response to the RFI will be issued confirming whether or not the alternate system is acceptable.

1.11 **DIMENSIONS AND QUANTITIES**

1.11.1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.

1.11.2 Quantities or lengths indicated in Tender Documents are approximate only and shall not be held to gauge or limit the Work.

1.11.3 Make necessary changes or additions to routing of conduit, cables, and the like to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.

1.12 **EQUIPMENT LOCATIONS**

1.12.1 Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Tender Drawings, to a maximum distance of 3 m without adjustment to Tender price.

1.12.2 Switch, control device and outlet locations are shown diagrammatically.

1.13 **WORKING DRAWINGS AND DOCUMENTS**

1.13.1 Contractor may be required to prepare working detail drawings supplementary to the Tender drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one (1) trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.

1.13.2 Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the Tender documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.14 **INSTALLATION DRAWINGS**

1.14.1 Prepare installation drawings for equipment, based upon approved Vendor drawings, to check required Code clearances, raceway, busway and cable entries, sizing of housekeeping pads and structure openings. Submit installation drawings to Consultant for review.

1.15 **"AS BUILT" DRAWINGS**

1.15.1 Maintain a set of Tender Drawings on site and record all deviations from the Tender Documents. As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.

1.15.2 Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run underground either below the building or outside the building.

1.15.3 Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.

1.15.4 Record deviations from branch circuit numbers shown on Drawings.

1.15.5 Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by Owner and under other Specification Sections.

1.16 TEST REPORTS

1.16.1 For each check and test performed prepare and submit a Test Report, signed by the Test Engineer, and where witnessed, by the Consultant.

1.16.2 Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.

1.16.3 Include calibration record, percentage error and applicable correction factors.

1.16.4 Submit a Certified Test Report from each manufacturer, signed by the certifying inspector, confirming correct installation and operation of each product and part of Work. Include name of certifying inspector, date and times of inspection, ambient conditions.

1.17 FIRE BARRIERS

1.17.1 Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.

1.17.2 Prior to installation, submit for review, proposed fire barrier seal materials, method of installation and ULC system number.

1.17.3 Acceptable Manufacturers:

.1 A/D Fire Protection Systems

.2 Dow Corning

.3 Fire Stop Systems

.4 IPC Flamesafe Firestop

.5 Nelson Electric

.6 3M

.7 Tremco

1.18 MISCELLANEOUS METAL FABRICATIONS

1.18.1 Provide miscellaneous structural supports, platforms, braces, brackets and preformed channel struts necessary for suspension, attachment or support of electrical. All supports, platforms, brackets and channel struts shall be made of stainless steel material.

1.19 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

1.19.1 Prepare and submit to the Consultant for review and forward to the appropriate Sub-trade drawings indicating all required sleeves. Such drawings shall be completely and accurately dimensioned and shall relate sleeves, recesses, and formed openings to suitable grid lines and elevation datum. Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Tender. Make all modifications to locations as directed by a Structural Engineer at no extra cost to Tender.

1.20 **SUPERINTENDENCE**

1.20.1 Maintain at the job site, at all times, experienced personnel and supporting staff, with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.

1.21 **PATENTS**

1.21.1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent right, and save the Owner and Consultant harmless of loss or annoyance on account of suit, or claims of any kind for violation of infringement of any letters, patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters, patent or rights.

1.22 **RIGHTS RESERVED**

1.22.1 Rights are reserved to furnish any additional detail drawings, which in the judgment of the Consultant may be necessary to clarify the work and such drawings shall form a part of this Tender.

1.23 **METALS**

1.23.1 Steel construction required solely for the work of electrical trades and not shown on architectural or structural drawings shall be provided by this trade in accordance with applicable code requirements.

1.24 **FLASHING**

1.24.1 Flash electrical parts passing through or built into a roof, an outside wall, or a waterproof floor.

1.24.2 Provide sleeves passing through outside walls with lead or copper flashing as directed.

1.25 **WORKMANSHIP**

1.25.1 Install equipment, ductwork, conduit and cables in a workmanlike manner to best suit space, to present a neat appearance and to function properly to the satisfaction of the Consultant.

1.25.2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore.

1.25.3 Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers installation instruction.

1.25.4 Replace work unsatisfactory to the Consultant without extra cost.

1.25.5 Make provision to accommodate future plant and equipment indicated on drawings.

1.25.6 Protect from damage all equipment delivered to the site and during installation. Any damage or marking of finished surfaces shall be made good to the satisfaction of the Consultant.

1.26 MOUNTING HEIGHTS

1.26.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

1.26.2 If mounting height of equipment is not indicated verify before proceeding with installation.

1.27 OWNER RIGHT TO RELOCATE ELECTRICAL ITEMS

1.27.1 The Owner reserves the right to relocate electrical items (light fixtures, battery pack) during construction, but prior to installation, without cost, assuming that the relocation per item does not exceed 3 m (10'-0") from the original location. No credits shall be anticipated where relocation per item of up to and including 3m reduces materials, products and labour.

1.27.2 Should relocations per item exceed 3m from the original location the Tender price will be adjusted accordingly.

1.27.3 Necessary changes, due to lack of co-ordination, and as required and when approved, shall be made at no additional cost, to accommodate structural and building conditions. The location of pipes and other equipment shall be altered without charge to the Owner, if approved, provided the change is made before installation.

1.28 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

1.28.1 Each copy of the manual shall include:

.1 A set of as-built prints;

.2 Letters of Owners Instructions;

.3 Final Electrical Safety Authority and Technical Standards and Safety Authority Certificates of Inspection;

.4 Verification Certificates for all systems as specified hereinafter;

.5 A copy of "reviewed" shop drawings;

.6 Complete explanation of operation principles and sequences;

.7 Complete part lists with numbers;

.8 Recommended maintenance practices and precautions;

.9 Parts manual and repair manuals

.10 Complete wiring and connections diagrams;

.11 Certificates of guarantee;

.12 Single Line Diagram for Entire Facility in paper, PDF and AutoCAD formats.

1.28.2 Ensure that operating and maintenance instructions are specific and apply to the models and types of equipment provided.

1.28.3 Submit three hard copies of the maintenance manuals in heavy-duty binders complete with record drawings and all instructions suitably labelled with project name and

locations at project close-out. Submit three copies on USB key with all of the same contents as the hard copies of the maintenance manuals at project close-out.

1.29 **TRIAL USAGE**

1.29.1 The Consultant reserves the right to use any system, piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.

1.29.2 Perform and pay for all costs associated with any testing required on the system components where, in the opinion of the Consultant the equipment manufacturer's ratings or specified performance is not being achieved.

1.30 **INSTRUCTION TO OWNERS**

1.30.1 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of all systems and equipment.

1.30.2 Arrange for, and pay for services of service engineers and other manufacturer's representatives required for instruction in the operation of systems and equipment.

1.30.3 Submit to the Consultant at the time of final inspection a complete list of systems stating for each system:

.1 Date instructions were given to the Owner's staff.

.2 Duration of instructions.

.3 Name of persons instructed.

.4 Other parties present (manufacturer's representative, consultants, etc.)

1.30.4 Obtain the signature of the Owner's staff verifying that they properly understood the system installation, operation and maintenance requirements, and that they have received the specified manuals and "as-built" record drawings.

1.31 **SYSTEM ACCEPTANCE**

1.31.1 Submit original copies of letters from the manufacturers of all systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the method of installation, connection and operation.

1.31.2 These letters shall state the names of persons present at testing, the methods used, and a list of functions performed with location and room numbers where applicable.

1.32 **CLEANING**

1.32.1 Before energizing any systems, inspect and clean the inside of panel boards, switchgear, and cabinets to ensure that they are completely free from dust and debris.

1.32.2 Clean all polished, painted and plated work bright.

1.32.3 Remove all debris, surplus material and all tools

1.32.4 Carry out additional cleaning of systems as specified in other sections of this Division.

1.33 **PAINTING WORK SUPPLIED UNDER DIVISION 16**

1.33.1 Touch up minor chips or damage to electrical equipment, installed in this Division, with standard, factory supplied, enamel finish.

1.33.2 Colour code, as specified herein, outlet boxes, pull boxes, junction boxes by applying a small dab of paint to inside of each item during installation.

1.33.3 Colour code, as specified herein, all exposed ducts, conduits, outlet boxes, and similar items by applying a 25 mm (1") wide band of paint around ducts and conduits adjacent to boxes described in above paragraph and on both sides of wall penetration.

1.34 **REMOVALS**

1.34.1 Co-ordination Between New and Existing Installations

.1 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

1.34.2 Existing Services

.1 Ensure existing services remain undisturbed and energized except where indicated.

.2 Disconnect and remove abandoned wiring materials and devices.

1.34.3 Modifications to Existing Structures

.1 Provide new electrical equipment to existing structures as detailed on drawings. Remove existing devices as shown and as required. Salvage existing circuits for reuse as noted.

1.34.4 Interruption of Services

.1 Maintain existing systems in existing building at all times during construction.

.2 Obtain Consultant's and Owner’s written approval before interrupting any service. Long outages are not acceptable.

.3 The Contractor shall apply to the Owner in writing for any power interruptions a minimum of two (2) weeks before requested shutdown date and obtain the Owner's written approval for any shutdowns. The Contractor shall indicate the approximate length of the shutdown and services affected in their written request for permission. Contractor shall include all costs for overtime work

1.34.5 Premium Time

.1 Include cost of premium time in bid price for work during nights, weekends or other time outside normal working hours necessary to do the work and maintain electrical services in operation.

.2 Premium time is to include work by local hydro authority, ESA, fire marshal and any other authorities having jurisdiction as required.

1.34.6 Use of Existing Material And Equipment

.1 Unless noted otherwise, do not use any existing panels, boxes and wiring materials unless shown on drawings.

.2 The Owner’s equipment is not available for Contractor use. Contractor must provide all equipment required to complete the work.

1.34.7 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 Consultant's approval of methods before proceeding.

2 PRODUCTS

Nil

3 EXECUTION

Nil

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 Comply with the City of Brampton General Conditions, Section 01000, Tender Documents and Division 16.

1.2 SCOPE OF WORK

1.2.1 Supply all labour, tools, service and equipment and provide all the materials required to complete the electrical work specified in Division 16.

1.3 SHOP DRAWINGS

1.3.1 Shop drawings need not be submitted for standard manufactured items and materials provided they are as specified.

1.4 SUBMITTALS

1.4.1 Submit the following to the Consultant for review prior to commencement of work:

.1 A sample of lamicoid nameplates and list of proposed nameplate legends.

1.5 QUALITY ASSURANCE

1.5.1 All components shall be C.S.A. and/or U.L.C approved listed and labelled.

2 PRODUCTS

2.1 CONDUIT AND RACEWAYS

2.1.1 Conduits and Fittings

.1 Rigid Galvanized Steel Conduit Epoxy Coated:
- .1 To CAN/CSA C22.2 No. 45-M.
- .2 Rigid thickwall steel threaded conduit
- .3 All coating and treatments are to be applied at the factory. Onsite application is not allowed.

.2 EMT
- .1 To CSA C22.2 No. 83-M
- .2 EMT galvanized cold rolled steel tubing

.3 Liquid Tight Flexible Steel Conduit
- .1 To CSA 22.2 No. 56.
- .2 Liquid-tight flexible steel conduit with PVC cover.
- .3 Watertight connectors with nylon insulated throat.

.4 Rigid PVC Conduit
- .1 To CSA C22.2 No. 211.2-M
- .2 Rigid PVC conduit

.5 Rigid Galvanized Steel Epoxy-Coated Conduit Fittings
- .1 All fittings (e.g. threaded hubs, couplings, conduit bodies, straps, elbows) shall be PVC or epoxy coated rigid galvanized steel and shall have no sags, blisters or other surface defects.

.2 PVC/Epoxy shall be applied at factory of origin. All fittings shall be of the same type and treatment as the adjoining conduit. All repairs done on deficient conduit requiring PVC/epoxy shall be done at factory of origin. PVC/epoxy treatment, including repairs, shall not be permitted on site and shall be done in the factory of origin.

.6 Rigid PVC Conduit Fittings
- .1 To CSA C22.2 No. 85-M
- .2 Rigid PVC fittings of same manufacture as rigid PVC conduit

.7 Liquid Tight Flexible Steel Conduit Fittings
- .1 Watertight connectors with nylon insulated throat

.8 EMT Fittings
- .1 Compression type, steel (cast fittings and set screw fittings not acceptable).
  - .1 Gland compression connectors with insulated throats
  - .2 Watertight compression couplings and connectors.

.9 Minimum conduit size shall be 21mm diameter.

.10 All conduit shall contain a separate dedicated ground conductor.

.11 All conduit must have adequate support systems complete with approved fittings, outlet boxes, junction boxes, sealing fittings and drains as indicated or as required. Provide hot dipped galvanized steel beam clamps, hot dipped galvanized steel channel type supports where required. Provide six (6)mm threaded galvanized steel rods to support suspended channels and provide all necessary galvanized steel spring loaded bolts, nuts, washers and lock washers. Support systems shall be Thomas & Betts Superstrut or equal.

.12 Provide all conduit, fittings and ducts necessary to complete the distribution of all power, lighting and control conductors to electrical equipment specified under the corresponding Section. Include that necessary for connecting to mechanical heating and ventilating equipment, also equipment specified under other Divisions.

.13 Fasten conduit with malleable PVC coated galvanized steel two-hole straps at intervals to suit code requirements and job conditions.

2.2 FASTENINGS, SUPPORTS AND SLEEVES

2.2.1 Galvanized steel, size and load rating to suit application.

2.2.2 One hole steel straps to secure surface mounted conduits or surface mounted cables 50 mm dia. and smaller. Two hole steel straps for conduits and cables larger than 50 mm.

2.2.3 Beam clamps to secure conduits to exposed steel work.

2.2.4 Channel type supports for two or more conduits.

2.2.5 6 mm minimum dia. threaded rods to support suspended channels.

2.2.6 6 mm minimum dia. U-bolts.

2.2.7 Sleeves - schedule 40 steel pipe minimum I.D. 13 mm larger than O.D. of conduit or cable passing through.

2.2.8 Strut

.1 Continuous slotted channel

.2 12 gauge pre-galvanized steel

.3 41.2 mm x 41.2 mm minimum

.4 Acceptable manufacturers:
- .1 B-Line
- .2 Pilgrim
- .3 Pursley
- .4 Unistrut
- .5 Or approved equal

2.2.9 Acceptable Manufacturers: Burndy, Electrovert, Unistrut.

2.3 JUNCTION BOXES

2.3.1 Galvanized steel EEMAC Type 12 size as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminal blocks and mounting rails.

2.3.2 Screw-on sheet steel covers to match enclosure for surface mounting boxes.

2.3.3 Covers with 25 mm minimum extension around for flush-mounted junction boxes.

2.3.4 Galvanized steel barriers as required.

2.3.5 Outdoor junction boxes shall be EEMAC Type 3R.

2.4 PULL BOXES

2.4.1 Galvanized sheet steel welded construction, EEMAC Type 12.

2.4.2 Screw-on galvanized sheet steel covers for surface mounting boxes.

2.4.3 Covers with 25mm minimum extension around, for flush mounted pull boxes.

2.4.4 Galvanized steel barriers as required.

2.4.5 Outdoor junction boxes shall be EEMAC Type 3R.

2.5 CONDUIT BOXES - GENERAL

2.5.1 Size boxes in accordance with latest edition of Electrical Safety Authority (ESA) Electrical Safety Code.

2.5.2 Code gauge, galvanized pressed steel for EMT.

2.5.3 Galvanized cast or pressed steel, for rigid thickwall threaded conduit.

2.5.4 Corrosive resistant coated: cast boxes for corrosive resistant coated rigid steel conduit with same finish as conduit.

2.5.5 200 mm square or larger outlet boxes as required for special devices.

2.5.6 Gang boxes where wiring devices are grouped except in classified hazardous areas.

2.5.7 Blank cover plates for boxes without wiring devices.

2.5.8 50 mm x 100 mm outlet boxes for devices, ganged for grouped devices, barriers where required by code.

2.6 **OUTLET BOXES - FITTINGS**

2.6.1 Bushings and connectors with nylon insulated throats.

2.6.2 Knock-out fillers to prevent entry of foreign materials.

2.6.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

2.6.4 Double locknuts and insulated bushings for sheet steel metal boxes.

2.7 **RIGID CONDUIT BOXES**

2.7.1 Zinc electroplate and polymer enamelled cast FS boxes with factory-threaded hubs and mounting feet for surface mounted switches and receptacles, with gasketted coverplate for exterior work and wet areas.

2.8 **BRANCH CIRCUIT CONDUCTORS**

2.8.1 Conductors

.1 ASTM Class B, soft drawn, electrolytic copper

.2 Stranded

2.8.2 Insulation

.1 CSA type RW90 XLPE (-40°C)
- .1 Heat and moisture resistant
- .2 Low temperature, chemically cross-linked thermosetting polyethylene material
- .3 600V-rated
- .4 For maximum 90°C conductor temperature
- .5 For installation at minimum -40°C temperature
- .6 To CSA C22.2 No. 38

.2 CSA type RWU90 XLPE (-40°C):
- .1 Heat and moisture resistant
- .2 Low temperature, chemically cross-linked thermosetting polyethylene material
- .3 1000V rated
- .4 For maximum 90°C conductor temperature
- .5 For installation at minimum -40°C
- .6 To CSA C22.2 No. 38

2.8.3 Branch circuit conductors up to and including #12 AWG shall be solid. Branch circuit conductors in sizes larger than #12 AWG shall be stranded. All branch circuit conductors shall be constructed of 90% conductive copper, unless otherwise noted, and shall be approved for 600 volts.

