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ELECTRICAL SPECIFICATION

PROJECT NAME:

POWER DISTRIBUTION, ASPHALT AND LIGHT STANDARD REPLACEMENT
1660 NORTH PARK DRIVE
BRAMPTON, ON

OUR PROJECT NUMBER:

20257.001.E.001

DATE:

2024.03.07

ISSUED / REVISION:

ISSUED FOR TENDER

26 00 00.00 Index

END OF SECTION

26 01 00.00 Operating and Maintenance Instructions

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 03.00 – RECORD DRAWINGS.

1.1.3. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.4. Section 26 08 00.00 – COMMISSIONING.

1.1.5. Section 26 08 01.00 – TECHNICAL SERVICES DIVISION START-UP SERVICE.

2. Products

2.1. NOT USED

3. Execution

3.1. REQUIREMENTS FOR MANUALS

3.1.1. A minimum of three copies of complete and approved operating and maintenance instructions for all electrical equipment and systems shall be supplied before substantial completion. Provide additional copies if required under the General Requirements. In addition to the three copies of manuals, the contractor to provide a manual in a searchable PDF format on USB and cloud server. As-Built Drawings to be included on the CD or DVD or sent via electronic transfer.

3.1.2. The contractor to identify the cost of Record Drawings and the Operation and Maintenance Manuals as a separate line item on their progress draw. The values to be broken out can be found in Section 26 05 03.00 – Record Drawings. The project will remain incomplete and no money will be released until the final versions, both hard and electronic, of the drawings and manuals are received and reviewed without comments.

3.1.3. Binders shall be three-ring, hard-cover, loose-leaf type and identified on the binding edges as “Maintenance Instructions and Data Book”, for “Power Distribution, Asphalt and Light Replacement at 1660 North Park Dr., brampton, ON (Professor's Lake)”.

3.1.4. Terminology used in all the sections shall be consistent.

3.1.5. Volume One shall contain the master index of all systems, the name of the Contractor, Electrical Subcontractors and the date of substantial performance for the Contract.

3.1.6. Volume One shall contain a section with all necessary warranty information.

3.1.7. Each binder shall have a complete index for all volumes.

3.1.8. Each binder shall be no more than half filled.

3.1.9. There shall be a separate section for all materials used on the project which fall under the WHMIS legislation. There shall be Material Safety Data Sheet (MSDS), hazard data sheet, for each of the materials.

3.1.10. There shall be a separate section for all Insurance Certificates, Test Certificates, Verification Forms and Test Forms.

3.1.11. All relevant information relating to a system or product shall be contained within one binder.

3.1.12. The manual sections shall follow the specification sections.

3.1.13. Any diagrams, installation drawings, single line diagrams charts, etc. shall be mechanically reduced while maintaining full legibility to standard page size. If this cannot be achieved they shall be carefully folded and contained within a clear plastic wallet within the manual.

3.2. DATA FOR MANUALS

3.2.1. Equipment data shall contain:

.1 Operating instructions.

.2 Operating conditions such as temperature and pressure.

.3 Location of equipment.

.4 Maintenance instructions and schedules for one year routine.

.5 Recommended list of spare parts.

.6 Maintenance schedule.

.7 A trouble shooting table showing where to look for problems under various conditions of malfunction.

.8 All wiring diagrams.

.9 Equipment operating curves.

.10 Equipment nameplate data and serial numbers.

3.2.2. System data shall contain:

.1 A listing of all systems.

.2 All panel, mcc and fire alarm schedules and locations.

.3 Equipment name tags.

.4 Cleaning, maintaining and preserving instructions for all material, products and surfaces. Include warnings of harmful cleaning, maintaining and preserving practices.

3.2.3. Sub-Contractor manuals are required for:

.1 Switchboards and power distribution systems.

.2 Lighting systems.

.3 Fire alarm systems.

3.2.4. As-Built documentation shall contain:

.1 Reviewed As-Built Shop Drawings.

.2 As-Built Construction Drawings.

.3 Originals of test forms.

.4 Originals of test certificates.

3.3. OPERATING INSTRUCTIONS

3.3.1. Instruct the Owner’s representative in all aspects of the operation and maintenance of systems and equipment.

3.3.2. Where commissioning is a requirement of the project, the Contractor shall comply with all requirements of Section 26 08 00.00 – COMMISSIONING, for duration of tests.

3.3.3. Instruct the Owner for a minimum of five (5) working days.

3.3.4. All instruction sessions to be video-taped and copy must be provided to the Engineer's Representative/owner.

3.3.5. Arrange for and pay for the services of engineers and other manufacturers' representatives required for instruction on the systems and the equipment as requested by the Engineer's Representative and/or the Owner.

3.3.6. At the time of final review, provide a sheet for each system and piece of equipment showing the date instructions were given. Each sheet shall show the duration of instruction, name of persons receiving instruction, other persons present (manufacturer's representative, Engineer's Representative, etc.), system or equipment involved and signature of the Owner's staff stating that they understood the system installation, operating and maintenance requirements. This information shall be inserted in the manuals after all instructions have been completed.

3.3.7. Review information with the Owner's representative to ensure that all information required has been provided.

3.3.8. Electrical equipment and systems included in the instruction requirements, include but not limited to the following:

.1 Switchboards and related power distribution equipment.

3.4. TRIAL USAGE

3.4.1. The Owner shall be permitted trial usage of systems or parts of systems for the purpose of testing and learning operational procedures. Trial usage shall not affect the warranties nor be construed as acceptance, and no claim for damage shall be made against the Owner for any damage or breakage to any part or parts due to the tests, where such injuries or breakage are caused by a weakness or inadequacy of parts, or by defective materials or workmanship of any kind.

END OF SECTION

26 05 01.00 General Instructions for Electrical Sections

1. General

1.1. WORK INCLUDED

1.1.1. Conform to the requirements of Division 1, which applies to and forms part of all sections of the work.

1.2. DESCRIPTION OF SECTION

1.2.1. The specification is divided into sections of work and a section may consist of the work of more than one subcontractor. The responsibility as to which electrical subcontractor provides labour, materials, equipment and services required to complete the work rests solely with the Electrical Contractor.

1.3. SECTIONS AFFECTED

1.3.1. These instructions apply to and form a part of all electrical sections.

1.4. SCOPE

1.4.1. Provide all labour, materials, equipment and services to complete the work of the electrical division as further specified and as shown on the drawings.

1.4.2. Should any discrepancy appear between any parts of the specifications and/or the drawings to cause doubt as to the true meaning and intent of the drawings and specifications, a ruling shall be obtained from the Engineer's Representative before submitting the tender. If this is not done the following will be assumed:

.1 Where a discrepancy occurs between the specification and the drawings, the more expensive/onerous alternative will be deemed as included in the contract.

.2 Where a discrepancy occurs in the drawings the more expensive/onerous alternative will be deemed as included in the contract.

.3 Where a discrepancy occurs in the specifications the more expensive/onerous alternative will be deemed as included in the contract.

1.5. REGULATIONS

1.5.1. All work shall be performed in accordance with the latest codes, rules, regulations, by-laws and requirements of all authorities having jurisdiction except where the requirements of the drawings and specifications exceed the codes, rules, regulations, by-laws and requirements of the authorities having jurisdiction.

1.5.2. These specifications are supplementary to the requirements above.

1.5.3. Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies the contractor shall notify the Engineer's Representative.

1.6. PERMITS, FEES, AND REVIEWS

1.6.1. Make submissions to obtain all permits. Include for and pay for all fees and arrange for all reviews required for the work of this division.

1.6.2. If required by code, plans and specifications have been previously submitted to the Authority Having Jurisdiction.

1.6.3. Furnish certificates of Acceptance from the Authority Having Jurisdiction and include them in the Operation and Maintenance manual.

1.7. VOLTAGE RATINGS

1.7.1. Operating voltages are as specified in CAN3-C235-(latest edition).

1.7.2. Motors, electric heating, control and distribution devices and equipment are to operate satisfactorily at 60 Hz within operating limits established by the above standard.

1.8. COORDINATION WITH MECHANICAL DIVISIONS.

1.8.1. Unless indicated otherwise on the Electrical Drawings, Electrical Contractor will be responsible for the supply and installation of the following:

.1 Starters.

.2 Line and load side wiring for starters.

.3 Reduced voltage starters including “Soft Start” starters.

.4 Line and load side wiring to variable speed drives, including but not limited to wiring of associated harmonic filters, AC line input reactors, dV/dT filters, and output filters.

.5 Provisions of disconnects to all mechanical equipment.

.6 All power wiring (120V & above) to all mechanical equipment.

.7 Electrical ramp heating cables and controls.

.8 All motorized damper power connections (120V & above).

.9 Fire alarm devices.

.10 Wiring to electric space heaters.

1.8.2. Mechanical Divisions will be responsible for the supply and installation of the following:

.1 All variable speed drives and control wiring to starters.

.2 Pipe tracing and related controls.

.3 Electric hot water heaters.

.4 All electrical heaters including baseboard heaters, cabinet heaters, force flow heaters and radiant heaters.

.5 All interposing relays, relays, contactors and 120V control devices.

.6 All 120V and low voltage control wiring and conduits.

1.8.3. Determine exact location of starters, motors and line voltage controls based on the mechanical drawings to coordinate with the locations of all equipment to ensure the required clearances are maintained. If no wall location is suitable for the motor starters then mount the starters on a plywood backboard on unistrut supports near the respective equipment to meet the applicable code requirements for motor isolation switches. If a motor or piece of equipment is listed on one of the starter schedules but is not shown on the floor plans, the contractor is to reference the mechanical drawings for the location of the respective piece of equipment. No additional costs will be entertained.

1.8.4. Should the mechanical contractor change any of the motor or equipment sizes from those identified on the mechanical schedules and drawings at any stage of the project to aide their installation, the mechanical contractor will incur all extra electrical costs to revise the electrical feeders, breakers, starters and equipment to supply power to the revised piece of equipment.

1.9. PLYWOOD BACKBOARDS, EQUIPMENT MOUNTING, & HOUSEKEEPING PADS

1.9.1. Provide fire rated plywood backboards as shown on the drawings and mount where all communication equipment is to be wall mounted. Plywood is to be 21 mm, urea-formaldehyde (UF) free and shall be either, Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI) or CSA Z809-(latest edition) certified. Plywood to be either fire rated with the appropriate label displayed once installed or coated with fire retardant paint. Do not paint over plywood fire rating certification stamp. All Certification not to be painted. Submit documentation as a shop drawing for review by the LEED Representative prior to ordering.

1.9.2. Surface mounted electrical equipment boxes are to be installed on galvanized unistrut stand-offs. Electrical equipment boxes shall include, but not be limited to electrical panels, LV lighting control, fire alarm, security, communication, electrical sub-metering, etc. Panels are to be grouped on common base wherever practical.

1.9.3. Provide steel re-enforced concrete housekeeping pads under all floor mounted electrical equipment and where noted on the drawings. All housekeeping pads to be a minimum of 100mm high above finished floor and shall not extend beyond 50mm beyond the electrical equipment unless shown otherwise on the drawings.

1.10. FINISHES

1.10.1. Metal enclosure surfaces are to be finished by the application of rust resistant primer on both the inside and outside, with at least two coats of enamel.

1.10.2. Clean and touch up all surfaces of equipment scratched or marred during shipment or installation. Match the original paint.

1.10.3. Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.10.4. All paints, coatings, sealants and adhesives shall meet the VOC limits in accordance with the LEED Specification sections. Submit documentation as a shop drawing for review by the LEED Representative prior to ordering.

1.11. SAFETY

1.11.1. Protect exposed live equipment during construction for personnel safety.

1.11.2. Shield and mark all live parts "LIVE 120 VOLTS", or with appropriate voltage in English.

1.11.3. Arrange for the installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of an electrician.

1.12. FIRE STOPS

1.12.1. Provide fire stops in accordance with front end, and Division 1 documents and as described herein. Contractor to coordinate fire stops with General Contractor. All paints, coatings, sealants and adhesives shall meet the VOC limits in accordance with the LEED Specification sections. Submit documentation as a shop drawing for review by the LEED Representative prior to ordering

1.12.2. Fire stops and smoke seal systems: in accordance with CAN/ULC-S115 (latest edition).

.1 Asbestos free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN/ULC-S115 (latest edition) and not to exceed opening sizes for which they are intended.

.2 Fire stop system rating for service penetrations: to suit the latest edition of the National Building Code of Canada with local amendments or the Local/Provincial Building Code, and meet requirements of local authority having jurisdiction.

.3 Fire stop system rating for sealing junction of rated walls to rated floors and ceilings: to suit the National Building Code of Canada with local amendments or the Local/Provincial Building Code, and meet requirements of local authority having jurisdiction.