2.8.4 Electric service, distribution and special conductors are specified in this Section and/or on the drawings.

2.9 WIRE AND CABLE CONNECTORS

2.9.1 Copper compression type wire and cable terminations for #8 AWG and larger conductors, colour keyed, sized to suit. Long barrel NEMA 2 hole lugs for sizes #1/0 AWG and larger.

.1 Factory-insulated copper compression connectors sized for installed conductors approved by ESA for use in the location in which they are installed manufactured by ILSCO or approved equivalent.

.2 Acceptable Manufacturers: Thomas & Betts, Ideal, Hubbell Burndy, nVent Erico, ILSCO.

2.9.2 Twist type splicing connectors, copper, sized to suit, with black nylon or plastic shroud for tee connections in #10 AWG and smaller conductors.

.1 Acceptable Manufacturers: Thomas & Betts spring type, Ideal Twister, Marr Marrette.

2.9.3 Conductor compression splice for #10 AWG or smaller.

.1 Acceptable Manufacturers: Thomas & Betts STA-Kon series, Ideal Splices, Burndy

2.10 HEAT SHRINKABLE TUBING INSULATION, HEAVY WALL

2.10.1 Acceptable Manufacturers: Thomas & Betts, Shrink-Kon series, Ideal Thermo-Shrink, TS-46, Raychem tubing WCSM, 3M cable sleeve ITCSN.

2.11 FUSES

2.11.1 H.R.C. fuses to CSA C22.2 No. 59-M, CSA C22.2. No. 106-M with interrupting capacity minimum 100,000 amps symmetrical.

2.11.2 Unless otherwise noted, provide time delay fuses as follows:

.1 Fuses 600V, up to 600A HRCI-R, Form I: Class R Bussman FRS-R600 volt, Gould Shawmut TRSR.

2.11.3 Provide spare fuses of all sizes and types provided under this project. Provide spare fuse for each single fuse provided. Submit a list of spare fuses to Consultant for review and comment.

2.12 SLEEVES

2.12.1 In concrete slabs, except as noted below, sleeves shall be #24 gauge galvanized steel or factory fabricated plastic sleeves, each with an integral flange to secure the sleeve to form work construction.

2.12.2 In waterproof concrete slabs and in other slabs where waterproof sleeves are required sleeves shall be Schedule 40 mild steel galvanized.

2.13 ESCUTCHEON PLATES

2.13.1 One-piece chrome plated steel sized to completely cover sleeves and complete with set screws to secure the plates to the conduit. Split plates will not be acceptable.

2.14 INSERTS, BEAM CLAMPS FASTENERS, EQUIPMENT HANGERS AND SUPPORTS

2.14.1 Inserts for concrete formwork shall be Crane Canada type, #4-M Unistrut, or approved equal cast iron inserts, multiple type where required.

2.14.2 Inserts for precast concrete and existing concrete shall be lead cinch anchors of "WEJ-IT" or self-drilling "STARR" or "PHILLIPS" anchors.

2.14.3 Beam clamps for hanging and support to structural steel shall be Crane Canada Ltd., or equal.

2.15 ACCESS DOORS

2.15.1 Minimum #12 gauge prime coat painted bonderized steel flush access doors, each complete with a heavy frame and anchor, heavy duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing provisions to suit the particular construction in which it is installed. Access door sizes shall suit the concealed work for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc., shall be U.L.C. listed and labelled and of a rating to maintain the fire separation integrity.

2.15.2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout.

2.15.3 Access doors shall be, wherever possible, of a standard size, for all applications. Confirm exact dimensions with the Consultant, prior to ordering.

2.15.4 Submit a sample of each proposed type of access door to the Consultant for approval.

2.16 WATER RESISTANT PROTECTION

2.16.1 Where the area is sprinklered and electrical distribution equipment is located in sprinklered areas, enclosures shall be louvred and gasketed and provided with water-tight roof assemblies with overhanging drip shields. The equipment shall be fabricated by the manufacturer in such a way as to prevent sprinkler fluid from entering the equipment and/or interfering with its operation as per the requirements of C.S.A. C22.1 Rule 26-006.

2.16.2 Weatherproof equipment where noted in the specifications and or drawings shall have EEMAC 3R enclosures in accordance with the requirements of C.S.A. C22.2 No. 94 Standard.

2.17 PLYWOOD BACKBOARDS

2.17.1 Plywood backboards, good one side, 4' x 8' x ¾" fire rated type, unless indicated otherwise. Treat with primer and two coats of fire retardant paint.

2.17.2 Mount plywood on vertical strapping, on 40 mm centres to provide 10 mm clearance between wall and rear of plywood. Treat strapping similar to plywood.

2.18 **FINISH**

2.18.1 Equipment enclosure finish: baked grey enamel, ANSI 49 or ANSI 61.

3 **EXECUTION**

3.1 **GENERAL CONDUIT AND CONDUCTOR INSTALLATION REQUIREMENTS**

3.1.1 Install conduit and conductors concealed in all finished areas, and concealed to the degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished area such as Electrical Rooms and Mechanical Rooms, unless otherwise noted on the drawings or specified herein. Refer to and examine the architectural drawings and room finish schedules to determine finished, partially finished and unfinished areas of the building.

3.1.2 Where conduit and/or conductors are exposed, arrange same to avoid interference with other work and parallel to the building lines, where horizontal conduits and/or conductors are exposed, install as high as possible. Do not install conduit and/or conductors within 150mm of flue or heating pipes or equipment.

3.2 **CONDUIT AND EMT - GENERAL**

3.2.1 Run parallel or perpendicular to building lines.

3.2.2 Group raceways wherever possible. Support on channels.

3.2.3 Install expansion joints as required.

3.2.4 Run raceways in web portion of structural steel columns and beams.

3.2.5 Do not drill structural members to pass through.

3.2.6 Locate raceways not less than 125 mm clear where parallel to steam or hot water lines with a minimum of 75 mm at crossovers.

3.2.7 Use metallic raceway where temperatures exceed 75°C or where enclosed in thermal insulation.

3.2.8 All conduits to contain insulated green ground wire.

3.2.9 Install 6 mm diameter nylon pull cord in empty raceways.

3.2.10 Install 6 mm¼" diameter nylon pull cord in empty raceways.

3.3 **CONDUIT AND FITTINGS**

3.3.1 Minimum conduit sizes:

.1 Surface installation 21mm trade size conduit

3.3.2 Conduit application and type:

	Application	Type
.1	Wet indoor areas and indoor areas below grade	rigid galvanized steel epoxy-coated

.2	Indoor dry areas above grade not exposed to mechanical injury	EMT
.3	Outdoor surface installation	rigid galvanized steel epoxy coated
.4	Embedded in concrete, other than grade slab	rigid PVC
.5	In or below grade slab, underground installations	rigid PVC
.6	Connections to vibrating equipment or equipment Mounted in ceilings	liquid-tight flexible metal conduit

3.3.3 EMT shall be provided with watertight compression couplings and connectors. Set-screw connections between portions of EMT are not acceptable.

3.3.4 Connection to motors and equipment subject to vibration use liquid tight flexible steel conduit. Maximum length of liquid-tight conduit shall be 900mm.

3.3.5 Use field threads on rigid conduit of sufficient length to draw conduits up tight.

3.3.6 Do not bend coated steel conduit. Use elbows for deflections.

3.3.7 Do not install conduit in or under slab.

3.3.8 Do not install PVC conduit on exterior wall surfaces. Use rigid galvanized steel epoxy-coated conduit.

3.3.9 Use factory "ells" where 90° bends are required for 27mm trade size and larger conduits.

3.3.10 Bend conduit offsets cold. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Prevent the entrance of water and lodging of concrete, plaster, dirt, or trash in conduit, boxes, fittings, and equipment during course of construction.

3.3.11 Where conduit joints occur in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible.

3.3.12 Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc., with standard galvanized plumber's pipe caps.

3.3.13 Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.

3.3.14 Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings, or floors, and fill void between sleeve and conduit with caulking. If fire-rated caulking is required by code, use same class as walls, ceilings or floors.

3.3.15 Terminate conduit stubbed up through concrete floor for connection to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except where required, use flexible conduit from a point 150 mm above floor.

3.3.16 Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit bushing to be fully seated against end of conduit.

3.3.17 Mechanically bend steel conduit.

3.3.18 Install sealing condulets in conduits at hazardous area boundaries.

3.4 FASTENINGS AND SUPPORTS

3.4.1 Provide supports and fastenings for the Work of this Division. Do not use supports or equipment provided by other Trades.

3.4.2 Equipment fastenings and supports shall conform to manufacturers recommendations.

3.4.3 Do not attach to, or suspend any electrical product or service from the roof deck, mechanical ductwork or piping.

3.4.4 Do not use wire lashing or perforated strap to support or secure raceways or cable.

3.4.5 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.

3.4.6 For surface mounting of two or more raceways or cables use channels.

3.4.7 Where there is no wall support for raceways and cables dropped vertically to equipment, provide channel properly secured to floor and structure.

3.4.8 Hang supports from structural members. Where location does not permit direct support from structure provide necessary brackets, frames, channels secured to structural members.

3.4.9 Fasten exposed conduit and cables to building construction or support systems using straps. Use beam clamps on exposed steelwork.

3.4.10 Masonry, tile and plaster surfaces: use lead anchors.

3.4.11 Poured concrete: use expandable inserts. Low velocity powder activated fastenings may be used only in poured concrete.

3.4.12 Steel structures: use clips, spring loaded bolts, cable clamps, designed as accessories to basic channel members.

3.4.13 Do not use powder activated fasteners in, tile, precast concrete or steel structure.

3.4.14 Do not install conduits or cables on the bottom chord of joists or trusses.

3.4.15 Use beam clamps of the 2-bolt design and of such type that the rod load is transmitted only concentrically to the beam web centreline. The use of "C" and "I" beam side clamps will not be allowed.

3.5 JUNCTION BOXES

3.5.1 Install junction boxes in inconspicuous but accessible locations. Secure to structure.

3.5.2 Install terminal blocks on mounting rails, for termination of each wire and cable regardless of size.

3.5.3 Only one voltage source is permitted in a junction box.

3.5.4 Install barriers to separate different auxiliary systems.

3.6 PULL BOXES

3.6.1 Install pull boxes in inconspicuous but accessible locations. Secure to structure.

3.6.2 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.6.3 Only one voltage source is permitted in a pull box.

3.6.4 Install barriers to separate different auxiliary systems.

3.7 OUTLET AND CONDUIT BOXES

3.7.1 Install conduit outlet boxes for conduit up to 35 mm and pull boxes for larger conduits.

3.7.2 Support boxes independently of connecting conduits.

3.7.3 Seal boxes during construction to prevent entry of debris, dust and dirt.

3.7.4 For flush installations mount plaster rings to box, flush with wall surface to permit wall finish to come within 6 mm of opening.

3.7.5 Provide correct size of openings in boxes for conduit, armoured cable connections. Reducing washers will not be acceptable.

3.7.6 Install switches and other controls close to door lock or latch jambs and other openings, maintaining a minimum of 100 mm from trims of doors (except where installed in door frames of metal partitions) check door swings.

3.8 INSTALLATION OF BRANCH CIRCUIT CONDUCTORS

3.8.1 Install wiring in raceways unless noted otherwise.

3.8.2 Minimum wire sizes:

.1 Power and lighting -No. 12 AWG

.2 Control -No. 14 AWG

3.8.3 Wire and cable application and type:

.1 Branch circuits other than those covered above use RW90

.2 Equipment feeders and circuits use RW90

.3 Underground and under slab raceways, direct burial use RWU90.

3.8.4 Use lubricant when pulling wires into conduit. Ensure that wires are kept straight and are not twisted or abraded.

3.8.5 Neatly secure exposed wire in apparatus enclosures with approved supports or ties.

3.8.6 Junctions of all conductors shall be done with Ideal Wing nut #450 Series (Black) for conductors from #14 AWG to #8 AWG.

3.8.7 For all conductors larger than #8 AWG junctions shall be done with Burndy Servit connectors wrapped with 3M #33 Scotch tape.

3.9 CONNECTORS

3.9.1 Install compression terminations and splices in accordance with manufacturer's written instructions.

3.9.2 Make splices in junction boxes.

3.9.3 Make connections in lighting circuits with twist type splicing connectors.

3.9.4 Terminate and splice conductors No. 8 and larger at terminal blocks in junction boxes.

3.9.5 Seal terminations and splices exposed to moisture, corrosive conditions or mechanical abrasions with heavy wall heat shrinkable insulation.

3.10 **FUSES**

3.10.1 Store fuses in a moisture free location until ready to energize.

3.10.2 Install fuses, in accordance with manufacturer's printed instructions, immediately prior to energization, only of circuits which fuses protect.

3.10.3 Prior to acceptance of the Work, clearly mark manufacturer's labels on inside cover of each fusible unit, with ampere rating and catalogue symbol of replacement fuses to be used.

3.11 **INSTALLATION OF ESCUTCHEON PLATES**

3.11.1 Provide escutcheon plates over all exposed conduit passing through walls, floors, ceilings, partitions, furrings etc., in finished areas.

3.12 **FIELD FABRICATED METAL WORK**

3.12.1 Clean and prime paint field fabricated metal work.

3.12.2 After fabrication deburr, scrape, grind smooth, wire brush with power brush and degrease metal work.

3.12.3 Prime paint steel with 1 coat of CISC/CPMA 2.75 oil alkyd primer.

3.12.4 Prime paint aluminum as follows: wash with detergent solution and wipe down with SSPC-SP1 solvent. Apply Glidden #Y-5229 primer to 1.5 mils DFT.

3.12.5 For brass and bronze alloy materials, prepare as for aluminum but apply 1 coat of CAN/CGSB-1.40-M zinc chromate primer.

3.13 **CUTTING AND PATCHING**

3.13.1 Inform other trades in time concerning required openings. In work already finished, cutting and patching shall be done by the trades installing the affected work at the expense of Division 16. Obtain the approval of the Consultant, before doing any cutting.

3.13.2 Repair damaged or otherwise affected surfaces to match condition of existing adjacent surfaces prior construction.

3.14 **PENETRATIONS IN EXISTING STRUCTURE**

3.14.1 Perform cutting, patching and repairing. Obtain Consultant's approval before proceeding.

3.14.2 Where necessary to penetrate existing floors, walls, ceiling, roof or structural members provide sleeve and follow Consultant's instructions.

3.14.3 Restore surfaces to same finish and condition as existed prior to penetration.

3.14.4 Core Drilling Procedure

.1 Examine locations to be core drilled where:

.2 Diameter is greater than 25 mm

.3 Multiple drillings required and where the distance between centres is less than 10 times the diameter of the hole

3.14.5 Examine by most suitable method including:

.1 X-ray

.2 Ferro scan

.3 Cable detection

3.14.6 Examine from both sides of the structure to be drilled.

3.14.7 Examine proposed core drilling locations to determine:

.1 Possible interference with
.1 Services
.2 Structural components

3.14.8 Select locations as suitable for core drilling and label them:

.1 Uniquely number each drilling location and core so that markings will be legible after drilling

.2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall

3.14.9 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.

3.14.10 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.

3.14.11 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval prior to drilling to Consultant.

3.14.12 Proceed with core drilling only after approval has been received from Consultant.

3.14.13 Confine drilling operation to time-of-day as stipulated by Consultant.

3.14.14 Position suitable warning notices of a type acceptable to Consultant 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.

3.14.15 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.

3.14.16 Cover open holes with secured covers to guard against fall through of objects.

3.14.17 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 Consultant.

3.14.18 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

3.15 INSTALLATION OF SLEEVES

3.15.1 Where conduits, raceways and conductors pass through structural poured concrete, install sleeves, to suit structural details.

3.15.2 Size sleeves, unless otherwise noted, to leave 12mm clearance around the conduit, raceway, etc. Pack and seal the void between the sleeves and the conduit, raceway, conductor etc. for the length of the sleeves as follows:

.1 Pack sleeves set in interior concrete slabs, masonry walls, fire rated partitions, etc., with a U.L.C. and C.S.A. approved fire barrier caulk equal to 3M #CP25.

.2 Pack sleeves set in exterior walls with lead wool or oakum and seal the ends of the sleeves water-tight with an approved non-hardening sealant compound. Co-ordinate with the waterproofing trade.

.3 Submit to the concrete reinforcement detailed at the proper times, drawings, indicating all required sleeves, recesses and formed openings in poured concrete work. Such drawings shall be completely and accurately dimensioned and shall relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.

.4 Install sleeves of a water protecting type in the following locations:
- .1 In Mechanical Room floor slabs except where on grades.
- .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.

.5 "Gang" type sleeving will be permitted only with the Consultant's approval. All sleeves locations in precast slabs shall be approved by structural Engineer.

.6 Terminate sleeves for work which will be exposed so that the sleeve is flush at both ends with the wall, partition or slab surface so that the sleeves may be completely covered by escutcheon plates.

.7 Openings for multiple conduit or conductor runs, etc., will be provided by the Division responsible for the particular construction in which the opening is required. Carefully co- ordinate the opening locations with the particular Division and ensure that openings are suitably sized and located. Seal the space between the opening and the conduit, conductors, etc., for the length of the opening as for sleeves above.

.8 Where a round or formed opening is required, where placement of a sleeve has been missed, or where provision of an opening has not been properly, coordinated with the Concrete Division, neatly cut a suitably sized hole or opening using proper tools to the approval of the Consultant. Prior to cutting any such hole or openings, determine whether or not any reinforcing steel or services, are concealed behind the surface where the holes or opening is to be cut and be responsible for all costs incurred for correcting any damage caused to

the structure or services due to cutting holes or openings without prior study and approval.