1.12.3. Service penetration assemblies: certified by ULC in accordance with CAN/ULC-S115 (latest edition) and listed in ULC Guide No. 40 U19.

1.12.4. Service penetration fire stop components: certified by ULC in accordance with CAN/ULC-S115 (latest edition) and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.

1.12.5. Fire resistance rating of installed fire stop assembly not less than the fire resistance rating of surrounding floor and wall assembly, and in accordance with the National Building Code of Canada with local amendments or the Local/Provincial Building Code, and meet requirements of local authority having jurisdiction.

1.12.6. Fire stops and smoke seals at openings intended for ease of re-entry, such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.

1.12.7. Fire stops and smoke seals at openings around penetrations for conduits, cable trays, pipes, ductwork and other electrical and mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations.

1.12.8. Primers: to manufacturer's recommendation for specific material, substrate, and end use.

1.12.9. Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

1.12.10. Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

1.12.11. Sealants for vertical joints: non-sagging.

1.12.12. Colour: if range available to Engineer’s Representative's choice of standard colours, generally to match background colour where visible in finished spaces.

1.12.13. Through non-fire or non-smoke separations or where waterproof membrane is field applied, where pipes are insulated, sleeves shall be sized to accommodate the insulation and vapour barrier.

1.12.14. Where-holes are core drilled in existing structures, sleeves shall be provided as specified complete with fire stopping as noted above.

1.12.15. Submit a complete fire stop system shop drawing package, identifying the products that may be used on the project. Prior to submitting data, review with Authority having Jurisdiction to confirm acceptability of proposed materials and assemblies.

1.12.16. Installation

.1 Install fire stops and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

.2 Seal-holes or voids made by through penetrations, poke through termination devices, and un-penetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to a neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

1.13. ACOUSTIC TREATMENT

1.13.1. Electrical Contractor will be responsible for coordinating the electrical installation with the recommendations of the acoustic consultant and their report where one has been included in the contract documents.

1.13.2. Refer to the recommendations of the acoustic report where provided, and provide and install acoustic treatments as necessary. This may include separation of receptacles in stud bays, sealing of junction boxes, application of sound insulating materials etc. Coordinate the installation of these materials with the General Contractor and Drywall/Partition Subtrade.

1.13.3. Do not install back to back receptacles/back boxes within the same stud bay wherever possible. Where it is not possible to stagger receptacles, provide acoustic seal around receptacle/back box to provide acoustic isolation/separation of spaces.

1.14. HOISTING

1.14.1. Electrical Contractor will be responsible for the hoisting of all the equipment in the contract. Contractor to coordinate with General Contractor for use of the general hoisting facilities. If hoist facilities are inadequate then subcontractors must provide their own. Subcontractors must inform general contractors in writing of requirements before tender closing date. Any hoisting required in addition to that provided by the General, will be included in the bid price.

1.14.2. Electrical Contractor to include for the qualified millwrights to move and place all equipment over 1000lbs. Contractor to provide proof of millwright certification.

1.15. CLEANING AND WASTE REMOVAL

1.15.1. Clean all electrical equipment that has been exposed to construction dust and dirt.

1.15.2. Contractor to clean all electrical equipment, inside and out, prior to turn over to Owner. Equipment is subject to review by Engineer's Representative and/or Owner.

1.15.3. Contractor is responsible to remove their own waste from the site. All re-usable materials shall be recycled.

1.16. SPRINKLERS

1.16.1. All electrical equipment shall be suitable for installation in a sprinklered environment and enclosures are to be CSA Type-2 sprinkler proof.

1.17. TEMPORARY LIGHT AND POWER

1.17.1. Temporary light and power for construction shall be provided, metered, and maintained by the electrical trade, as directed by the General Contractor; but each trade shall provide all extension cords, lamps, etc., required to complete their work.

1.17.2. All temporary light to be fluorescent or LED. Provide adequate lighting to meet all health and safety standards.

1.18. EXAMINATION AND PROTECTION OF SITE

1.18.1. Before submitting Bid, each trade shall examine the site to determine the conditions which may affect the proposed work. No claims for extra payment will be considered because of failure to fulfil this condition.

1.18.2. Contractor to document any existing conditions on site and submit a pre-condition survey including pictures. Contractor will be responsible to return the site back to its original form, which includes but is not limited to ground repair including grading and new sod and repair of damaged walls, doors and/or floors.

1.18.3. Contractor is to protect trees and plants on site and on adjacent properties. Plants to be protect with burlap. Trees and roots within construction area to be protected by the erection of temporary 2m high plywood hoarding at the drip line of the tree. Contractor to avoid unnecessary traffic, dumping and storage of materials at or near trees or plants.

1.18.4. When requested by the Owner and/or Engineer's Representative, the Contractor is to provide digital pictures of the site, including but not limited to progress of work and installed equipment, via e-mail to the Owner and/or Engineer's Representative.

1.19. DRAWINGS AND INSTALLATION

1.19.1. The drawings are intended to show the general character and scope of the work and not the exact details of the installation. The installation shall be complete with all accessories required for a complete and operative installation.

1.19.2. The location, arrangement and connection of equipment and materials shown on the drawings represent a close approximation to the intent and requirements of the contract. The right is reserved by the Engineer's Representative to make reasonable changes required to accommodate conditions arising during the progress of the work, at no extra cost to the Owner.

1.19.3. Certain details indicated on the drawings are general in nature and specific labelled detail references to each and every occurrence of use are not indicated, however, such details shall be applicable to every occurrence on the drawings.

1.19.4. The actual location of switches, outlets and luminaries, etc. shall be reviewed by the Engineer's Representative before installation.

1.19.5. The location and size of existing services shown on the drawings are based on the best available information. The actual location of existing services shall be verified in the field before work is commenced. Particular attention shall be paid to buried services.

1.19.6. Changes and modifications necessary to ensure co-ordination and avoid interference and conflicts with other trades or to accommodate existing conditions, shall be made at no extra cost to the Owner.

1.19.7. Leave areas clear where space is indicated as reserved for future equipment, and equipment for other trades.

1.19.8. Adequate space and provisions shall be left for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.

1.19.9. Where equipment is shown to be 'roughed-in only' obtain accurate information from the Engineer's Representative before proceeding with the work.

1.19.10. Contractor is to review Architect's specifications, drawings and details to confirm locations of devices and equipment.

1.19.11. This Contractor is responsible to mark-out his work, fully co-ordinated with all other trades, in sufficient time for review by Architectural Consultant prior to rough-in. Prepare dimensioned layouts of each room prior to rough-in for review by Architectural Consultant. Do not proceed with any work until the Architectural Consultant has reviewed the layout drawings.

1.19.12. The Contractor will reimburse the Engineer's Representative for their time spent on answering any written questions or requests for information where the answer is clearly identified on the drawings or in the specifications.

1.20. INSTALLATION, INTERFERENCE AND SETTING DRAWINGS

1.20.1. The Contractor is to complete installation, interference and setting drawings, dimensioned and to scale for all systems. They shall be made available for review by the Engineer's Representative, if requested. The drawings are required to make clear the work intended or to show its relation to adjacent work or to the work of other trades. When an alternative piece of equipment is to be substituted for equipment shown, drawings of the area involved shall be prepared by this division.

1.20.2. Slab layout drawings are to be submitted for review by the Structural Engineer's Representative. These slab layout drawings are to be included in the as-built drawings. Refer to Section 26 05 03.00 – RECORD DRAWINGS.

1.20.3. Interference drawings are required for shafts, ceiling spaces, basement areas, typical floors and wherever there is possible conflict in the positioning of electrical equipment, piping, ductwork sub-trades or architectural features.

1.20.4. This Division shall prepare sleeving drawings indicating the size and locations of openings required in concrete floor slabs, roof slabs/decks and walls for conduit, bus ducts and equipment for review by the Structural Engineer and Architect. In case of failure to provide information in time (i.e. before the concrete is poured) any extras incurred shall be at the expense of this Division.

1.21. SUPPLEMENTARY BID FORM AND SUBMISSIONS OF BID

1.21.1. Submit with tender, if included in the documents, a complete Electrical Supplementary Bid Form. Tenders not completed in full may, at the discretion of the Owner be rejected.

1.21.2. Several alternative, separate and itemized prices may have been requested. These shall be completed on the Electrical Supplementary Bid Form. Refer to the specific sections of the specifications and to the drawings for details.

1.22. APPROVED MANUFACTURERS

1.22.1. Where only one name appears in the specification, the bid shall include for the specified equipment.

1.22.2. Where two or more names are shown in the specifications as alternates or equal to, this division can select which manufacturer is to be carried.

1.22.3. The Contractor is to list substitute equipment as a price deduction to the Bid Price on the Electrical Supplementary Bid Form. Space has been provided to show manufacturers not specifically mentioned. Acceptance of substitute equipment shall be at the discretion of the Owner and/or Engineer's Representative. Any substitutes not listed on the Electrical Supplementary Bid Form will not be entertained.

.1 The proposed substitution shall show product name and complete description and also what difference, if any, will be made in the amount of the Bid Price for each substitution, should it be accepted.

.2 Materials and products specified by the name of the manufacturer, the brand or trade name, or catalogue reference, shall be the basis of the Bid Price.

.3 Any alternate and/or substitute equipment listed shall be equal in performance and quality to that specified. If space, power, structural or any other requirements are different from the equipment specified, the cost of any changes shall be included for in the price shown on the Electrical Supplementary Bid Form.

.4 The Owner reserves the right to accept or reject any substitution without question.

.5 The "Base and Alternate Equipment" is for North American manufactured products. Where a listed manufacturer can offer either North American or non-North American

source for the equipment, the country of origin shall be shown under "Substitute Equipment" and the cost savings shown under "Deduct from Tender Price".

1.23. PRODUCTS AND MATERIALS

1.23.1. Make and quality of materials used in the construction of this project shall be subject to the approval of the Engineer's Representative.

1.23.2. All equipment and material are to be CSA certified or approved by an accredited organization. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Authorities.

1.23.3. Factory assemble control panels and component assemblies.

1.23.4. Materials and equipment supplied by this division shall be new and free from defects and shall be equivalent in physical characteristics and performance to that specified by the manufacturer's name and catalogue reference.

1.23.5. Where a certain manufacturer's equipment has been specified by name or model number, the contractor shall be responsible for ensuring that the performance and quality meets the specified equipment and that the same access or maintenance space is available for an alternative manufacturer's equipment that is used and that interfacing connections with other trades can be made at no extra cost.

1.23.6. Within 30days of the award of contract, the Contractor is to submit a complete list of the manufacturers for all equipment being supplied on the project.

1.23.7. Availability

.1 In submitting Bid, Contractor warrants that all materials are available in suitable time to meet Contract dates.

.2 Subject to sentence .3 below, where the Contractor advises that the Contractor cannot supply materials in suitable time to meet Contract dates, and should it subsequently appear that Work may be delayed for such reason, the Engineer's Representative reserves the right to substitute more readily available products of similar character, even if more costly to the Contractor, at no increase in Contract Price.

.3 Where the Contractor can show that the Contractor promptly ordered the originally specified materials the Owner will pay the differential in cost between the originally specified material and the substitute material without any mark-ups applicable by the Contractor, subcontractors, sub-subcontractors or suppliers. For greater certainty, the Contractor's failure to submit shop drawings or other submittals or seek direction in those instances where the Contract Documents so require in sufficient time to permit ordering materials is not cause for the Owner to pay the cost differential in sentence .2 above.

1.24. CO-OPERATION WITH CONSULTANTS

1.24.1. To assist in the successful execution of the project, the Contractor shall receive a job report that summarizes the expectations of the Consultant and the Contractor. This document covers topics such as progress billings breakdowns, shop drawing requirements, change order pricing breakdowns, the commissioning process, installation drawings, the specifications, as-built drawings and O+M manuals, along with a number of other items. This job report is intended to reiterate and elaborate on key items of the Contract Documents and is not intended to impose new requirements.

1.24.2. At the appropriate time during construction the Contractor shall submit the applicable documentation listed in the “Mechanical/Electrical Unfinished Building Occupancy Checklist”. The list shall be issued by the Consultant during the course of the project; however, a sample checklist can be provided at any time upon request. The checklist shall be completed by the Contractor when the information required for occupancy is submitted. The Consultant shall review the information and checklist and shall identify when the information is complete. The Consultant’s general review letter (required for building occupancy) shall only be issued when all the information requested in the checklist is submitted by the Contractor and deemed to be complete by the Consultant.

1.25. CO-OPERATION WITH OTHER DIVISIONS

1.25.1. Particular attention must be paid to the proximity of electrical conduit and cable to mechanical piping and equipment.