3.16 INSTALLATION OF INSERTS, BEAM CLAMPS, FASTENERS, HANGERS AND SUPPORTS

3.16.1 Install all inserts, beam clamps, fasteners, and similar hardware required for conduit, duct, raceway, conductor, etc., and equipment hanger and/or support materials to best suit structural details.

3.16.2 Accurately and properly set concrete inserts in the concrete framework.

3.16.3 For runs of three (3) or more conduits, raceways, or conductors in concrete formwork, use multiple type inserts used for the smallest conduit in the group.

3.16.4 Where inserts are required in precast concrete and in concrete work where concrete inserts have not been installed, drill a neat hole of the proper diameter and depth in the concrete and insert an anchor to accept the hanger rod, bolt, etc., or where concrete mass permits, use self-drilling concrete anchors.

3.16.5 Fasten hangers and support provisions to brick or masonry with expansion shields and machine bolts, or for light loads, use plugs, and screws.

3.16.6 In cavity walls and/or ceilings use two (2) wing toggles and for heavy loads, provide steel anchor plates with two (2) or more toggles to spread the load.

3.16.7 Provide beam clamps for attaching, hanging and/or support provisions to the Consultant, weld the hanging and support provisions to the structural steel.

3.16.8 Explosive power actuated fasteners will not be permitted unless specific approval for their use has been obtained from the Consultant.

3.16.9 Securely mount plywood backboards to structure or use independent mounting channels, secured to floor.

3.17 STANDARD IDENTIFICATION

3.17.1 Identify electrical work as specified below.

3.17.2 For each piece of electrical equipment and for any other piece of equipment where specified in this Section, provide engraved lamacoid identification nameplates. Nameplates shall generally be lamacoid black with white letters and with bevelled edges, secured to apparatus with stainless steel screws. Warning signs, if and when required, shall be red with white lettering.

3.17.3 Exact nameplate wording and sizes must be approved by and confirmed by the Consultant prior to manufacture.

3.17.4 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting the outside of the covers. Paint colours shall be in accordance with the following schedule:

3.17.5 Colour code conductors, throughout to identify phases, neutrals and grounds by means of self-laminating coloured tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours shall be as follows:

.1 Phase A - Red

.2	Phase B	-	Black
.3	Phase C	-	Blue
.4	Ground	-	Green
.5	Neutral	-	White

3.18 INSTALLATION OF ACCESS DOORS

3.18.1 Install access doors to give access to all junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair but which is concealed in inaccessible construction except as otherwise specified herein or on the drawings.

3.18.2 Before commencing installation of electrical work, prepare on a set of reflected ceiling plans with complete layouts of all ceiling access door which will be required. Submit these layouts to the Consultant for approval and show the exact sizes and locations of such ceiling access doors. Locate access doors in walls and partitions to the Consultant's approval, and arrange electrical work to suit.

3.18.3 Access doors will be installed by the Division responsible for the particular type of construction in which the access doors are required. Supply the access doors to the Division installing same at the proper time.

3.18.4 Access doors shall be, wherever possible, of a standard size, for all applications. Confirm exact dimensions with the Consultant, prior to ordering.

3.18.5 Submit a sample of each proposed type of access door to the Consultant for approval.

3.19 PAINTING AND FINISHES

3.19.1 Provide all painting and patching to match existing services as required.

3.19.2 All exposed electrical fittings, supports, hangers, frames conduit, racks, boxes, raceways and similar material and apparatus shall be galvanized or finished with corrosion resistant primer ready to accept paint. Take special care when priming work exposed to the elements or in wet areas to prevent rust or corrosion from damaging adjacent surfaces.

3.19.3 Touch up and/or repaint any factory finished equipment that has been scratched or otherwise damaged during installations.

3.19.4 Provide for all patching and painting for all removals and as required. Painting shall be completed to the approval of the Consultant and Owner. Paint shall match adjacent surfaces. Include all costs.

3.19.5 Where cutting, patching, fire stopping and construction involves painted surfaces these must be painted to match the surrounding surfaces or as directed by Consultant.

3.20 PROVISIONS FOR SERVICES CROSSING BUILDING EXPANSION JOINT

3.20.1 Wherever services (conduit, cables, etc.) cross building expansion joints, install the services in order to permit free movement without imposing additional stress or loading upon the support system, and to prevent excessive movement at joints and connections.

3.20.2 Provide expansion conduit couplings to cross the building expansion joints at all locations at which conduits cross expansion joints.

3.21 **PLYWOOD BACKBOARDS**

3.21.1 Install plywood backboards.

3.21.2 Paint with fire-rated paint.

3.21.3 Install equipment on plywood backboards with uni-strut standoffs.

3.21.4 Ensure integrity of plywood backboards with equipment mounted on them after installation of equipment.

3.22 **TESTS**

3.22.1 Branch circuit balancing.

3.22.2 Connect all new branch power circuits to existing panelboards so as to balance the actual loads (wattage) within 5%.

3.22.3 Perform other testing and submit reports in accordance with the requirements of section 16950 Commissioning and Field Quality Control.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 Comply with the City of Toronto General Conditions, Division 01, Tender Documents and Division 16.

1.2 REFERENCES

1.2.1 Section 16010 Electrical General Provisions also applies to and is a part of this Section of the Specification.

1.2.2 Conform to latest issues, amendments and supplements of following standards:

CSA C22.2 No. 5.1M Moulded Case Circuit Breakers

CSA C22.2 No.39-M1987 (R2007), Fuseholder Assemblies.

1.3 SCOPE OF WORK

1.3.1 Supply all labour, tools, services and equipment and provide all materials and equipment required to complete service and distribution work in accordance with this section of the specification and the drawings.

1.4 QUALITY ASSURANCE

1.4.1 All low voltage distribution work shall be executed by skilled tradesmen fully experienced in the installation of electrical power systems.

1.4.2 All equipment shall be constructed to EEMAC standard and shall carry the CSA label or the contractor shall obtain Electrical Safety Authority approval.

1.4.3 All equipment shall be suitably noted for the system available fault and HRC fuses shall comply with CSA C22.2 No. 106.

1.5 SUBMITTALS

1.5.1 Refer to Division 1 General Requirements and submit shop drawings for the following:

.1 Circuit breakers

.2 Panelboards

.3 Fusible and Non-Fusible Disconnect Switches

.4 Motor Starter

.5 Contactor

.6 Variable Frequency Drive

.7 Grounding

2 PRODUCTS

2.1 REFERENCES

2.1.1 Refer to Section 16100 Basic Materials and Methods. This Section also applies to and is part of this section of the specifications.

2.2 CIRCUIT BREAKERS GENERAL

2.2.1 Bolt-on moulded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

2.2.2 Common trip breakers with single handle for multipole applications.

2.2.3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3 -10 times current rating.

2.2.4 Circuit breakers with interchangeable trips as indicated.

2.2.5 Where breakers are installed in enclosures, the enclosure shall be EEMAC Type 2 sprinkler-proof.

2.2.6 Short circuit rating of 120/208/ 240V breakers to be 22kA rms sym. or as shown on drawings.

2.3 PANELBOARDS

2.3.1 The panelboards shall be as scheduled on drawings and as specified herein after.

2.3.2 Ratings

.1 Panelboards rated 208 Vac or less shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 22,000 amperes RMS symmetrical.

.2 Panelboards shall be labelled with a CSA short circuit rating where the short circuit ratings are used to achieve a specified short circuit current rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the CSA series ratings including:

.1 Size and type of upstream device.
.2 Branch devices that can be used.
.3 CSA series short circuit rating.

2.3.3 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 Trims for panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Furnish semi flush cylinder lock and catch assembly to secure hinged door over circuit breaker handles. Provide door-in-door type construction so that the trim may be opened to access wireways without removing the trim from the panel. All trims shall have concealed mounting hardware when the door is closed.

.3 Panelboard trims shall cover all live parts. Switching device handles shall be accessible.

.4 Surface trims shall be same height and width as box.

.5 A fully labelled directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

.6 All locks shall be keyed alike.

2.3.4 Bus

.1 Main bus bars shall be silver flashed copper, sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

.1 A insulated ground bus shall be included in all panels.

.2 100% rated insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

2.3.5 Enclosure

.1 Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the Canadian Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

.2 Enclosures shall be provided with one (1) blank end and one end with knockouts.

.3 Enclosures shall be EEMAC Type 2 sprinklerproof.

2.3.6 The panelboard shall be selected so that it can fit into the space available in the electrical room and shall meet the requirements of the Ontario Electrical Safety Code.

2.3.7 Acceptable manufacturers are Eaton, Schneider Group (Square D), Siemens or approved equal.

2.4 FUSIBLE AND NON-FUSIBLE SAFETY SWITCHES (DISCONNECTS)

2.4.1 Safety switches shall be heavy duty series safety switches.

2.4.2 Each safety switch shall be front operated with red handle suitable for padlocking in the "OFF" position and arranged so that the enclosure cover cannot be opened with the handle in the "ON" position. Operating mechanisms shall be quick-make, quick- break, positive acting with visible blades, and a line terminal shield. Fusible units shall be complete with fuse clips suitable for H.R.C., Class "J" fuses unless otherwise noted. Each unit shall also be equipped with solderless lugs and a front cover nameplate identifying the catalogue number and electrical characteristics.

2.4.3 Enclosures for safety switches shall be, unless otherwise noted, EEMAC 3R raintight (sprinkler-proof) enclosures.

2.4.4 The ampere rating, number of poles, and fuse requirements for safety switches shall be as specified on the drawings.

2.4.5 The discount switches shall be selected so that they will fit into the space available in the electrical room and meet the requirements of the Ontario Electrical Safety Code.

2.4.6 Electrical Interlock: Mechanically operated from switch mechanism, rated 120 VAC, 15A, 1 NO and 1 NC contact.

2.4.7 Acceptable manufacturers are Schneider Group, Siemens, Eaton or approved equivalent.

2.5 **MOTOR STARTERS**

2.5.1 Motor starter units: Combination magnetic full voltage non-reversing type, 3 pole (or 1 pole), 600 V rated, HMCP magnetic trip circuit breaker type with overload relay and heater element in each phase. Enclosures shall be EEMAC 3R.

2.5.2 Overload relays: Solid State, manually resettable type. Reset pushbutton on starter door. Relays shall be sized to suit motor hp (kw), speed, load conditions and ambient temperature. Motor overload relay in each phase shall be manual reset type from outside enclosure equipped with trip-indicating handle.

2.5.3 Control transformer: Grounded secondary complete with primary (2) and secondary (1) fuses. Control Transformer: 120V secondary, fused, sized to suit control circuit load plus 50VA.

2.5.4 Starter contactor: Minimum two spare normally open and two spare normally closed, separate, 120 V auxiliary contacts, wired to terminal blocks. Supply additional contacts where indicated. Relays shall be totally enclosed plug-in type relay with four form-c contacts, operating coil to suit required voltage complete with mounting socket.

2.5.5 Circuit breakers: Moulded case, 3-pole (or one pole), 600 V, magnetic only type, with adjustable instantaneous trips, MCP (motor circuit protector).

2.5.6 Circuit breaker auxiliary contacts: One normally open and one normally closed, separate contacts minimum, rated 120 V.

2.5.7 External circuit breaker operating handle: Interlocked with unit door, to be in OFF position before door can be opened. Allow padlocking of handle in ON or OFF position with three padlocks minimum.

2.5.8 Starter size: EEMAC sizes as indicated. Minimum starter size EEMAC size 1. Intermediate size (non-EEMAC) starters will not be accepted.

2.5.9 Operators

.1 Hand/Off/Auto Selector switch: 3 position.

2.5.10 Pilot lights

.1 Lens colour:

.1	running	- red (green)
.2	stopped	- green (red)
.3	alarm/malfunction	- amber
.4	on	- white or (clear)

.2 Acceptable manufacturers: Allen Bradley type 800T, Square D Class 9001 type K, Eaton equivalent.

2.5.11 Devices and components by one manufacturer to facilitate maintenance.

2.5.12 Acceptable manufacturers are Eaton, Schneider Group (Square D), Siemens or approved equivalent.

2.6 CONTACTOR

2.6.1 Provide heavy-duty electrically-held contactors for loads suitable in all respects for the application. Mount the contactor in a suitable EEMAC 3R enclosure complete with the hand/off/auto switch and pilot lights as indicated on the drawings. The current rating, number of poles etc. for contactors shall be as noted on the drawings. The contactors shall be selected so that they can fit into the space available in the enclosure and shall meet the requirements of the Ontario Electrical Safety Code. Contactors shall be provided with control transformer for 120V or 24V control operation. Confirm existing emergency power off button voltage at site and provide correct control transformer and wiring in conduit to tie in existing emergency power off button. Include remote hand/off/auto switch mounted inside existing distribution enclosure. See drawings for ampacities. Acceptable manufacturers are: Allen-Bradley, Siemens, Eaton and Schneider Group (Square D).

2.6.2 Provide all the necessary relays for contactors. Relays shall be rated for a heavy duty, long life operation and require a minimum of maintenance. All control, time delay or double voltage relays shall be supplied and connected into their respective control circuits as indicated on the drawings. All relays shall be of robust construction, heavy duty hardened steel magnet faces for long life, silver to silver contacts. Relays shall have readily reversible contact arrangements. Relays shall be of time delay type and current ratings to suit the control requirements. The contractor shall submit for approval the relays they intend to use in the shop drawing submission of the contactors.

2.6.3 Wiring between the contactor and the devices outside the contactor to which the contactor is connected shall be provided in conduit.

2.7 VARIABLE FREQUENCY DRIVES

2.7.1 Variable frequency drives specified on Mechanical Drawings. Refer to Mechanical Drawings for variable frequency drive requirements.

2.8 GROUNDING EQUIPMENT

2.8.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

2.8.2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

2.8.3 Insulated grounding conductors: green, type RWU.

2.8.4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

2.8.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

2.8.6 Grounding and bonding bushings.

2.8.7 Protective type clamps.

2.8.8 Bolted type conductor connectors.

2.8.9 Thermit welded type conductor connectors.

2.8.10 Bonding jumpers, straps.

2.8.11 Pressure wire connectors.

3 EXECUTION

3.1 GENERAL

3.1.1 Protect equipment from dust, debris, moisture, and physical damage, with sealed envelope of plastic or other impervious material until building is enclosed and cleaned and equipment is energized.

3.1.2 Protect from condensation by maintaining at suitable temperature above 0°C.

3.1.3 Finish equipment enclosures to ANSI 49 or ANSI 61, baked grey enamel.

3.1.4 Arrange and pay for services of manufacturer's representative during testing and commissioning of switchboard.

3.2 INSTALLATION OF PANELBOARDS

3.2.1 Locate panelboards and fasten to wall/concrete housekeeping pad.

3.2.2 Connect main secondary service to line terminals of main breaker.

3.2.3 Connect load terminals of distribution devices to feeders.

3.2.4 Check factory made connections for mechanical security and electrical continuity.

3.2.5 Run grounding conductors from ground bus to building ground to suit the Electrical Safety Code.

3.2.6 Check trip unit settings and or fuse sizes against the co-ordination study to ensure proper working and protection of components.

3.2.7 Balance phases to the maximum extent possible.

3.2.8 Connect the metering cabinets as required with conduit and provide slack coiled conductors in the cabinet.

3.2.9 The provision of meters will be carried out by Alectra Utilities.

3.1 INSTALLATION OF CIRCUIT BREAKERS

3.1.1 Install breakers per the manufacturer's recommendations and the Tender Drawings.

3.2 DISCONNECT SWITCHES

3.2.1 Install disconnect switches complete with fuses as indicated.

3.3 MOTOR STARTERS

3.3.1 Secure equipment plumb true and square to structure.

3.3.2 Check nameplate rating of motor to select overload relay heater elements; install heater elements.

3.3.3 Check operation of starters and correct motor rotation. Co-ordinate with Divisions 22, 23 and 25 and building automation system installation.

3.3.4 Provide plastic covers to exclude dirt and dust until starters are energized.

3.3.5 Co-ordinate connections to building automation system and control sequences with mechanical division.

3.3.6 Test operation of systems with building automation system contractor, mechanical contractor and Owner.

3.4 **CONTACTORS**

3.4.1 Secure equipment plumb true and square to structure.

3.4.2 Check nameplate rating of loads served to select relays.

3.4.3 Check operation of contactors and correct motor rotation. Co-ordinate with Division 15, building automation system installation and emergency stop push button installation.

3.4.4 Provide plastic covers to exclude dirt and dust until equipment is energized.

3.4.5 Co-ordinate connections to mechanical equipment, building automation system and control sequences with mechanical division.

3.4.6 Test operation of systems with building automation system contractor, mechanical contractor and Owner.

3.5 **GROUNDING INSTALLATION GENERAL**

3.5.1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories and connect to the existing building ground system. Provide ground wire in all conduits.

3.5.2 Install connectors in accordance with manufacturer's instructions.

3.5.3 Protect exposed grounding conductors from mechanical injury.

3.5.4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

3.5.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

3.5.6 Soldered joints not permitted.

3.5.7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

3.5.8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.5.9 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.6 SYSTEM AND CIRCUIT GROUNDING

3.6.1 Install system and circuit grounding connections to neutral of secondary 120/208V systems.

3.7 GROUNDING FIELD QUALITY CONTROL

3.7.1 Perform tests in accordance with Section 16010 - Electrical General Requirements.

3.7.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction over installation.

3.7.3 Perform tests before energizing electrical system.

3.8 TESTING AND INSPECTION OF POWER DISTRIBUTION SYSTEM

3.8.1 Provide the following on-site inspection and testing of the following main distribution equipment:

.1 Distribution Equipment

.2 Grounding System

3.8.2 This engineering inspection and testing shall be done prior to the system being energized and shall include the following items where applicable:

.1 Testing, cleaning and where necessary, calibrating all relays and circuit breaker trip devices.