1.25.2. Electrical conduits shall not touch or be supported on pipe or duct walls.

1.25.3. Each section shall confine itself to installing all materials in the spaces shown without encroaching upon space for materials installed under other sections or divisions. Where the space allocated to another section or division is encroached upon, the materials shall be relocated to their proper space allocation in such a manner to complete the work using space allocated to the various sections and divisions. Relocation of materials and work involved shall be paid for by the section responsible for the encroachment at no extra cost to the Owner.

1.25.4. The supply of all items is to have built-in to the delivery schedule, ample time for rapid progress of work. Proceed with work determined by the construction schedule.

1.25.5. The Electrical Contractor shall coordinate the exact breaker/fuse sizes with all mechanical equipment shop drawings prior to rough-in and ordering of the electrical distribution equipment. Size of breakers/fuses shown on drawings are based on generic equipment manufacturers and sizes may change depending on successful equipment manufacturer. No additional costs shall be allowed for non-coordinated mechanical shop drawing reviews by the Electrical Contractor.

1.26. TEMPORARY USE OF EQUIPMENT

1.26.1. Where the electrical systems are operated during construction, the Electrical Contractor shall maintain the system and equipment in proper operating condition.

1.26.2. Before any area of the building is turned over to the Owner for acceptance and for beginning of the guarantee/warranty period, the systems and equipment shall be returned to the initial new condition.

1.26.3. Permanent electrical equipment is only to be used upon permission of Owner and Engineer’s Representative and is only to be used on a limited basis. All equipment must be cleaned prior to turnover.

1.27. STATEMENT OF PRICES

1.27.1. To form a basis for progress payments the successful bidder shall submit a sample progress draw for the various portions of the work. The format of the sample progress draw shall be as shown in the example progress draw below. The sample progress draw shall include a breakdown which illustrates all categories shown on the example progress draw which are relevant to the project. The categories shall be broken down to clearly illustrate the value of the material being supplied as the first subcategory and the value of the labour being supplied as the second subcategory, as shown on the example progress draw. The electrical Engineer's Representative reserves the right to request that additional categories be added to the progress draw if the Engineer's Representative feels that doing so will aid in assessing the contractor's progress on site, thereby expediting contractor payment. Progress draws not including the categories shown on the example progress draw where relevant to the project and / or not providing separate labour value and separate material value subcategories will be rejected.

1.27.2. The total price of all portions of the work shall equal the total price of the work covered under the electrical division. Cost for as-built drawings and manuals to be carried as a separate line item.

1.27.3. Contractor to list and track all fixed per unit cost luminaires as part of Light Fixtures - Materials on the progress draw.

1.27.4. Contractor to list and track each of the approved changes on separate lines on the progress draw.

1.27.5. Costs of temporary facilities and utilities shall be amortized over the duration of the Work. Claims for 'mobilization', 'bidding costs', or similar lump sums at or before start of work are not acceptable.

EXAMPLE PROGRESS DRAW

Electrical Contractor Name
Billing Application Electrical Division
Project Name

Application Number – xx **Date – xxxx to xxxx**

Description	Contract Value	%	Billed To Date	%	Prev. Billed	%	This Billing	Balance to Complete
Permits / Mobilization	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Demolition & Removals	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Duct Banks – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Duct Banks – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Feeder Conduit – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Feeder Conduit – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Feeder Wire – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Feeder Wire – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Power & Ltg. Branch Conduit – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Power & Ltg. Branch Conduit – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Power & Lighting Branch Wire – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Power & Lighting Branch Wire – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Fire Alarm Conduit – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Fire Alarm Conduit – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx

Fire Alarm Cable – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Fire Alarm Cable – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Comms / Security / AV Conduit – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Comms / Security / AV Conduit – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Comms / Security / AV Cable – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Comms / Security / AV Cable – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Distribution Equipment – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Distribution Equipment – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Generator / Inverter – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Generator / Inverter – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Light Fixtures – Material†	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Light Fixtures – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Lighting Controls – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Lighting Controls – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Fire Alarm Equipment – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Fire Alarm Equipment – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Wiring Devices – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Wiring Devices – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Hand Dryers – Material	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Hand Dryers – Labour	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Commissioning / Training	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Demobilization / Clean-up	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Manuals / As-Built Drawings	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Subtotal	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Additions to Contract								
CO # / PC # / CCN #	xx,xxx.xx	xxx	xx,xxx.xx	xxx	xx,xxx.xx	xxx	xx,xxx.xx	xx,xxx.xx
Cash Allowance #	xx,xxx.xx	xxx	xx,xxx.xx	xxx	xx,xxx.xx	xxx	xx,xxx.xx	xx,xxx.xx
Subtotal	xx,xxx.xx	xxx	xx,xxx.xx	xxx	xx,xxx.xx	xxx	xx,xxx.xx	xx,xxx.xx
Total Contract	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx	xxx,xxx.xx	xxx,xxx.xx
Less Holdback			xxx,xxx.xx		xxx,xxx.xx		xxx,xxx.xx	
Total			xxx,xxx.xx		xxx,xxx.xx		xxx,xxx.xx	

† Inclusive of fixed per unit cost luminaires. Refer to luminaire schedule and/or electrical supplementary bid form for luminaire fixed unit costs.

1.28. METRIC CONVERSIONS

1.28.1. Particular care shall be taken with imperial versus S.I. metric conversions. This applies to all services including, but not limited to, equipment, conduit and site services in both new and existing installations.

1.29. INTERRUPTION OF SERVICES

1.29.1. Any interruption of the electrical services to any part of the building shall come at a time agreeable to the Engineer's Representative. Make all necessary arrangements with those concerned and include for any overtime required to ensure that the interruption is held to a minimum.

1.29.2. Testing and operation of major equipment shall be approved by the Engineer's Representative to avoid excessive electrical utility charges. Such testing to be generally carried out after normal working hours or on weekends.

1.29.3. All such overtime work shall be carried out without additional cost to the Owners.

1.29.4. Modifications to existing electrical equipment, which will require shutdown, must be coordinated with the Owner and will only be permitted on weekdays from 10:00 pm to 6:00 am and on weekends from Friday at 7:00 pm to Sunday 6:00 pm. Exact weekends to be co-ordinated with the Owner. Consecutive weekends of shutdowns will not be allowed. Contractor to pay for all utility costs associated with shutdowns. Any work not associated with live equipment can be done during normal working hours. Work considered disruptive to the normal operation of the building will be done after normal business hours. Exact times to be co-ordinated with Owner.