.2 Function test of protection and control devices.

.3 Megger test interconnecting cables.

.4 Replacement of fuses destroyed or damaged during the start- up or testing;

.5 Grounding continuity testing

3.8.3 Acceptance tests shall be conducted in the presence of and to the satisfaction of the Consultant.

3.8.4 Make good any defects indicated in the equipment and in the installation by the tests.

END OF SECTION 16400

1 GENERAL

1.1 WORK INCLUDED

1.1.1 Comply with the City of Toronto General Conditions, Division 01, Tender Documents and Division 16.

1.2 REFERENCES

1.2.1 CAN/ULC-S524, Installation of Fire Alarm Systems.

1.2.2 CAN/ULC S525, Audible Signal Devices for Fire Alarm and Signaling Systems Including Accessories

1.2.3 CAN/ULC S526, Visual Signal Devices for Fire Alarm and Signaling Systems Including Accessories

1.2.4 CAN/ULC-S527, Standard for Control Units for Fire Alarm Systems

1.2.5 CAN/ULC-S528, Manual Pull Stations

1.2.6 CAN/ULC-S529, Smoke Detectors.

1.2.7 CAN/ULC-S530, Heat Actuated Fire Detectors.

1.2.8 CAN/ULC S536 Inspection and Testing of Fire Alarm Systems.

1.2.9 CAN/ULC S537 Verification of Fire Alarm Systems.

1.2.10 CAN/ULC-S1001, Standard for Integrated Systems Testing of Fire Protection System

1.2.11 OBC Ontario Building Code.

1.2.12 NBC, National Building Code of Canada.

1.2.13 OESC Ontario Electrical Safety Code

1.2.14 NFPA No. 13 Sprinkler Systems

1.2.15 NFPA No. 72 National Fire Alarm Code

1.2.16 NFPA No. 101 Life Safety Code

1.3 DESCRIPTION OF SYSTEM

1.3.1 All equipment and components shall be new, and the manufacturer's current model.

1.3.2 Provide As-built drawing to show all fire alarm system equipment quantities and locations.

1.3.3 Annunciators shall cover all zones and all parts of building.

1.3.4 Panels will be tied into emergency standby generators, security panels, and auxiliary and ancillary devices. Provide additional spare modules for tie-ins.

1.3.5 Generator supervisory zones.

1.3.6 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.

1.3.7 System shall carry out fire alarm and protection functions; including receiving alarm signals; initiating general and single-stage alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signaling to monitoring agency.

1.3.8 Zoned, non-coded single stage.

1.3.9 Modular in design to allow for future expansion.

1.3.10 Operation of system shall not require personnel with special computer skills.

1.3.11 System to include:

.1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signaling.

.2 Data Gathering Panels/Transponders with stand-alone capabilities if applicable.

.3 Power supplies.

.4 Initiating/input circuits.

.5 Output circuits.

.6 Auxiliary circuits.

.7 Wiring.

.8 Manual and automatic initiating devices.

.9 Audible and visual signaling devices.

.10 End-of-line resistors.

.11 Local and remote annunciators.

.12 Historic event recorder.

.13 Isolation modules.

.14 Addressable modules for connections to non-addressable devices

.15 Central alarm monitoring.

.16 Programmed features.

1.3.12 Software Modifications

.1 Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

.2 Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications onsite. Modification

of software shall not require power down of the system or loss of system fire protection while modifications are being made.

1.3.13 Certifications:

.1 Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

1.4.1 System components shall be listed by ULC/CSA and comply with applicable provisions of the Ontario Building Code and meet requirements of local authority having jurisdiction.

1.4.2 The system shall have proper listing and/or approval from ULC Underwriters Laboratories Canada.

1.4.3 The Fire Alarm Control Panel and all components shall meet the modular listing requirements of Underwriters Laboratories of Canada. Each subassembly, including all printed circuits, shall include the appropriate ULC modular label. This includes all printed circuit board assemblies, power supplies, and enclosure parts. Systems that do not include modular labels may require return to the factory for system upgrades, and are not acceptable.

1.5 SHOP DRAWINGS

1.5.1 1.5.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

1.5.2 1.5.2 Include:

.1 Detail assembly and internal wiring diagrams for control units and auxiliary cabinets.

.2 Overall system riser wiring diagram identifying control equipment initiating zones signaling circuits; identifying terminations, terminal numbers, conductors and raceways.

.3 Details for devices.

.4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

.5 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.6 OPERATION AND MAINTENANCE DATA

1.6.1 Provide operation and maintenance data for fire alarm system for incorporation into manual.

1.6.2 Include:

.1 Instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

.4 List of recommended spare parts for system.

.5 Detailed sequence of operation or operation matrix.

.6 Full fire alarm verification inspection report.

1.7 **MAINTENANCE MATERIALS**

1.7.1 Include:

.1 Spare glass rods for manual pull stations - 6.

.2 Key for fire alarm panel, remote annunciator, and pull stations - 2 sets.

.3 Specialty tool for resetting sprinkler supervisory - 2 sets.

.4 Spare fuses for control circuits - 6.

1.8 **TRAINING**

1.8.1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system for a minimum duration of four (4) hours.

2 **PRODUCTS**

2.1 **MATERIALS**

2.1.1 Equipment and Devices: ULC listed and labelled and supplied by single manufacturer.

2.1.2 Power Supply: to CAN/ULC-S524.

2.1.3 Audible Signal Devices: to ULC-S525.

2.1.4 Visual Signal Devices: to CAN/ULC-S526.

2.1.5 Control Unit: to CAN/ULC-S527.

2.1.6 Manual Pull Stations: to CAN/ULC-S528.

2.1.7 Smoke Detectors: to CAN/ULC-S529.

2.1.8 Thermal Detectors: to CAN/ULC-S530.

2.1.9 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.

2.1.10 CAN/ULC-S537, Verification of Fire Alarm Systems.

2.1.11 CAN/ULC-S1001, Standard for Integrated Systems Testing of Fire Protection System

2.2 **SYSTEM OPERATION: SINGLE STAGE SIGNALS ONLY**

2.2.1 Actuation of any alarm initiating device to:

.1 Cause electronic latch to lock-in alarm state at central control unit and data gathering panel/transponder.

.2 Indicate zone of alarm at central control unit and remote annunciator.

.3 Cause audible signaling devices to sound continuously throughout building and at central control unit.

.4 Transmit signal to fire department via central station.

.5 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.

.6 Cause fire doors and smoke control doors, if normally held open, to close automatically.

2.2.2 Acknowledging alarm: indicated at central control unit.

2.2.3 Actuation of supervisory devices to:

.1 Cause electronic latch to lock-in supervisory state at central control unit and data gathering panel/transponder.

.2 Indicate respective supervisory zone at central control unit and at remote annunciator.

.3 Cause audible signal at central control unit to sound.

.4 Activate common supervisory sequence.

2.2.4 Resetting of alarm or supervisory device shall not return system indications/functions back to normal until control unit has been reset.

2.2.5 Trouble on system to:

.1 Indicate circuit in trouble at central control unit.

.2 Activate “system trouble” indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.

2.2.6 Trouble on system: suppressed during course of alarm.

2.2.7 Trouble condition on any circuit in system not to initiate alarm conditions.

2.3 **CONTROL PANEL**

2.3.1 Central Control Unit (CCU):

.1 Suitable for Data Communication Link style C (DCL-C) unless otherwise noted on the Contract Drawings to CAN/ULC-S524.

.2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.

.3 Minimum capacity of 1000 addressable monitoring and 500 addressable control/signal points. Points may be divided between two communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.

.4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.

.5 Integral power supply, battery charger and standby batteries.

.6 Basic Life Safety Software: retained in non-volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (e.g. zone labels, priorities) and changing of system operation software.

.7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.

.8 Communication between CCU and remote DGP's/TPR's to be supervised, DCLA. Should communications fail between CCU and remote units, audible and visual trouble to be indicated at CCU. Data communication to be binary DC, baseband, time-division multiplex, half-duplex. Each data channel: capable of communicating up to distance of 3000m.

.1 Communication between nodes in networked system to be supervised, DCLA. Should communications fail between any two nodes, other nodes on loop to continue to communicate with each other and programmed functions on communicating nodes to continue operating.

.9 Support up to 4 RS-232-C I/O ports. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.

.10 Equipped with software routines to provide Event-Initiated-Programs (EIP); change is status of one or more monitor points, may be programmed to operate any or all of system's control points.

.11 Software and hardware to maintain time of day, day of week, day of month, month and year.

.12 On-board, 20-column, DC strip printer, thermal head with automatic paper take-up and silent operation; operational while system is operating on standby power. Expanded font available for selected printing conditions.

.13 Printer to record activities on system controlled by EIA RS-232-C link from within CCU.

.14 Software to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.

.15 The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.

2.3.2 Data Gathering Panels (DGP's)/Transponders

.1 Fire control modules: distributed throughout building complex in separately enclosed units (DGP'S) and interconnected to central control unit utilizing multiplex data transmission techniques.

.2 Fire alarm integrated DGP's: microprocessor based, provide interface between standard alarm input/output devices and central control unit.

.3 Each DGP: circuitry with ability to detect failure in communication with CCU resulting from faults in communication wiring. In event of loss of communication with CCU, DGP capable of operating in stand-alone mode. In this mode, DGP capable of reacting to connected input devices, and apply stand-alone programming to determine state of connected outputs. Stand-alone programming instructions: independent of, but capable of executing same type of algorithms as that of CCU.

.4 Each DGP: self-contained unit, with integral power supply, battery charger and standby batteries. Short circuit, over voltage, and brown-out monitoring to protect powered components by automatically switching to standby batteries whenever trouble condition exists in power supply.

.5 Addressable DGPs:
- .1 DGPs are to be of the addressable type which provide two-way data communication with up to 128 addressable devices/interface modules, utilizing digital poll/response protocol communication format. Each addressable device: uniquely identified by own address, set at time of installation.
- .2 Addressable DGP's must have stand-alone operating capability.
- .3 Interface modules: facilitate connection of non-addressable devices (e.g. flow switch) to addressable DGP; provided in different types for connection to monitoring devices (e.g. flow/tamper switch), signaling devices (e.g. bells, horns), and control functions (e.g. fan shutdown, door release); communicate with addressable DGP over minimum number of wires (specified by manufacturer).
- .4 Possible to connect all three types of addressable interface modules (monitoring, signal and control) to same addressable communication loop.
- .5 Possible to connect variable-sensitivity addressable smoke detectors together with other addressable devices to same addressable communication loop.

2.3.3 Power Supplies

.1 120V, 60Hz as primary source of power for system. The circuit shall be labelled at the main power distribution panel as "FIRE ALARM". The fire alarm disconnect must be locked, a locked electrical room or panel door does not constitute the lock for the disconnect.

.2 Voltage regulated, current limited distributed system power.

.3 Primary power failure or power loss (less than 102V) will activate common trouble sequence.

.4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.

.5 During any abnormal operating conditions such as a fault in battery charging circuit, short or open in the battery leads, is to activate a common trouble sequence and standby power trouble indicator.

.6 Standby batteries five year Nicad sealed, maintenance free.

.7 Continuous supervision of wiring for external initiating and alarm circuits are to be maintained for 24 hours with capability of maintaining alarm activation for a minimum of two hours.

2.3.4 Initiating/Input Circuits

.1 Fire alarm system wiring configuration and zoning shall be addressable.

.2 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCL-C, as per CAN/ULC-S524-06, configuration to central control unit or DGP's / transponders.

.3 Alarm receiving circuits (active and spare) are to be compatible with smoke detectors and open contact devices.

.4 Actuation of alarm initiating device is to cause system to operate as specified in "System Operation".

.5 Receiving circuits for supervisory devices are to be wired in DCL-A configuration to central control unit or DGPs / transponders.

.6 Actuation of supervisory initiating device is to cause the system to operate as specified in "System Operation".

.7 Sprinkler devices such as pressure switches and flow switches are to have the tamper switch wired after the switch and before the EOL, to create a trouble condition while still allowing the device to electrically initiate its respective zone.

.8 Low room temperatures devices are to be provided in sprinkler rooms whenever a dry sprinkler system is provided.

2.3.5 Alarm Output Circuits

.1 Alarm output circuits are to be connected to signals, wired in class B configuration to the central control unit or DGP's/transponders.

.2 The signal circuits' operation are to be capable of sounding bells, horns as required. Each signal circuit: rated at 2A, 24 VDC; fuse-protected from overloading/overcurrent.

.3 Manual alarm silence, automatic alarm silence and alarm silence inhibit is to be provided by system's common control.

.4 2.7.2 Separate circuits shall be provided for audible signal devices on each floor area.

2.3.6 Auxiliary Circuits

.1 Auxiliary contacts for control functions.

.2 Actual status indication (positive feedback) from controlled device.

.3 Alarm or supervisory trouble on system to cause operation of programmed auxiliary output circuits.

.4 Upon resetting system, auxiliary contacts are to return to normal or to operate as pre-programmed.

.5 Fans: stagger-started upon system reset; timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system. Timing circuit: controlled by CCU.

.6 Auxiliary circuits: rated at 2A, 24 VDC or 120 VAC, fuse-protected.

2.3.7 Wiring

.1 Use new wiring in accordance with CAN-ULC-S537.

.2 Twisted copper conductors: 300 V CSA FAS minimum 105°C with FT4 rating and in mechanical protection i.e. EMT or flex as specified under Division 26.

.3 Initiating circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

.4 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

.5 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

.6 All initiating circuits are to be wired in a DCL-C configuration.

.7 All output circuits are to be wired in a Class-B configuration.

.8 All wiring between junction boxes and waterflow switch, pressure switch or supervisory switches will be liquid tight flex.

2.3.8 Detection Devices General

.1 Provide addressable detection devices at the locations shown on the drawings and installed in accordance with the requirements of the Ontario Building Code and ULC-S524. Provide wiring in conduit to tie into existing fire alarm zone in the renovated area. The detection devices shall be in accordance with the following general requirements:

.1 Communication Transmitter and Receiver: integral to device. Provides each device with a unique identification and capability for status reporting to the FACP.

.2 External Addressable Interface Unit: may be used where specified devices are not manufactured and labeled with integral multiplex transmitter and receiver. Arrange to monitor status of each device individually.

.3 Displaying Communication and Alarm Status: a LED shall flash to confirm communication and illuminate steady for display alarm status.

.4 Pre-Alarm and Alarm Signal: transmit pre-alarm and alarm signals in addition to the normal and trouble.

.5 Environmental Conditions: contain an algorithm that continually monitors environmental conditions and compensate for various conditions. Each detector may be individually programmed to operate at any one of a multiple of sensitivity settings.

.6 Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector

sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be accepted.

.7 It shall be possible to address each detector without the use of mechanical (DIP or rotary) switches. Devices using mechanical switches for addressing shall not be acceptable.

.8 The system detectors shall be capable of full digital communications using both broadcast and polling protocol.

.9 Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.

.10 Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable.

.11 Maximum total analog loop response time for detectors changing state shall be 0.5 seconds. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status.

.12 The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

.13 Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

.14 Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24-hour long term and 4-hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.

.15 The intelligent analog detectors shall be suitable for mounting on any detector mounting base.

.16 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base.

2.3.9 Automatic Alarm Initiating Devices

.1 Addressable Manual Pull Station:
.1 Pull lever, break glass rod, semi-flush wall mounted type, single stage, or two stage, electronics to communicate station's status to addressable module/transponder over two wires and to supply power to station. Station address to be set on station in field.

.2 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non- restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute.
.1 Electronics to communicate detector's status to addressable module/transponder.
.2 Detector address to be programmed on site.

.3 Heat Detectors:
.1 General: Heat detectors shall comply with ULC S530 and be compatible with the existing fire alarm system. Include the following features:
.1 Factory Nameplate: serial number and type identification
.2 Operating Voltage: 24 V dc, nominal
.3 Self-Restoring: detectors do not require resetting or readjustment after actuation to restore them to normal operation
.4 Remote Controllability: individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.

.4 Smoke Detectors:
.1 General: comply with ULC S529. Include the following features:
.1 Factory Nameplate: serial number and type identification
.2 Operating Voltage: 24 V dc, nominal
.3 Self-Restoring: detectors do not require resetting or readjustment after actuation to restore them to normal operation
.4 Remote Controllability: individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.
.2 Addressable, plug-in, two-wire, multi-sensor or application specific, detector with both photoelectric and thermal inputs. Each detector shall consist of a dust resistant, field cleanable photo chamber, a solid state non-mechanical thermal sensor, microprocessor based electronics with a low-profile plastic cover and base. The detector shall utilize a state-of-the-art ASIC and surface mount technology for maximum reliability. Every detector shall be shipped with a protective dust cover to protect against dust during construction.
.3 The smoke detector shall be modular and allow for replacement of the photoelectric chamber, should the detector become dirty enough to require it. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems

using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

.1 Temperature: 32°F to 120°F (0°C to 49°C).
.2 Humidity: 0-93% RH, non-condensing.
.3 Elevation: no limits

.5 Multi-Criteria Intelligent Fire/CO Detector

.1 Multi-Criteria Fire/CO detector shall be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.

.2 The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

.3 The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.

.4 The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.

.5 The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.

.6 The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.

.7 The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.

.8 The detector shall provide a test means whereby it will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide aerosol or direct heat method.

.9 The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.

.10 Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.

.11 The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

.1 4.0" (10.16 cm) square box with and without plaster ring
.2 4.0" (10.16 cm) octagonal box
.3 3.5" (8.89 cm) octagonal box
.4 Single-gang box.
.5 Double-gang box

.12 Meets Agency Standards

.1 ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
.2 CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
.3 FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
.4 UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

.6 Duct Detectors:

.1 General: comply with ULC S524. Include the following features:

.1 Factory Nameplate: serial number and type identification
.2 Operating Voltage: 24 V dc, nominal
.3 Self-Restoring: detectors do not require resetting or readjustment after actuation to restore them to normal operation
.4 Remote Controllability: individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.

.2 See smoke detector specifications and general detection devices specifications for basic detector performance characteristics.

.3 Addressable, plug-in, two-wire, multi-sensor or application specific (with the application set for DUCT) detector with both photoelectric and thermal inputs. Each detector shall consist of a dust resistant, field cleanable photo chamber, a solid state non-mechanical thermal sensor, microprocessor-based electronics with a low-profile plastic cover and base. The detector

shall utilize surface mount technology for maximum reliability. Every detector shall be shipped with a protective dust cover to protect against dust during construction.

.4 The detector shall mount in a duct detector housing, which shall be designed for detection of combustion products and/or smoke in air conditioning and ventilation system ducts. The assembly shall consist of a housing to accommodate sampling tubes that extend into and across the duct of the ventilation system. Provisions shall be made for local or remote indicator lamp and/or auxiliary relay.

.5 Provide for variations in duct air velocity between 100 and 4,000 feet per minute and include a wide sensitivity range of .79 to 2.46%/ft. Obscuration. Include one Form-C shut down relay rated 2.0 amps @ 30 Vdc and also include slave high contact relays if required. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. The addressable DUCT housing shall be suitable for extreme environments, including a temperature range of –20 to 158 degrees F (-29 to 70 degrees Celsius) and offer a harsh environment gasket option. Provide remote alarm LED indicators.

.6 Provide suitably sized sampling tube.

2.3.10 Conventional 2-wire smoke and heat detectors:

.1 Shall only be used at specific locations shown on the Contract Drawings.

.2 Smoke detection in accordance with CAN/ULC S529 requirements.

.3 Heat detection in accordance with CAN/ULC S530 requirements.

.4 Electrical
- .1 Voltage 6.5 — 33VDC
- .2 Maximum ripple (peak to peak) 10% (Vp - p)
- .3 Typical standby current (24V) 88µA
- .4 Typical alarm current (24V) up to 60 mA max, if not limited by control panel
- .5 Photoelectric Sensitivity 0.5% to 4.36%/ft
- .6 Operating temperature 32°F to 120°F (0°C to 49°C) for photo
- .7 32°F to 100°F (0°C to 38°C) for Heat & Photo/Heat
- .8 Operating humidity range 0 to 95% Non-condensing
- .9 RFI immunity 20 V/m min; 0-1000 MHz
- .10 Remote LED output current 5 mA min, 8.5 mA max
- .11 Drift compensation adjustment 1.0%/ft. max
- .12 Compatibility FX5, FX10, SIGA-UM/MAB, RZI16-2, IDC8-4

.5 Environmental
- .1 Heat Sensor Ratings
  - .1 Fixed 135°F/ Rate of rise 15°F/min., >105°F (8.3°C/min., >40.6°C), FM response - Quick

.6 Maximum wind velocity 0 to 4000 ft/min

.7 Field wiring size 12-18 AWG

.8 Reset voltage 2.5V max

.9 Reset time 1 second max

.10 UL two-wire compatibility identifier S10A

.11 Physical
.1 Color: White head and base

.12 Detector head dimensions: 4" D x 1.75" H (10 cm x 4.44 cm)

.13 Listing: UL 268 7th ed, ULC, FM, CSFM

2.3.11 Supervised valve switches:

.1 The tamper switch located within the supervisory switch shall be wired and installed as per manufacturer's recommendations such that if the valve is in the open position a trouble condition will be initiated.

2.3.12 Audible Signal Devices

.1 Horns: 24V DC, indoor horn type with compression driver, surface mounted.
.1 Corrosion, vibration and vermin resistant.
.2 Taps: multiple, adjustable with maximum tap output sound level of 100db at 3m.
.3 Frequency response: 400 to 4000Hz.

2.3.13 Weatherproof Audible Signal Devices

.1 Same electrical characteristics as Audible Signal Devices described in Paragraph 2.3.12.

.2 Weatherproof devices marked on Contract Drawings shall be provided with Corrosion, vibration and vermin resistant: NEMA 4X / IP661 UL listing (when installed in surface/flush-mount applications) - IP672 Compliant Device only (standalone)

2.3.14 Visual Alarm Signal Devices

.1 Strobe type: white flashing light, wall mount or ceiling mounted as per the Contract Drawings.
.1 Synchronized at one flash per second.
.2 Flash tube enclosure in clear LEXAN.
.3 "FIRE" installed red letters.
.4 Operating on 20-24V dc.
.5 Field adjustable for minimum 15cd unless specified otherwise. See Drawings for candela output required in different locations

2.3.15 Weatherproof Visual Alarm Signal Devices

.1 Same electrical characteristics as Visual Alarm Signal Devices described in Paragraph 2.3.14.

.2 Weatherproof devices marked on Contract Drawings shall be provided with Corrosion, vibration and vermin resistant: NEMA 4X / IP661 UL listing (when installed in surface/flush-mount applications) - IP672 Compliant Device only (standalone)

2.3.16 End-of-Line Devices

.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated in Contract Documents.

2.3.17 Annunciator Panels

.1 LED type, with designation cards to indicate zones.

.2 Display:
.1 Alarms for alarm initiating circuits.
.2 Common supervisory alarm for supervisory initiating circuits.
.3 Common system trouble.

.3 Trouble buzzer: Acknowledging trouble at main panel to silence trouble buzzers in system.

.4 Supervised, with LED test button.

.5 Minimum wiring configuration with main panel.

2.3.18 Building Diagram Graphic Panel (Passive) – at the FA Panel and Remote L.E.D. Annunciator Location

.1 Provide panel where indicated with a computer-drawing diagram on lexan plate complete with aluminium frame and plexi-glass cover.

.2 Diagram shall display each floor complete with initiating, supervisory and evacuation zones and indicate each device. Each zone be indicated by means of a distinctive colour.

.3 Panel shall be secured to wall with countersunk screws – finish to match panel.

.4 Colours shall be determined during shop drawing review (up to 10 colours).

.5 Size -17” W x 11” H.

.6 Submit shop drawings for approval by consultant prior to production.

2.3.19 Isolation Module

.1 Provide isolation modules in accordance with CAN-ULC-S524.
.1 Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an DCL-C branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the DCL segment branch.
.2 If a wire-to-wire short occurs, the isolator module shall automatically disconnect the DCL-C segment. When the short circuit condition is corrected, the isolator module shall automatically
.3 The isolation module will provide a single LED that flashes to indicate the isolation module is operating and illuminate steadily to indicate that a short circuit condition has been detected and isolated.
.4 Isolator bases shall include isolators that in a Class A configuration, the loop controller shall identify an isolated circuit condition and provide communications to all non-isolated analog devices.

.5 Isolators that are not controlled by a detector processor shall not be accepted.

.6 Following a short circuit condition, each isolator/detector shall be capable of performing an internal self-test procedure to re-establish normal operation.

.7 Isolator/detectors not capable of performing independent self-tests shall not be acceptable. The isolator base shall support all detector types and have the following minimum requirements:

.1 The isolator shall operate within a minimum of 23 msec. of a short circuit condition on the communication line.

.2 When connected in Class A configuration the Loop Controller shall identify an isolated circuit condition and provide communications to all non isolated analog devices.

2.3.20 Addressable Dry Contact Monitor Module

.1 Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel DCLs.

.2 The IDC zone shall be suitable for Class A operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

.3 For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/ 4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include an LED.

2.3.21 Addressable Relay Module

.1 Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

2.3.22 Central Alarm Monitoring

.1 Provide a Digital Voice Access Channel (DVAC) line for central monitoring unless noted otherwise on the Contract Drawings.

.1 Monitoring of the system shall consist of alarm and supervisory.

.2 Provide a demarcation point for the utility connection between the DVAC line and fire alarm panel, refer to CAN-ULC-S524 appendix E.

2.3.23 Programmed Features

.1 By-pass feature for signaling devices:

.1 Bypassing of audible devices shall be provided through the programmable keys. The use of the feature is intended for personal with programming access.

.2 Evacuation feature.

.1 Evacuation key will be programmed and accessible for any personnel working on the fire alarm panel.

2.3.24 Ancillary Devices

.1 Remote relay unit to initiate fan shutdown, door hold open devices.

2.3.25 Relay Base for Fire Detectors

.1 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.

.2 Provide power along with the relay base detector such that the device that is being controlled with the normally open or normally closed relay base may operate or function. Power requirements and relay condition to be determined on site.

2.3.26 Sounder Base for Fire Detectors

.1 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.

.2 A sounder base with a built-in (local) sounder rated at 85 DBA minimum.

.3 The system shall support an intelligent programmable sounder base. The programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.

2.4 FIRE ALARM SYSTEM INITIATED FAN SHUT-DOWN

2.4.1 Where required and scheduled on the drawings, interlock fan starters and control panels with the building fire alarm system so that upon actuation of the alarm system the fans will shut down as required. Suitable contacts shall be provided in the fan starters for fire alarm shut down or start up interlocking wiring. Connect sprinkler system alarm contacts into the fire alarm system so that a flow of water through the sprinkler system will actuate the fire alarm system. Connect the sprinkler supervisory contacts into the fire alarm system so that a trouble alarm is initiated when required. Verify interlocking of fan starters after new fire alarm control panels have been installed.

2.5 MANUFACTURERS

2.5.1 The following are acceptable manufacturers:

.1 CHUBB Edwards
.2 Simplex
.3 Notifier
.4 Mircom

3 EXECUTION

3.1 INSTALLATION

3.1.1 Installation shall be in accordance with the CAN/ULC S-524 Installation of Fire Alarm standard, local and provincial codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

3.1.2 All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

3.1.3 All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

3.1.4 Manual Pull Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed not less than 1050mm and not less that 1200mm to the top of the device, above the finished floor.

3.1.5 Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

.1 Factory trained and certified personnel.

.2 Canadian Fire Alarm Association Fire Alarm Certified personnel.

.3 Personnel licensed or certified by state or local authority.

3.1.6 The installing company shall employ qualified Fire Alarm Technicians on site to guide the final checkout and to ensure the systems integrity.

3.2 **EQUIPMENT INSTALLATION**

3.2.1 Furnish and install the devices as described herein and as shown on the plans. Include sufficient control unit(s), audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

3.2.2 Thermal Detectors: Install to ceiling mounted back boxes and in an upright position.

3.2.3 Smoke Detectors: Install ceiling-mounted detectors not less than 100 mm from a side wall to the near edge. Install detectors located on the wall at least 100 mm, but not more than 12” (300 mm), below the ceiling. On smooth ceilings, install detectors not over 9 m apart in any direction. Install detectors no closer than 1520 mm from air registers. For exposed construction do not mount on sides, or underside of beams, joist, ducts or structures projecting below actual ceiling level.

3.2.4 Smoke Detectors: Ensure that dust covers are on devices during construction.

3.2.5 Duct Detectors: Install duct detectors a minimum of 6 duct widths from an upstream bend and 2 duct widths ahead of downstream bends. Install single detectors at duct centres, 2 detectors at the ¼ points, etc. Sample tubes must be a minimum of 80% of the duct width 40% for opposite mounted pairs.

3.2.6 Duct Detectors: Install a remote alarm lamp assembly for each duct mounted detector not visible from floor level. Wall mount each lamp assembly on back box as close as possible to the detector.

3.2.7 Audible Alarm-Indicating Devices: Adjust taps on speaker line transformers to suit anticipated ambient noise level in area of each speaker and to meet AODA and code requirements.

3.2.8 Audible Alarm-Indicating Devices: Install on back boxes. Support ceiling mounted devices from structure and not from the suspended ceiling grid or tiles. In finished areas utilize flush mounted.

3.2.9 Visual Alarm-Indicating Devices: Install on back boxes.

3.2.10 Device Location-Indicating Lights: Locate in common area for easy identification.

3.2.11 Line Isolator: Install as per ULC S524.

3.2.12 End of Line Resistor (EOL): Do not install in ceilings or ceiling spaces. Locate at ceiling lines above a pull station location. Identify each EOL resistor with lamicoid nameplate indicating zone/circuit number. EOL to be located at same location on each in multiple floor building.

3.2.13 Wire and connect the following ancillary devices to appropriate panel(s).

.1 Door controller

.2 Sprinkler system flow alarm switches, pressure switches, valve position switches and post indicating valve(s), dry pipe valves.

.3 HVAC equipment controllers.

.4 Fan and damper controls.

3.2.14 Provide all necessary contacts and relays required to complete the wiring.

3.2.15 Interconnect security system to provide common “Alarm” signal to release all locked doors throughout the building upon an alarm condition. Co-ordinate with door controller manufacturer.

3.2.16 Provide mounting square electrical box 4” x 4” (102mm), 2 1/8” (54mm) minimum depth or single gang electrical box 2 ½” (64mm) minimum depth with all devices (Isolators, Individual Addressable Module (IAM), End of Line (EOL).

3.3 WIRING INSTALLATION

3.3.1 Wiring Method: Install wiring in metal surface raceway according to Section 26 05 83 “Electrical Basic Materials and Methods.”

3.3.2 Install wiring for standard alarm initiating circuits in separate raceway system from alarm signal circuits.

3.3.3 Wire alarm signal appliances in accordance with requirements by manufacturer and operation. Install end of line device for signal circuit in suitable box adjacent to last signal of signal circuit. If circuit has only one device, end-of-line- device can be mounted in device.

3.3.4 Equip raceways with separate green ground-wire and connect to ground lug at each outlet box of device and connect ground wires directly to ground bus in control panel.

3.3.5 Mount detectors on ceiling as per CAN/ULC-S524 Standard unless otherwise specified herein with minimum and maximum distances as required for respective type of detector, at highest point where variations in ceiling height exist. Do not mount detectors on sides, underside, or less than 600mm from walls, beams, joints, ducts, open web steel joists or any structure projecting below actual ceiling height and from

lighting fixtures and air exhaust handling or heating outlets, but 900mm from air supply handling or heating outlet.

3.3.6 Conductors shall be solid copper. The minimum size of conductor shall be:

.1 14 AWG for individual conductors

.2 14 AWG for integral assembly of two or more conductor cables

.3 14 AWG for control and audible signal circuits. In no case shall the voltage drop exceed 10%.

3.3.7 Class A wiring shall be used for all alarm initiating devices.

3.3.8 Should interference from obstruction, lamp positions, air outlets or heat radiating surfaces be encountered in locating any detector where indicated, locate detector as near as possible to indicated position, clear of obstacles, to satisfaction of The Owner, but maintain clear space of 600mm on ceiling, below and around.

3.3.9 Provide, install and connect wiring and interconnecting wires and cables as specified herein, as required by control panel manufacturer and as indicated on Drawings.

3.3.10 In general, no place in any room or space required to have a visual signal appliance shall be more than 50 ft (15m) from the signal (in horizontal plane). In large rooms and spaces exceeding 100 ft (30m) across, without obstructions 6 ft (2m) above finish floor, such as auditoriums, devices may be placed around the perimeter, spaced a maximum 100 ft (30m) apart, in lieu of suspending appliances from the ceiling.

3.3.11 No place in common corridors or hallways in which visual alarm signalling appliances are required shall be more than 50 ft (15m) from the signal.

3.3.12 System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of the Canadian Electrical Code.

3.3.13 Contractor shall obtain from the Fire Alarm System Manufacturer written instructions regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

3.3.14 Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

3.3.15 Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3.16 Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

3.3.17 Color Coding: Color-code fire alarm red conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and a different color code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction and pull box covers red.

3.3.18 Identify fire alarm system conduits and cables with a 25mm red mark every 6000 mm, and at access locations.

3.3.19 Alarm Loops: Do not exceed 75% of circuit capacity.

3.3.20 Signal Circuits: Do not exceed 75% of circuit capacity

3.3.21 T-tapping of Class A circuits are NOT permitted.

3.3.22 T-tapping Class B circuits are permitted.

3.3.23 Install and connect wiring as follows:

.1 In conduit independent of all other wiring.

.2 Make wiring splices only in junction boxes using pressure type terminal blocks.

.3 Wire markers for wiring.

.4 Uniformly colour code initiating, signal and ancillary wiring using a different colour of wire for each.

.5 Identify terminal blocks.

.6 Terminate each wire under a separate terminal.

.7 Do not exceed wiring unbroken from one terminal to another.

.8 Transient suppression devices: all circuits.

.9 Surge/transient protection for wiring including shields that is connected to the FACP from the exterior.

3.4 IDENTIFICATION

3.4.1 Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

3.4.2 Identify all addressable devices with a label attached to devices indicating its address.

3.4.3 Identify each horn with the panel number and circuit number. Attach identification to horn's junction box.

3.5 GROUNDING

3.5.1 Ground cable shields and equipment according to system manufacturer's instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup and other impairments.

3.5.2 Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

3.5.3 Ground equipment and conductor and cable shields. Measure, record, and report ground resistance.

3.5.4 A separate #14 AWG, RW90, grounding conductor in each conduit.

3.5.5 All wiring to be free of ground faults except those circuits that are intentionally grounded to detect ground faults.

3.5.6 Install one #6 AWG insulated grounding conductor in conduit from each control panel, nodes, and each surge/transient suppressor to building ground electrode.

3.6 PROGRAMMING

3.6.1 For addressable devices provide a unique address for each device.

3.6.2 Enter system programme into erasable, programmable read only memory.

3.6.3 Enter descriptor labels for each device.

3.7 TYPICAL OPERATION

3.7.1 Actuation of any manual station, smoke detector heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:

.1 Activate all programmed NAC circuits.