1.29.5. Contractor to provide a minimum of 5 days written notice of a requirement for a shutdown. Contractor to include for separate meetings with the Owner and Engineer's Representative to discuss the shutdown in detail and to coordinate all the work being performed.

1.29.6. The Contractor is responsible for co-ordination and isolating of all existing services at all voltage levels required for the disconnections and connections to existing buildings. This includes shutting down and isolating existing low and medium voltage services. The owner will not perform any isolations for the contractor but will be present during the work. The contractor is to use qualified personnel for these shutdowns ensuring compliance with all applicable safety requirements.

1.29.7. The Contractor is responsible for any damages caused to existing systems when making connections.

1.29.8. The Contractor is to keep shutdowns of existing buildings to a minimum by scheduling the work and providing the required number of personnel to keep the shutdown to a minimum. This Contractor is to include for as many multiple teams of electricians as is feasible to keep the shutdown work to a minimum.

1.30. PRE-PURCHASED EQUIPMENT

1.30.1. The Electrical Trade shall assume complete responsibility for the Owner's pre-purchased equipment and its associated equipment as if it had been purchased by the Contractor, with the single exception of payment.

1.30.2. The Electrical Trade shall provide a warranty for all pre-purchased equipment during the warranty period and shall include for all labour, material and shipping charges not covered in the manufacturer's warranty to completely repair or replace any defective pre-purchased equipment at no cost to the Owner during the warranty period.

1.30.3. The Electrical Trade shall take complete responsibility for the co-ordination of delivery of the separate items of equipment and their proper placement as required by jobsite conditions.

1.30.4. The Electrical Trade shall provide all materials and labour required to incorporate pre-purchased equipment into a working system whether or not shown on the drawings or specified herein.

1.30.5. The following list of equipment is pre-purchased:

1.31. PRE-TENDERED EQUIPMENT

1.31.1. The Electrical Trade shall assume complete responsibility for the Owner's pre-tendered equipment and its associated equipment as if it had been purchased by the Contractor, including payment.

1.31.2. The Electrical Trade shall provide a warranty for all pre-tendered equipment during the warranty period and shall include for all labour, material and shipping charges not covered in the manufacturer's warranty to completely repair or replace any defective pre-tendered equipment at no cost to the Owner during the warranty period.

1.31.3. The Electrical Trade shall take complete responsibility for the co-ordination of delivery of the separate items of equipment and their proper placement as required by jobsite conditions.

1.31.4. The Electrical Trade shall provide all materials and labour required to incorporate pre-tendered equipment into a working system whether or not shown on the drawings or specified herein.

1.31.5. The following list of equipment is pre-tendered: Insert the list of Owner Pre-tendered equipment or delete this if none are being included in the project

1.32. VALUATION OF CHANGES

1.32.1. Further to contract requirements, the method to be used in determining the value of a change to the Work, by either Change Order or Change Directive, shall be:

.1 Estimate and acceptance in a lump sum, unless the Engineer’s Representative otherwise determines that the method shall be unit prices set out in the Contract.

1.32.2. Contractor shall provide the Engineer’s Representative with a detailed cost analysis of the contemplated change indicating:

.1 Quantity of each material.

.2 Unit cost of each material.

.3 Time involved.

.4 Sub-trade quotations including a complete analysis of costs.

.5 Mark-ups, if applicable.

.6 Value of GST or HST, as applicable.

.7 Proposed change in Contract Time.

1.32.3. The detailed cost breakdown is to list material and labour separately for each item on the proposed change. The breakdown for contemplated change is to follow the format of the attached document.

1.32.4. The following shall not be included in the cost of the work but are covered by the hourly labour rate:

.1 The Contractor’s payroll, administrative, head office and site office expenses, including stationary, postage and other office supplies.

.2 The costs of the Contractor’s Project Manager, clerical and administrative personnel, and executive personnel.

.3 Use of temporary offices, sheds, small/hand tools, storage, and site office consumables, etc., including but not limited to the cost of telephone, light, power, water and heat used therein.

.4 Transportation and overnight room expenses for out of town labour, if local labour is unavailable.

.5 Insurance premiums, all government payroll burdens, variable labour factors and union or association funds.

.6 Licenses and permits, except when these are special for a particular item of work.

.7 Printing charges for Proposed Changes, Change Orders and Drawings for Contractor's and Subcontractors' use in the work. Engineer's Representative will provide a PDF electronic copy of change notice documentation.

.8 The cost of preparing record, layout and working drawings and shop drawings.

.9 The cost of clean-up and disposal of waste material.

.10 Parking, travel, coffee break/rest periods, warranties, safety training, WHMIS and health and safety committee, and non-productivity time.

.11 Rentals, additional bonding, project financing.

1.32.5. The Contractor shall not be entitled to any additional compensation arising out of changes to the Work other than the amounts determined and agreed to under CCDC2-2008 GC 6.2.

1.32.6. In computing accounts for extras and credits for any Proposed Change, all credits shall be deducted from the total sum of the extras before mark-ups or charges for overhead and profit are added.

1.32.7. The Contractor shall inform the Surety Company or Companies who have issued any bonds for this Contract, and any Insurers who have insured any part of the work or operations or who have an interest in this Contract, of all changes in the Contract. Pay all costs of any changes in bonds or insurances required to maintain bonds or insurances in conformance with the requirements of the Contract Documents. Provide Owner immediately with any revised bonds or insurances.

1.32.8. Special equipment rental rates will be charged at cost. The Contractor shall provide an official quotation of the equipment rental with the Proposed Change quotation as backup, otherwise special equipment rentals will not be accepted by the Owner/Consultant.

1.32.9. The maximum percentage fee for mark-ups shall be as stated in the Division 0/1 specifications.

1.32.10. Where a proposed change order includes both credits and extras, overhead and permitted mark-ups apply to the net extra or credits, if any, of the entire change.

1.32.11. All changes, change notices, revisions to contract, site instructions, change directives or any additional costs or deletes to the stipulated lump sum contract price are subject to review and scrutiny by a qualified third party or individual.

1.32.12. Labour Rate

.1 During the duration of the electrical contract, extra work hourly labour units are to be based on the latest edition of the National Electrical Contractors Association (NECA) labour units column 1(one). No additional factors will be accepted.