.2 Actuate all strobe units until the panel is reset.

.3 Release all door locks controlled by security panel at doors to adjacent zones on the floor from that the alarm was initiated.

.4 Duct type smoke detectors shall, in addition to the above functions shut down the ventilation system or close associated control dampers as appropriate.

.5 Activation of any sprinkler system low pressure switch or valve tamper switch shall cause a system supervisory alarm indication.

3.8 TESTING

3.8.1 Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with CAN/ULC S537.

3.8.2 Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

3.8.3 Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

3.8.4 Verify activation of all flow switches.

3.8.5 Open initiating device circuits and verify that the trouble signal actuates.

3.8.6 Open Data Communication Link and verify that the trouble signal actuates.

3.8.7 Open and short notification appliance circuits and verify that trouble signal actuates.

3.8.8 Ground initiating device circuits and verify response of trouble signals.

3.8.9 Ground Data Communication Link and verify response of trouble signals.

3.8.10 Ground notification appliance circuits and verify response of trouble signals.

3.8.11 Check presence and audibility of tone at all alarm notification devices.

3.8.12 Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.

3.8.13 Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

3.8.14 When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.9 **FIELD QUALITY CONTROL**

3.9.1 Manufacturer's Field Service: Provide services of a factory-authorized and CFAA certified service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system. Engage manufacturer’s field representative to perform verifications as specified and in accordance with CAN/ULC-S537.

3.9.2 During period of pretesting, testing, adjustment of system and verification, Contractor must make available qualified electricians.

3.9.3 Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Provide the service of a competent person to supervise CAN/ULC S1001 testing as required by CAN/ULC S1001. The person supervising CAN/ULC S1001 testing shall be ULC-cerfified as an Integrated Testing Service Provider in accordance with ULC requirements. All testing for the fire alarm system and fire alarm functions for all building systems connected to the fire alarm system shall be in accordance with CAN/ULC S537 and CAN/ULC S1001. Provide all of the services required from relevant sub-trades for this testing, verification and the reports.

3.9.4 Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

3.9.5 Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

3.9.6 Final Verification Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance verification.

3.9.7 Minimum System Verification: Verify the system according to the procedures outlined in ULC S537.

3.9.8 Verify the absence of unwanted voltages between circuit conductors and ground.

3.9.9 Test all conductors for short circuits using an insulation-testing device.

3.9.10 With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.

3.9.11 Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.

3.9.12 Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened for not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.

3.9.13 Test each initiating and indicating device for alarm operation and proper response at the control unit.

3.9.14 Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, and quality, freedom from noise and distortion, and proper volume level.

3.9.15 Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

3.9.16 Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.9.17 Report of Tests, Verification and Inspections: Provide a written record of inspections, tests, verification and detailed verification results in the form of a verification log. Submit log upon the satisfactory completion of tests and verification.

3.9.18 Note: Open flame is not to be used for testing.

3.9.19 Arrange for personnel of Authorities Having Jurisdiction to be present for the verification of the system.

3.9.20 Contractor shall be responsible to ensure that the governing parties have accepted a complete functional fire alarm system.

3.9.21 On completion of testing, submit a report to (Owner) (and) (Consultant) detailing testing and verification performed on system including, but not limited to, the following information:

.1 Full name and address of facility at which system is installed.

.2 Full name and address of organization or company performing testing.

.3 Full name and address of contractor or subcontractor who installed system.

.4 Date of report.

.5 A statement and certification of verification confirming that fire alarm and voice communication system was left in a completely operable condition and that system was installed and operates in complete accordance with contract documents.

.6 A complete list of equipment installed.

.7 Results of tests.

.8 Serial numbers, location, zone and type of each detector.

.9 Sensitivity settings for each detector, as measured or set, with ventilation system in operation.

.10 A list of faults found, if any, and corrective action taken for each.

.11 The testing technician's full name and signature.

.12 Contractor shall provide a dB test report to the Owner and Consultant for consideration after the system is installed and two (2) weeks prior to the fire inspection.

.13 Proof of liability insurance for the pretesting, testing and verification.

3.9.22 The fire alarm system shall be tested and verified in accordance with the latest revisions of CAN/ULC-S536 (Standard for Inspection and Testing of Fire Alarm Systems) and CAN/ULC-S537 (Standard for the Verification of Fire Alarm Systems).

3.9.23 Perform any changes necessary as a result of the above items in accordance with the system manufacturer’s direction.

3.9.24 Fire alarm manufacturer to supply to electrical contractor reasonable amounts of technical assistance with respect to any changes necessary to execute work required by this section. During period of inspection by manufacturer, electrical contractor shall make available, to manufacturer, electricians as designated by manufacturer.

3.9.25 Inspect and check each individual device in entire system for proper connection, supervision and function in accordance with CAN/ULC-S536, CAN/ULC-S537 and CAN/ULC-S1001. Identify detectors, and signal appliances not installed within requirements of CAN/ULC-S524, in remarks column of verification report and bring to The Owner’s attention prior to their acceptance test.

3.9.26 Any software changes done, subsequent to verification of any portion of the system, shall require;

.1 Verification via “software utility” that no other portions of the software were affected. A printout of this report is to be incorporated as part of the verification documents. Or

.2 Re-verification of all system components verified at the time of the change.

3.9.27 Arrange for testing and verification by fire alarm system manufacturer or its representative firm and pay all fees and charges for the service. Obtain verification certificate and verification report showing each device checked, and that work has been carried out. Use verification forms similar to Canadian Fire Alarm Association (C.F.A.A.) forms.

3.9.28 Verify fire alarm system in accordance with the requirements of CAN/ULC-S537.

3.9.29 Verify only when entire system is fully operational and no subsequent work will be performed on system.

3.9.30 If such subsequent work is required, entire verification must be repeated.

3.9.31 Issue certificate of verification only after completion of deficiencies noted during verification have been corrected and re-verified.

3.9.32 On completion of the verification testing, obtain from the system manufacturer and forward to the Owner and Consultant a verification certificate complete with a detailed verification report listing each and every system component, its location in the building and its acceptability. It is intended that the third party verification shall complete its duties concurrently with the Vendor verification team. Include all fire alarm verification certificates in the Owner's manuals, binders and digital copies.

3.9.33 Ensure that all costs for the above testing, verification and certification are included in the bid price.

3.10 FINAL COMMISSIONING

3.10.1 After completion of work, make arrangements with the Owner, manufacturer of control equipment and other installers of related and connected equipment to conduct final functional acceptance test.

3.10.2 Tests:

.1 Spot check of devices to ensure proper connections and supervision.

.2 Operation of alarm initiating device on each detection circuit to verify required operation of alarm devices, annunciator and other installations.

.3 Testing of signal devices for correct operation and function.

3.11 INSTRUCTION

3.11.1 Provide instruction as required for operating the system. Hands on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

3.11.2 Instruct and demonstrate operation of manual pull station covers and that the covers themselves do not activate the fire alarm system alarm condition.

3.11.3 The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

3.11.4 Provide in the operations and maintenance manuals sequences of operation, maintenance instructions, the final set of shop drawings, device list, as-built wiring diagrams and plans showing the as-built wiring run configurations.

3.12 CLEANING AND ADJUSTING

3.12.1 Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

3.12.2 Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls

and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.13 **FINAL INSPECTION**

3.13.1 At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

Contractor to coordinate for the inspection and provide the consultant and Client with a copy of final inspection report.

3.14 **ON-SITE ASSISTANCE**

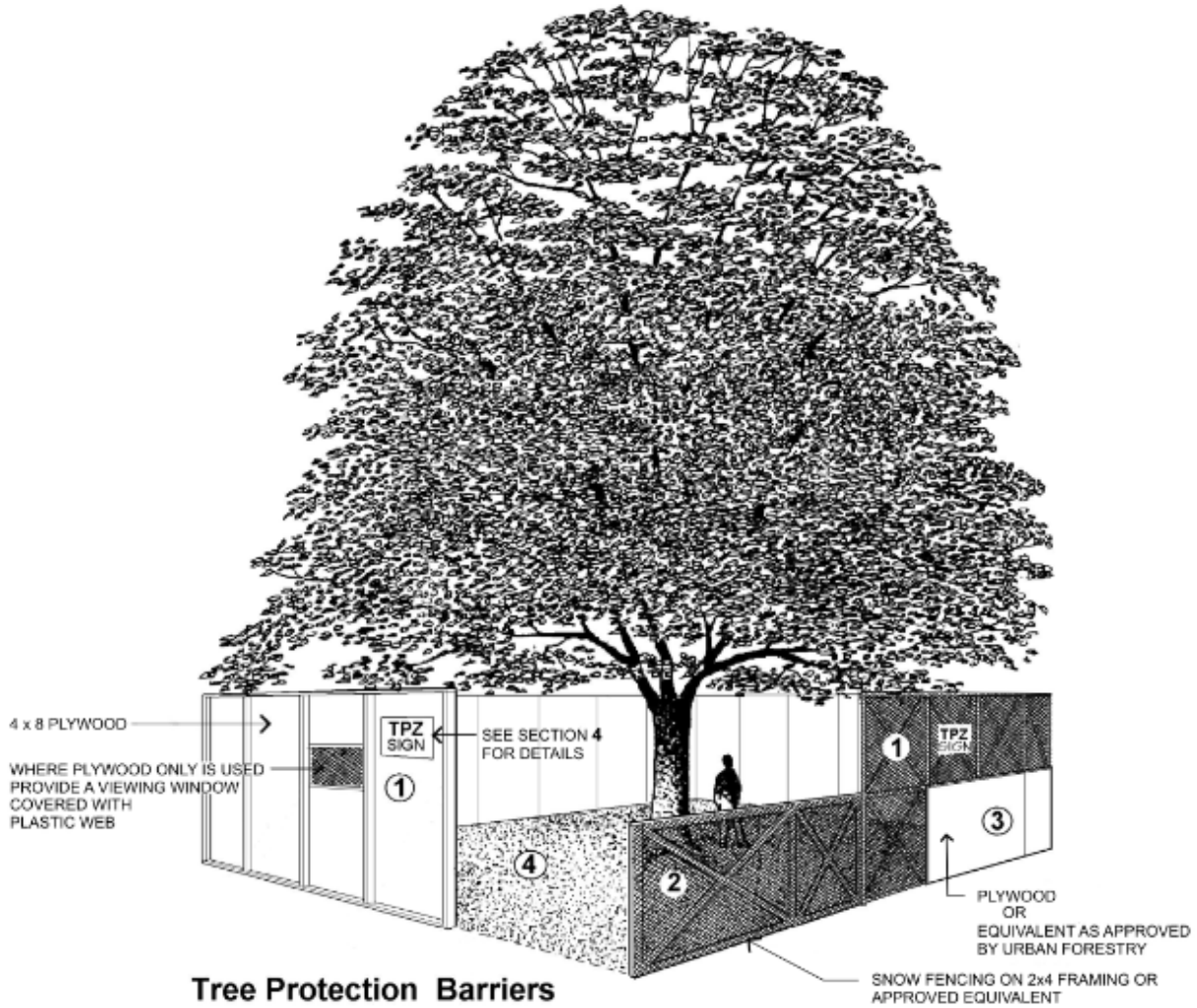
3.14.1 Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to 3 requested adjustment visits to the site for this purpose.

END OF SECTION

APPENDIX A

Parks, Forestry & Recreation
Urban Forestry

Tree Protection Policy
and
Specifications for Construction Near Trees



Tree Protection Barriers

July 2016

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1. Introduction

Maintenance, growth and enhancement of the urban forest are important goals of the City of Toronto. Preserving and protecting healthy trees can help the City to achieve these goals. Considering tree protection in the initial stages of construction planning may mean the difference between preserving a healthy tree and having to remove it. Plans created with tree protection in mind help protect the city's urban forest.

The tree protection policy and specifications outlined below reflect the policy of Toronto City Council. Anyone failing to adhere to the tree protection policy and specifications will be financially responsible for any resulting damage to trees and may be charged under the provisions of the applicable City of Toronto tree by-law or subject to orders to comply.

Prior to commencing with any demolition or construction activity it is important that an arborist[1] determines the location, species, size and condition of trees on the property and surrounding properties and becomes familiar with the tree protection by-laws that could impact the proposal.

The following by-laws protect trees in the City of Toronto:

- **Street Tree By-law**, City of Toronto Municipal Code Chapter 813, Article II, protects all trees situated on City streets.
- **Private Tree By-law**, Article III, Chapter 813 of the City of Toronto Municipal Code protects trees on private property with diameter of 30cm or more and trees of any diameter that were planted as a condition of a permit issued under this bylaw or a site plan agreement.
- The **Ravine & Natural Feature Protection By-law**, Chapter 658 of the City of Toronto Municipal Code prohibits and regulates the injury and destruction of trees, as well as filling, grading and dumping within designated areas of the City. There is no minimum diameter for a tree to qualify for protection under the Ravine and Natural Feature Protection By-law. Trees of any size located in the designated areas qualify for protection.
- The **Parks By-law**, Municipal Code Chapter 608, Article VII protects all trees located in a City park.

All above noted by-laws are implemented by Urban Forestry under the authority of the General Manager, Parks, Forestry and Recreation. City of Toronto's tree protection by-laws can be found at www.toronto.ca/trees.

Types of Tree Damage

Physical injury to the trunk, crown and roots of a tree will occur if construction equipment is permitted close to trees or if structures are built into the growing space of a tree. Inappropriate pruning may also result in tree injury. Physical injuries are permanent and can be fatal.

[1] Arborist – An expert in the care and maintenance of trees including an arborist qualified by the Ontario Training and Adjustment Board Apprenticeship and Client Services Branch, a certified arborist qualified by the International Society of Arboriculture, a consulting arborist registered with the American Society of Consulting Arborists, a registered professional forester or a person with other similar qualifications as approved by the General Manager, Parks, Forestry and Recreation.

Root cutting is another type of physical injury that can significantly impact the health of a tree. The majority of tree roots are found in the upper 30 to 60 cm of soil. Excavation for foundations or utility installation may cut roots if the excavation is too close to trees. Trees can become destabilized and may fall over if anchor roots are severed.

Compaction of the soil in the tree root zone is one of the leading causes of tree decline in Toronto's urban forest. Soil compaction occurs primarily from vehicles and equipment moving across the root zones. Piling or storing materials or debris on top of the root system can also result in soil compaction. Soil compaction causes the pore spaces in the soil, which contains air and water necessary for root growth, to be reduced. Without space available for oxygen and water, tree roots will suffocate and tree decline will follow. With rutting, a form of intense compaction, roots are severed by the tires of equipment. Root destruction can also be caused by changes to the existing grade. Adding soil on top of tree roots can smother them by reducing the amount of oxygen and water they can receive. Only a few centimetres of added soil can have a detrimental impact on tree health.

The structural elements of a tree in an optimal growing environment are shown on Figure 1. This figure illustrates the terms used in this policy.

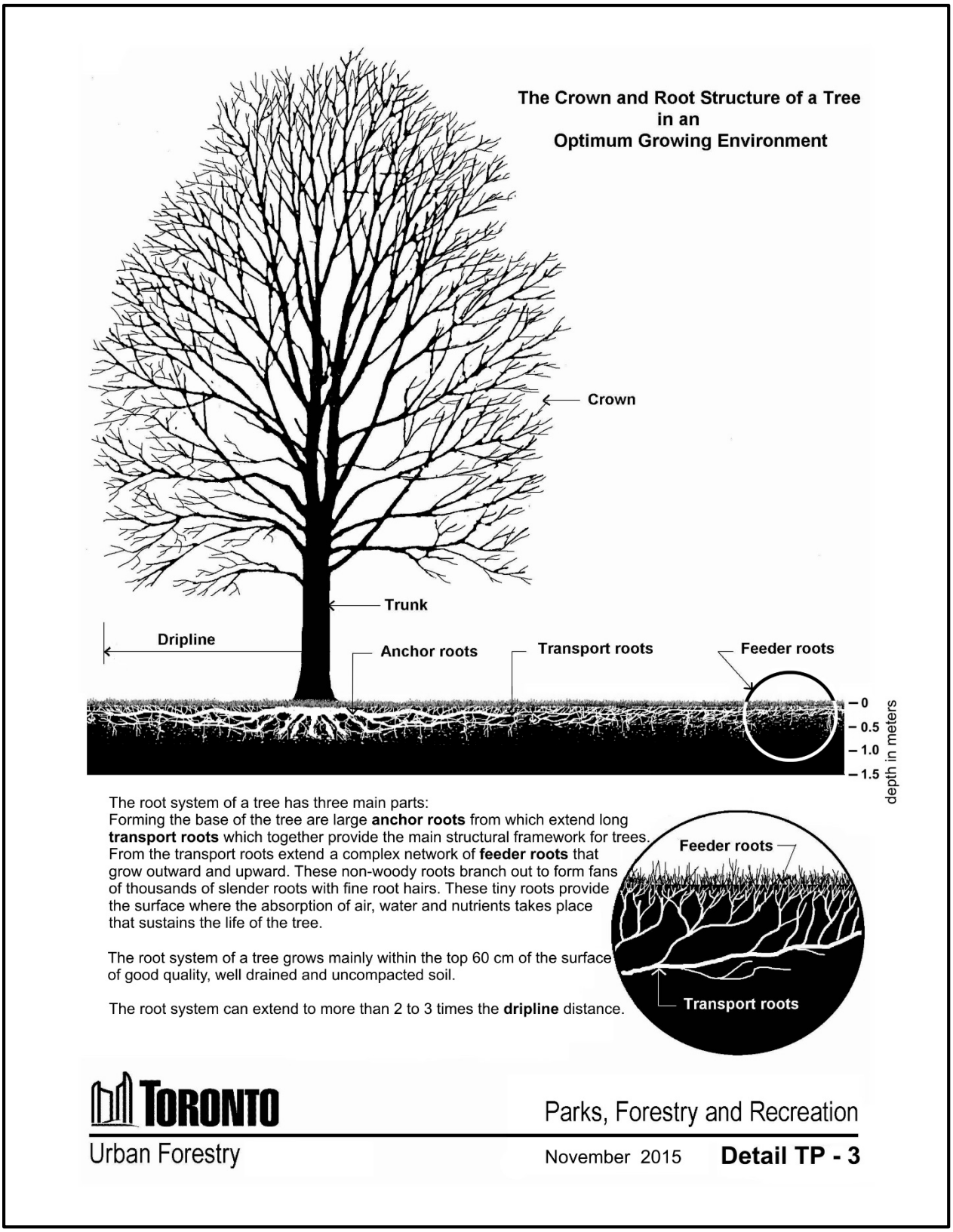

Figure 1: Urban Forestry Detail TP-3

2. Protecting Trees

There are a number of steps that can be taken to protect trees prior to, during and after any construction project. Hiring an arborist should be the first step. An arborist can advise on current tree maintenance requirements and determine the impact the proposal will have on trees and the surrounding natural environment.

An inventory of trees on subject and adjacent properties that may be impacted by the proposed work should be prepared in accordance with the City tree by-laws so that the project can be designed with tree protection in mind. A tree protection plan prepared by an arborist will identify the location, species, size and condition of all trees within the area of consideration, identify the extent of injury where applicable and outline proposed tree protection measures for the trees identified for protection.

The **area of consideration** for trees protected under the Private Tree By-law (Municipal Code, Chapter 813, Article III) includes the entire area of site disturbance, including construction related traffic and material storage, and extends 6m beyond the limit of site disturbance. For trees protected under Ravine and Natural Feature Protection By-law (Municipal Code, Chapter 658), the area of consideration includes the area of site disturbance and 12m area beyond.

The following chart provides the required distances for determining a **minimum tree protection zone** (TPZ) for trees located on a City street, in parks and on private property subject to Private Tree By-law and for trees located in areas regulated under the Ravine and Natural Feature Protection By-law. The minimum tree protection zones are based on the diameter of the tree. While these guidelines provide minimum protection distances for the anchor and transport roots of a tree, there can still be significant loss of the feeder roots beyond the established tree protection zone. Feeder roots are responsible for water and nutrient absorption and gas exchange. **For this reason, Urban Forestry may require a TPZ larger than the minimum, depending on the tree and the surrounding environment.**

Trunk Diameter (DBH)[1]	Minimum Protection Distances Required[2] City-owned and Private Trees	Minimum Protection Distances Required Trees in Areas Protected by the Ravine and Natural Feature Protection By-law
		Whichever of the two is greater:
<10cm	1.2 m	The drip line[4] or 1.2 m
10- 29 cm	1.8 m	The drip line or 3.6 m
30[3] – 40 cm	2.4 m	The drip line or 4.8 m
41 – 50 cm	3.0 m	The drip line or 6.0 m
51 – 60 cm	3.6 m	The drip line or 7.2 m
61 – 70cm	4.2 m	The drip line or 8.4 m
71 – 80cm	4.8 m	The drip line or 9.6 m
81 – 90 cm	5.4 m	The drip line or 10.8 m
91 – 100 cm	6.0 m	The drip line or 12.0 m
>100 cm	6 cm protection for each 1 cm diameter	12cm protection for each 1 cm diameter or the drip line[5]

Table 1: Minimum Tree Protection Zone (TPZ) Determination

[1]Diameter at breast height (DBH) measurement of tree stem taken at 1.4 metres (m) above the ground.
[2]MinimumTree Protection Zone distances are to be measured from the outside edge of the tree base.
[3]Diameter (**30** cm) at which trees qualify for protection under the Private Tree By-law.
[4]The drip line is defined as the area beneath the outer most branch tips of a tree.
[5]Converted from ISA Arborists' Certification Study Guide, general guideline for tree protection barriers of 1 foot of diameter from the stem for each inch of stem diameter.

The diagram below shows how the TPZ is determined:

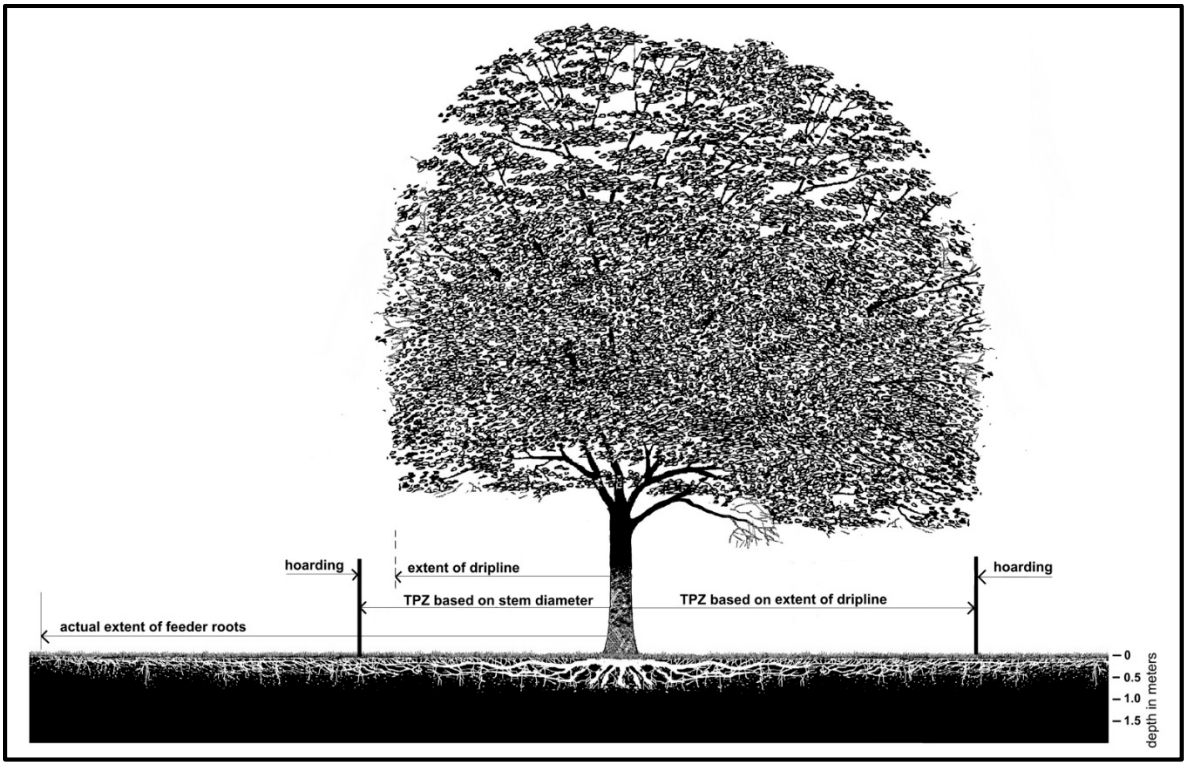

Figure 2: Minimum Tree Protection Zone (TPZ) Determination

In some cases, disturbances in the TPZ may be unavoidable, in which case, the TPZ must be adjusted in consultation with the arborist and Urban Forestry. In these situations, it may be necessary to implement other tree protection measures such as horizontal root protection as noted in section 3 of this document.

In addition to establishing and creating tree protection zones, it may be necessary to implement other protective measures, such as adding mulch to the root zone, aeration of the soil, pruning for deadwood or removing limbs that may be impacted by construction activity. This is also the time to determine the location where new trees can be planted to compliment the construction project and help with the renewal and growth of the urban forest.

Prior to commencing with any excavation, roots approved for pruning by Urban Forestry must first be exposed using pneumatic (air) excavation, by hand digging or by using a low pressure hydraulic (water) excavation. This **exploratory excavation** must be undertaken by an experienced operator under the supervision of a qualified and experienced arborist. The water pressure for hydraulic excavation must be low enough that root bark is not damaged or

removed. This will allow a proper pruning cut and minimize tearing of the roots. The arborist retained to carry out root pruning must contact Urban Forestry no less than three (3) working days prior to conducting any specified work.

Exploratory excavation may also be required for open face cuts outside the minimum tree protection zone (TPZ).

Communication between owners and their designated agents, arborists, contractors and sub-contractors throughout the construction process is critical to ensure that everyone involved is aware of the issues surrounding tree protection, and fully understands the tree protection methodology. Construction damage to trees is often irreversible.

Prohibited Activities Within a TPZ

Except where authorized by Urban Forestry, any activity which could result in injury or destruction of a protected tree or natural feature, or alteration of grade within a Ravine and Natural Feature Protection (RNFP) area, is prohibited within a TPZ, including, but not limited to, any of the following examples:

- demolition, construction, replacement or alteration of permanent or temporary buildings or structures, parking pads, driveways, sidewalks, walkways, paths, trails, dog runs, pools, retaining walls, patios, decks, terraces, sheds or raised gardens
- installation of large stones or boulders
- altering grade by adding or removing soil or fill, excavating, trenching, topsoil or fill scraping, compacting soil or fill, dumping or disturbance of any kind
- storage of construction materials, equipment, wood, branches, leaves, soil or fill, construction waste or debris of any sort
- application, discharge or disposal of any substance or chemical that may adversely affect the health of a tree e.g. concrete sluice, gas, oil, paint, pool water or backwash water from a swimming pool
- causing or allowing water or discharge, to flow over slopes or through natural areas
- access, parking or movement of vehicles, equipment or pedestrians
- cutting, breaking, tearing, crushing, exposing or stripping tree's roots, trunk and branches.
- nailing or stapling into a tree, including attachment of fences, electrical wires or signs
- stringing of cables or installing lights on trees
- soil remediation, removal of contaminated fill
- excavating for directional or micro-tunnelling and boring entering shafts

The above mentioned prohibitions are for area(s) designated as a TPZ. If possible, these prohibitions should also be implemented outside the TPZ in areas where tree roots are located. The roots of a tree can extend from the trunk to approximately 2-3 times the distance of the dripline.

3. Tree and Site Protection Measures

The following are examples of specific tree and site protection measures that may be required by Urban Forestry:

- Plywood tree protection hoarding (minimum 19mm or ¾"), or equivalent barriers, as approved by Urban Forestry, shall be installed in locations as detailed in an Urban Forestry approved Tree Protection Plan. Tree protection barriers must be made of 2.4m (8ft) high plywood hoarding or equivalent as approved by Urban Forestry. Height of hoarding may be less than 2.4m (8ft), to accommodate tree branches that may be lower, or as approved by Urban Forestry. Within a City road allowance where visibility is a consideration, 1.2m (4ft) high orange plastic web snow fencing on a 38 x 89mm (2"x 4") frame should be used. The detail on tree protection barrier construction is shown on Figure 4 in section 7 of this document
- In specific situations where the required full minimum tree protection zone (TPZ) cannot be provided, a **horizontal** (on grade) **root protection**, designed by a qualified professional such as arborist or landscape architect, may be considered, subject to approval by Urban Forestry. Urban Forestry's objective is zero soil compaction within the tree protection zone, therefore best efforts must be made to achieve this objective using materials and best practices available that minimize the vertical loading and spread the loading horizontally.
- Any area designated for stockpiling of excavated soil must be outside of TPZs and be enclosed with sediment control fencing. Sediment control fencing shall be installed in the locations as indicated in an Urban Forestry approved Tree Protection Plan. The sediment control fencing must be installed to Ontario Provincial Standards (OPSD-219.130 – see Section 7, Figure 5) and to the satisfaction of Urban Forestry. When feasible, the sediment control fencing can be attached to the tree protection barrier as shown in Figure 6. Sediment control fencing near trees shall be constructed as per detail shown on Figure 6 of this document

4. Tree Protection Signage

Figure 3: Tree Protection Sign

A sign that is similar to the illustration above may be required to be mounted on all sides of a tree protection barrier for trees protected by the Street Tree By-law and the Private Tree By-law. The sign should be a minimum of 40cm x 60cm and made of white corrugated plastic board or equivalent material. The sign may also be acquired from Urban Forestry Tree Protection and Plan Review (TPPR) district service counters.

5. Tree Protection Plan

All construction related applications must include a Tree Protection Plan that shows details of tree protection, prepared in conjunction with an arborist report or in consultation with an arborist, when protected trees are in proximity to the proposed work. All Tree Protection Plans must be legible, prepared at a usable metric scale and include the following information:

- Show all existing buildings, structures, hard surfaces and all existing trees within the area of consideration (as defined in Section 2 of this document). Depending on the extent of site disturbance, trees on neighbouring properties may need to be included. Note that area of disturbance must include all areas that will be disturbed by the proposed work, including the areas required for over-dig, stockpiling, construction traffic, vehicular access and construction staging
- The extent of the crown (drip line) or the extent of minimum tree protection zone TPZ (whichever is greater) of each existing tree
- Proposed changes on site, including all proposed structures, services, hard surfaces and grade changes
- Indicate vehicular access and construction staging areas. Areas proposed for temporary stockpiling of fill or excavated material shall be fenced with sediment control to prevent sediment runoff
- Indicate location of any excavation that requires root pruning
- Indicate trees proposed to be removed and/or injured
- Highlight and label tree protection barriers and the proposed tree protection zones. (See Table 1 to determine size of tree protection zone. Distances are to be measured from base of tree)
- The extent of proposed tree injury, where applicable.
- Include a comprehensive legend

See Section 6, Tree Protection Plan Notes, and Section 7, Tree Protection Plan Details, for further information.

6. Tree Protection Plan Notes

The following notes are to be included on tree protection plans submitted for construction related applications:

General Notes

- It is the applicants' responsibility to discuss potential impacts to trees located near or wholly on adjacent properties or on shared boundary lines with their neighbours. Should such trees be injured to the point of instability or death the applicant may be held

responsible through civil action. The applicant would also be required to replace such trees to the satisfaction of Urban Forestry

- Tree protection barriers shall be installed to standards as detailed in this document and to the satisfaction of Urban Forestry
- Tree protection barriers must be installed using plywood clad hoarding (minimum 19mm or ¾" thick) or an equivalent approved by Urban Forestry
- Where required, signs as specified in Section 4, Tree Protection Signage must be attached to all sides of the barrier
- Prior to the commencement of any site activity such as site alteration, demolition or construction, the tree protection measures specified on this plan must be installed to the satisfaction of Urban Forestry
- Once all tree/site protection measures have been installed, Urban Forestry staff must be contacted to arrange for an inspection of the site and approval of the tree/site protection requirements. Photographs that clearly show the installed tree/site protection shall be provided for Urban Forestry review
- Where changes to the location of the approved TPZ or sediment control or where temporary access to the TPZ is proposed, Urban Forestry must be contacted to obtain approval prior to alteration
- Tree protection barriers must remain in place and in good condition during demolition, construction and/or site disturbance, including landscaping, and must not be altered, moved or removed until authorized by Urban Forestry
- No construction activities including grade changes, surface treatments or excavation of any kind are permitted within the area identified on the Tree Protection Plan or Site Plan as a minimum tree protection zone (TPZ). No root cutting is permitted. No storage of materials or fill is permitted within the TPZ. No movement or storage of vehicles or equipment is permitted within the TPZ. The area(s) identified as a TPZ must be protected and remain undisturbed at all times
- All additional tree protection or preservation requirements, above and beyond the installation of tree protection barriers, must be undertaken or implemented as detailed in the Urban Forestry approved arborist report and/or the approved tree protection plan and to the satisfaction of Urban Forestry
- If the minimum tree protection zone (TPZ) must be reduced to facilitate construction access, the tree protection barriers must be maintained at a lesser distance and the exposed portion of TPZ must be protected using a horizontal root protection method approved by Urban Forestry
- Any roots or branches indicated on this plan which require pruning, as approved by Urban Forestry, must be pruned by an arborist. All pruning of tree roots and branches must be in accordance with good arboricultural practice. Roots that have received approval from Urban Forestry to be pruned must first be exposed using pneumatic (air) excavation, by hand digging or by a using low pressure hydraulic (water) excavation. The water pressure for hydraulic excavation must be low enough that root bark is not damaged or removed. This will allow a proper pruning cut and minimize tearing of the roots. The arborist retained to carry out crown or root pruning must contact Urban Forestry no less than three working days prior to conducting any specified work
- The applicant/owner shall protect all by-law regulated trees in the area of consideration that have not been approved for removal throughout development works to the satisfaction of Urban Forestry

- Convictions of offences respecting the regulations in the Street Tree By-law and Private Tree By-law are subject to fines. A person convicted of an offence under these by-laws is liable to a minimum fine of $500 and a maximum fine of $100,000 per tree, and /or a Special Fine of $100,000. The landowner may be ordered by the City to stop the contravening activity or ordered to undertake work to correct the contravention
- Prior to site disturbance the owner must confirm that no migratory birds are making use of the site for nesting. The owner must ensure that the works are in conformance with the Migratory Bird Convention Act and that no migratory bird nests will be impacted by the proposed work

The following additional notes shall be added on plans for properties regulated by the Ravine and Natural Feature Protection Bylaw:

- Ravine and Natural Feature Protection By-law (RNFP) note:

Ravine & Natural Feature Protection By-law

The Ravine & Natural Feature Protection By-law, Chapter 658 of the City of Toronto Municipal Code, regulates the injury and destruction of trees, dumping of refuse and changes to grade within protected areas.
Under this by-law protected trees may not be removed, injured or destroyed, and protected grades may not be altered, without written authorisation from Urban Forestry Ravine & Natural Feature Protection, on behalf of the General Manager of Parks, Forestry & Recreation.
Convictions of offences respecting the regulations in the Ravine and Natural Feature Protection By-law are subject to fines, and the landowner may be ordered by the court to restore the area to the satisfaction of the City. A person convicted of an offence under this Bylaw is liable to a minimum fine of $500 and a maximum fine of $100,000 for each tree destroyed, a maximum fine of $100,000 for any other offence committed under this chapter, and /or a Special Fine of $100,000. A person convicted of a continuing offence, including failure to comply with ravine permit conditions is liable to a maximum fine of not more than $10,000 for each day or a part of a day that the offence continues.