.2 The hourly labour rate for all changes will be based on a Journeyman Electrician rate as listed on the Bid Form and/or Electrical Supplementary Bid Form. The Owner and/or Engineer's Representative reserve the right to renegotiate the labour rate. The hourly labour rate will be inclusive of overhead, markup and profit. The labour rate will be inclusive of all labour burden charges as stated in this 'Valuation of Changes' section above.

.3 The following labour burdens are not part of the hourly labour cost, but are covered under the NECA labour unit rates: safety measures and regulations; drawing and specification study; layout, measuring and marking the installation location; material unloading, jobsite stoarage and delievery to the installation area; inspection, uncrating and shipping support removal; tool acquisition and return to storage; clean-up of excess material; and testing circuits for continuity.

.4 At the request of the Owner or the Engineer's Representative, the Contractor is to submit a detailed labour cost breakdown showing a breakdown of all adders to the base wage rate to show how the Contractor has come to the proposed hourly rate. The Owner and the Engineer's Representative reserve the right to negotiate the hourly labour rate with the Contractor.

1.32.13. When pricing additional work for Proposed Changes, the Electrical Contractor shall only price new materials that are required for the Proposed Change. Where existing materials and/or infrastructure (i.e. homerun conduits back to electrical panels) can be re-used for the Proposed Change, the Electrical Contractor shall utilize these items in the valuation of the Change at no extra cost.

PROPOSED CHANGE ORDER

Company Name:
Address:
City, Prov.:
Postal Code:

Telephone:
Fax:
E-Mail address:

Client Address:

CCN #
Date:
Project Name:
Project Number:
Page Number:
Change Order #:

Work Description

We reserve the right to correct this quote for errors and omissions.
This quote covers direct costs only.
This price is good for acceptance within 30 days from the date of receipt.

Itemized Breakdown

Description	Qty	Net Price U	Total Mat($)	Labor U	Total Hours
¾' EMT		150.39 C		5.00 C	
¾' EMT STL SS CONN		65.97 C		10.00C	
¾' EMT STL SS CPLG		70.60 C		5.00 C	
¾' EMT STRAO 1-H		11.24 C		4.00 C	
#10 x 1" SELF TAPPING SCREW		5.50 C		5.50 C	

TOTALS

Description

Material

General Materials
Permitted Mark-up (@ 10.000 %)
Material Total

Labour

Journeyman (xx Hrs. @ $xx.00)
Foreman @ 10% (xx Hrs. @ $xx.00)
Labour Total

Material and Labour Total

Final Amount

1.33. DEMOLITION

1.33.1. The demolition drawings show the general scope of the demolition and not exact details or total extent. For exact details and total extent each service must be carefully checked on site. Before removing services follow the service through to ensure other areas of the building are not affected.

1.33.2. Whenever existing services or equipment are to be removed, all electrical connections for such services shall be removed and securely terminated in an approved manner. If necessary to facilitate installation of new work, any existing services and equipment shall be removed and then replaced by this division.

1.33.3. Whenever it becomes necessary to relocate any electrical services equipment to make possible installation of the work under this contract, such relocation shall be done by this division without additional cost to the Owner.

1.33.4. Make safe and disconnect all power and systems, as and when, and to the extent required to facilitate the demolition.

1.33.5. Ensure that all electrical, life safety services, and services for existing equipment, in areas outside the areas of this work, that are required to remain in service, shall do so.

1.33.6. Relocate any electrical feeders or equipment that are required to remain in service, that are secured to existing walls, floors or ceilings to be demolished or that are buried and required to be excavated for new work.

1.33.7. Remove and replace any electrical equipment on walls or ceilings that will be demolished and rebuilt.

1.33.8. Disconnect and remove existing light fixtures, devices, outlets, CCTV, security devices, etc. which are not to be reused. Such items shall be packaged and turned over to the Owner at a place designated by the Owner. Cut back and cap unused raceway and outlets and remove unused wiring back to panelboard in an approved manner.

1.33.9. Ensure that all existing equipment which is to be reused and/or relocated is thoroughly reviewed and refurbished to ensure correct operation when put back into service and to meet the requirements of the local authorities having jurisdiction. All existing electrical equipment which is no longer required shall be removed and disposed of off-site.

1.33.10. Carry out the work with a minimum of noise, dust and disturbance.

1.33.11. Provide tools and clean up equipment. Obtain the Owner's permission for the use of electrical, plumbing or drainage outlets.

1.33.12. Where a device is shown to be relocated on the drawings, contractor to remove and re-install device and back box and re-feed the device with new conduit and wire from the nearest existing accessible junction box.

1.33.13. Electrical Contractor is responsible for the patching and re-painting the entire wall where a device and/or box has been added, removed or relocated.

1.34. CYBER SECURITY

1.34.1. Coordinate with Owner’s Information Technology representatives, obtain a copy of their cyber security policy and provide all applicable cyber security configurations.

1.34.2. Definitions

.1 Cyber Assets: Those Systems (including hardware, software, and data) and communication networks (including hardware, software, and data).

.2 Critical Cyber Assets: Those cyber assets that perform critical system functions. The loss or compromise of these cyber assets would adversely affect the operational reliability of the system.

.3 Cyber Attack: The use of electronic means to interrupt, manipulate, destroy, or gain unauthorized access to a computer system, network, or device.

.4 Cybercrime: to be any crime where cyber – the internet and information technologies, such as software, firmware, computers, tablets, personal digital assistants or mobile devices – has a substantial role in the commission of a criminal offence.

.5 Cyber Hygiene: is a reference to the practices and steps that users of computers and other devices take to maintain system health and improve online security. These practices are often part of a routine to ensure the safety of identity and other details that could be stolen or corrupted.

.6 Cyber Incident: Any unauthorized attempt, whether successful or not, to gain access to, modify, destroy, delete, or render unavailable any computer network or system resource.

.7 Cyber Security: refers to the body of technologies, processes and practices designed to protect networks, devices, programs, and data from attack, damage, or unauthorized access.

.8 Cyber Threat or Cyber Security Threat: is a malicious act that seeks to damage data, steal data, or disrupt digital life in general. Cyber threats include computer viruses, data breaches, Denial of Service (DDoS) attacks and other attack vectors.

.9 Cyber Threat Actors: is a broad term for any states, groups, or individuals who, with malicious intent, aim to take advantage of vulnerabilities, low cyber Security awareness, and technological developments to gain unauthorized access to information systems in order to access or otherwise affect victims' data, devices, systems and networks.