- The exact location of the limit of the RNFP area must be shown on all pertinent plans including Tree Protection Plan. The applicant/owner shall have this limit marked on their survey or other plans drawn to a suitable scale. This service costs $72.37 plus tax and can be requested by contacting the City of Toronto, Information and Technology, Geospatial Competency Centre, Map Service Counter at 416-392-2506 or mapsales@toronto.ca. This line may then be transferred onto other plans to be submitted.
- Sediment control fencing shall be installed in the locations as indicated in the Urban Forestry approved sediment control plan. The sediment control fencing must be installed to Ontario Provincial Standards (OPSD-219.130, see Section 7, Figure 5) and to the satisfaction of Urban Forestry. Sediment control near trees and over root zones shall be installed as shown on Figure 6 of this document and to the satisfaction of Urban Forestry.

7. Tree Protection Plan Details

The following diagrams provide details for tree protection barriers and sediment protection barriers:

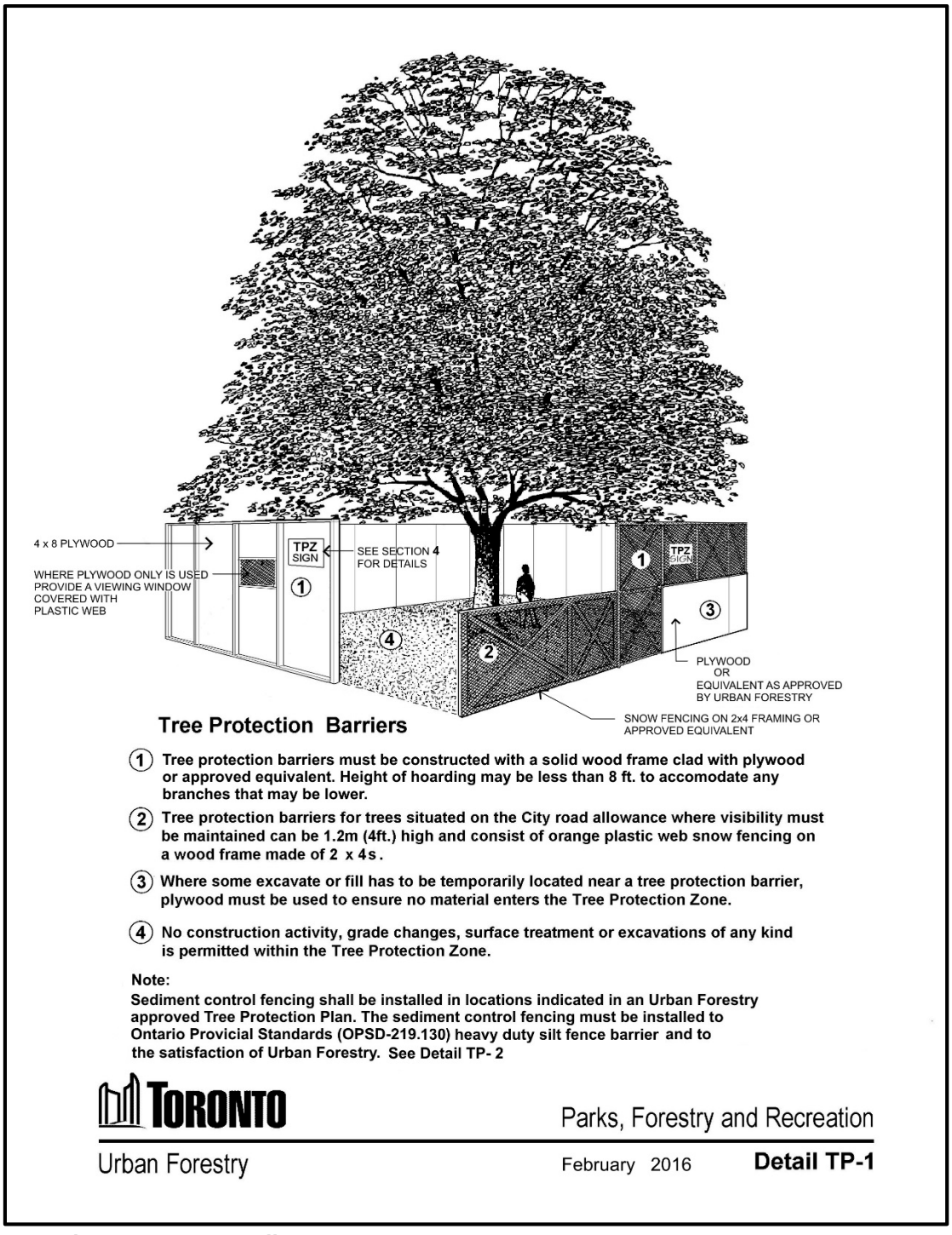

Figure 4: Urban Forestry Detail TP-1

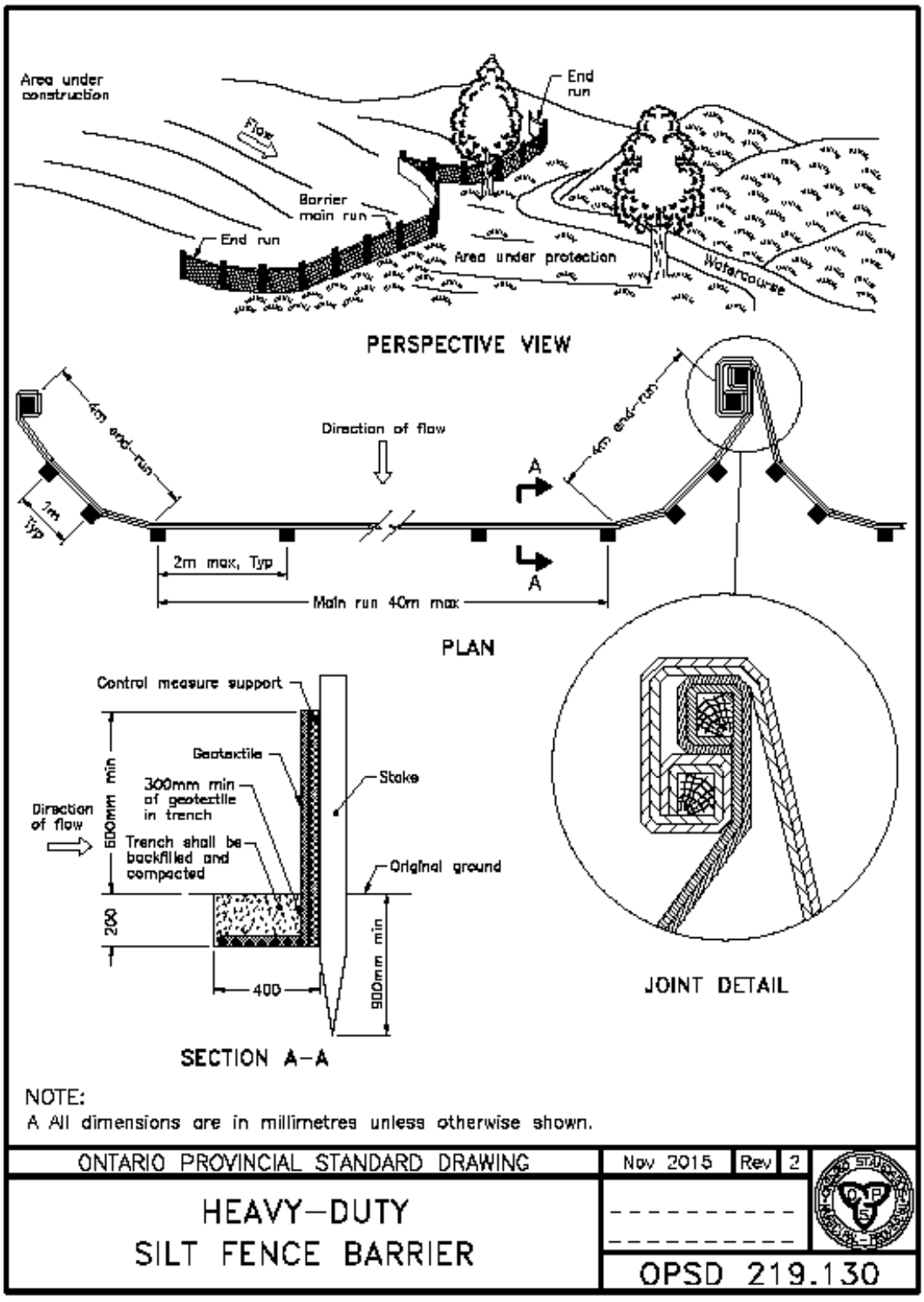

Figure 5: OPSD Detail for Heavy Duty Silt Fence Barrier

The following detail shall be used when constructing sediment protection fencing near trees.

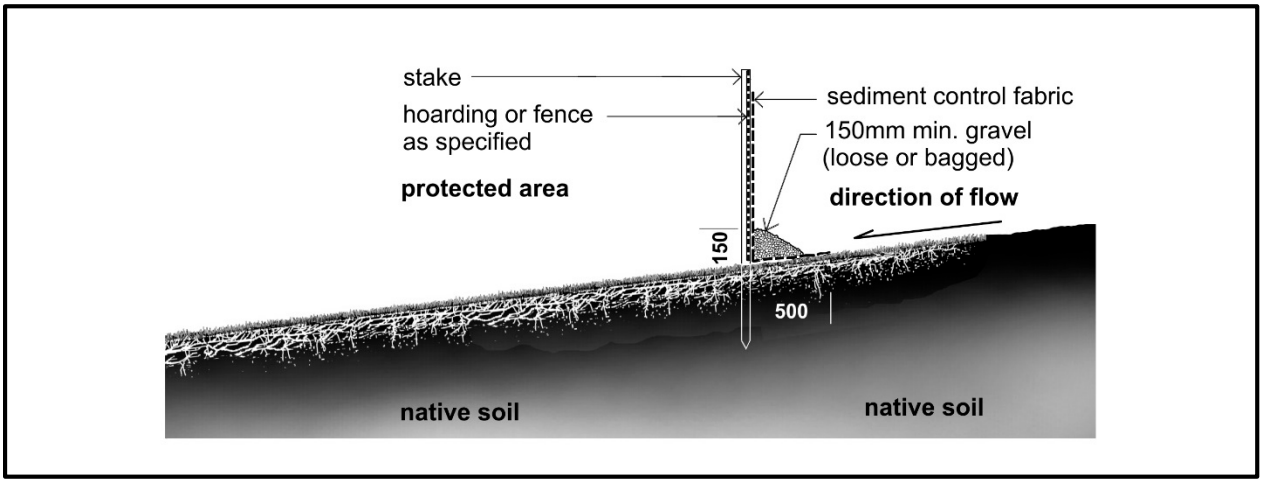

Figure 6: Sediment control barriers for use over tree root zone

8. Permits for Tree Removal or Injury

If the full minimum tree protection zone (TPZ) as identified in Section 2 cannot be provided, a permit to injure the tree must be obtained.

Any requests for removal or injury of a tree protected by City by-laws must be made on the appropriate application forms and submitted to Urban Forestry at the appropriate address. Permit application forms are available at www.toronto.ca/trees. Any requests for tree relocation will be considered as a tree injury.

If approval is granted for removal of a City-owned tree, applicants will assume all costs involved, which include appraised tree value, removal, and tree replacement costs. If approval is granted for removal of private trees or trees in ravine and natural feature protected areas, the permit will be subject to conditions, including tree replacement. If approval is granted for injury of City-owned, private trees or trees in ravine and natural feature protected areas, the permit will be subject to conditions, including implementation of a Tree Protection Plan, as determined by Urban Forestry.

In some instances, where the tree is healthy and the management of the tree or forest cover has not been addressed to the satisfaction of Urban Forestry, requests received by Urban Forestry may be forwarded to a Community Council and City Council for approval.

Urban Forestry does not have the authority to issue a permit to injure or remove a heritage tree[2]. Such requests would be forwarded to a Community Council and/or City Council for approval.

Butternut (*Juglans cinerea, L.*) is an endangered species. Butternuts and their habitat are protected under Endangered Species Act (S.O. 2007, c.6) available on the Government of Ontario website at http://www.ontario.ca/laws/statute/07e06/v1. A permit to injure or remove a butternut tree must be obtained from the Ministry of Natural Resources and Forestry Ontario.

[2] Heritage Tree – A tree that has been designated under Part IV of the Ontario Heritage Act or trees recognized as heritage trees by the Ontario Heritage Tree Program of Trees Ontario.

Any person who contravenes any provision of the City's tree protection by-law is guilty of an offence.

More information on tree protection and permit application forms for tree removal and injury are available on Urban Forestry web page at www.toronto.ca/trees.

For additional information regarding the removal or injury of trees protected under City by-laws, please call 311.

9. Tree Guarantee Deposits

Tree Protection Guarantee

Urban Forestry may request a **tree protection guarantee** to secure the protection of trees that may be impacted by work on city streets, or to secure the satisfaction of all conditions of permit issuance. Tree protection guarantees held by the City shall only be released by the City provided that all construction activities are complete, compliance with all permit terms and conditions has been verified, there has been no encroachment into the minimum tree protection zone (TPZ) and the trees are healthy and in a state of vigorous growth.

Where Urban Forestry has confirmed an unauthorized encroachment into the TPZ or the terms and conditions of a permit have not been complied with, Urban Forestry will retain the guarantee until satisfactory compliance.

It is the applicant's responsibility to submit a written request to Urban Forestry for the refund of the tree protection guarantee deposit as soon as construction and landscaping is completed.

Tree Planting Security

Urban Forestry may request a **tree planting security deposit** in an amount equal to the cost of planting and maintenance for two (2) years in order to ensure compliance with approved landscape or replanting plans. The security deposit may be held by the City after the planting of the trees for a period of two (2) years and shall be released by the City provided that the trees have been maintained, are healthy and in a state of vigorous growth upon inspection, two (2) years after planting. It is the applicant's responsibility to advise Urban Forestry that trees have been planted in accordance with approved plans, in order that the two (2) year maintenance period begin.

Prior to release by the City, any dead/dying trees must be replaced, deadwood and sucker growth should be pruned, and mulch should be topped up where necessary. If stakes and ties were used, they must be removed within one (1) year. Any encroachments are to be removed prior to assumption, including walkways, timbers or bricks that result in increased height of soil or mulch around the trees, and lights in trees.

It is the applicant's responsibility to submit a written request to Urban Forestry for the refund of a Tree Guarantee Deposit, two (2) years after the completion of all construction activity and/or two (2) years after tree planting. This request should be made during the growing season, not while

the trees are dormant, so that a site inspection can be arranged to confirm the trees are acceptable. The City will not release security deposits where trees are not in good condition, or if there are encroachments.

Financial securities must be in the form of a certified cheque, letter of credit or an alternative acceptable to Urban Forestry, with amounts payable to the Treasurer, City of Toronto.

10. Emergency Repairs to Utilities

The utility company is responsible for notifying Urban Forestry by calling 311 as soon as possible when by-law regulated trees are involved, so that an inspector can be dispatched. Urban Forestry staff may be contacted after hours by calling 311, and requesting the assistance of an on-call Urban Forestry inspector.

11. Tree Species that are Intolerant of Construction Disturbance

The following tree species are intolerant of construction disturbance, and tree protection plans must take this into account. The tree protection zones required by these species may need to be quite extensive to avoid damage to the roots and crown associated with compaction, excavation or construction above grade that will impact the branches.

Acer rubrum (red maple)
Acer saccharum (sugar maple)
Betula papyrifera (paper birch)
Carya glabra (pignut hickory)
Fagus grandifolia (American beech)
Liriodendron tulipifera (tulip tree)
Ostrya virginiana (ironwood)
Pinus resinosa (red pine)
Pinus strobus (white pine)
Prunus serotina (black cherry)
Quercus alba (white oak)
Quercus velutina (black oak)
Tsuga canadensis (eastern hemlock)
Tilia americana (basswood)

12. Contact Information

Tree Protection and Plan Review (City-owned and Private Trees)

North York District
5100 Yonge Street, 3rd Floor
Toronto, ON, M2N 5V7
Telephone: 416-395-6670
Fax: 416-395-7886
tpprnorth@toronto.ca

Etobicoke York District
399 The West Mall, Main Floor, North Block
Toronto, ON, M9C 2Y2
Telephone: 416-338-6596
Fax: 416-394-8935
tpprwest@toronto.ca

Scarborough District
150 Borough Drive, 5th Floor
Toronto, ON, M1P 4N7
Telephone: 416-338-5566
Fax: 416-396-4170
tppreast@toronto.ca

Toronto and East York District
50 Booth Avenue, 2nd Floor
Toronto, ON, M4M 2M2
Telephone: 416-392-7391
Fax: 416-392-7277
tpprsouth@toronto.ca

Ravine and Natural Feature Protection

General Enquiries
Telephone: 416-392-2513
Fax: 416-392-1915
Email: rnfp@toronto.ca

Office Location
18 Dyas Road, 1st Floor
Toronto, ON, M3B 1V5

Areas regulated under Ravine and Natural Feature Protection By-law can be viewed using the City's mapping tool available at www.toronto.ca/trees.