.10 IP Multicast: is a technique for one-to-many and many-to-many real-time communication over an IP Infrastructure network.

.11 Endpoint: is a remote computing device that communicates back and forth with a network to which it is connected. Such as a server, desktop, or laptop.

.12 Network Certificates: are also known as a Digital Certificates, which are an electronic "password" that allows a person, organization to exchange data securely over the internet using the public key infrastructure (PKI). Digital Certificates are also known as a public key certificate or identity certificate. There are 3 Main types of certificates:

.1 Secure Socket Layer Certificate (SSL) Digi-SSL

.2 Software Signing (Code Signing Certificate) Digi-Code

.3 Client Certificate (Digital ID) Digi-ID

.13 Social Engineering: are exploitation methods that target human vulnerabilities, such as carelessness and trust.

.14 Technical Vulnerabilities: are weaknesses or flaws in the design, implementation, operation, or management of an information technology system, device, or service.

1.34.3. Cyber Security Measures

.1 The following multi-layered cyber security measures shall be implemented at minimum to limit and or reduce the Owner's potential risk from a cyber threat event; Such as a cyber security data breach or Cyber Security attack.

.2 Password Management

.1 Employ password management best practices such as:

.1 Do not use default passwords.

.2 Use strong and unique passwords for all applications. Where there is no password policy inherent in the software use a minimum of 8 characters;

use a mixture of uppercase and lowercase letters, numbers, and include at least one special character (! @ # ?]).

.3 Reset passwords at regular intervals.

.4 Configure two-factor authentication for all accounts where possible in the system software.

.5 Do not use System Admin logins for simple tasks, Create separate User accounts with rights levels appropriate for the job function. These user accounts can be defined and created in many ways such as Role based, Individual logins or assigned roles.

.6 Use Different Passwords for Every Account

.7 Enforce secure password policies within the business environment.

.8 Have Interface lock after a predefined # of failed login attempts for a pre determined time interval.

.3 Port and Interface Management

.1 Employ Port Management techniques such as:

.1 Restrict access on network switch ports to assigned devices addresses.

.2 Be sure to lock down open, unused and unsecure ports on the networking devices such as switch's, routers, and firewalls.

.3 Shut off all unused communication services and hardware interfaces.

.4 The use of 3rd party port security monitoring such as Solarwinds should be investigated and is highly recommended.

.4 Physical and Virtual Networks

.1 Where a dedicated LAN has not been provided a Dedicated VLAN for the Security System including Video Surveillance, Access Control, Intrusion Detection, Duress Alarm, etc. is required.

.5 Encryption

.1 Minimum TLS 1.2 should be used and where available use of TLS 1.3 for all network attached equipment..

.6 Network Certificates

.1 Make sure Network Certificates are up to date and not expired for all equipment and systems.

.7 Firmware & Software Update Management

.1 Be sure to have the latest stable Firmware / Software version on all devices/ equipment/ as well as implement a Firmware/Software Update management process and procedure.

.8 Manufacturer's System Hardening Guides

.1 Be sure to have the Manufacturers System hardening guides provided for the equipment being installed and implement as many recommendations/features as practical to do so.

.9 External Memory

.1 Restrict the use of external memory. The use of devices such as external USB Thumb drives should be restricted or not used at all unless expressly allowed by the Owner's Information Technology representatives.

.10 Log Off

.1 Enable auto-logoff timer. Be sure to have the local Workstation being used to access the equipment has an auto–logoff timer set with a reasonable timer in the case that the employee leaves it unattended for any amount of time.

.11 Anti-Virus Software

.1 Enable and configure anti-virus software on PC endpoints

.12 Filtering Techniques

.1 There are many types of filtering Techniques and filters that can be applied and should be investigated for specific project requirements. Some of these Filtering techniques are:

.1 Web Filtering: A Web filter adds another layer to your anti-phishing defences by blocking the web based component of phishing and malware attacks.

.2 Multicast Message Filtering: Filters the packets sent to multicast groups they are not subscribed to.

.3 Content Filtering: is the use of a program to screen and or exclude access to web pages or email deemed objectionable. A content filter will then block access to this content

.13 Back up Regularly

.1 Provide backup schedule in the closeout submittals and configure system for automatic backups wherever possible. Regularly back up important files either manually or through a scheduled backup procedure. This helps to protect against many types of data loss, especially if a Cyber Threat Actor gains access.

1.34.4. IT Devices and Systems

.1 The above listed Cyber security measures can be applied in part or in full to a wide range of Information Technology (IT) Devices. A list of some of these device types are:

.1 Fire Walls

.2 Routers

.3 Network switches (Core and Edge Devices)

.4 Servers and databases

.5 Workstation computers

.6 Network connected system devices and controllers

.7 Wireless Access Points and wireless controllers

.8 Mobile phones and tablets

.9 Essentially any IT System or endpoint connected to the network can have some form of Cyber security measure applied to it.

1.34.5. OT Devices and Systems

.1 These Cyber security measures can also be applied in part or in full to a wide range of Operational Technology (OT) Network devices.

.1 Industrial Control Systems such as:

.1 (PLC's) Programmable Logic Controllers are an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices.

.2 (SCADA) Supervisory Control and Data Acquisition is a control system architecture comprising of computers, networked data communications

and graphical user interfaces (GUI) for high level process supervisory management.

.3 (DCS) Distributed Control System is a computerized control system for a process or plant usually with many control loops, in which autonomous controllers are distributed throughout the system.

.4 (CNC) Computer numerical Control is the automated control of machining tools (Drills, boring tools, lathes) and 3D printers by means of a computer.

.2 BMS/BAS Building Management and Building Automation Systems

.3 HVAC equipment

.4 Lighting controls for both internal and external applications

.5 Energy monitoring and metering equipment

.6 Transportation and parking systems

.7 Scientific equipment

.8 Essentially any OT System or endpoint connected to the network can have some form of Cyber security measure applied to it.

1.34.6. Report Cybercrime

.1 When doing any work on a network connected system advise the Owner and or their representatives of any indication of a Cyber Incident of a criminal nature.

1.34.7. Cyber Security Report Letter

.1 When implementing any and or all of the Cyber Security Measures mentioned in this Specification, be sure to include a Report letter in the closeout documents to the client stating which Cyber Security measures have been implemented.

2. Products

2.1. NOT USED

3. Execution

3.1. NOT USED

END OF SECTION

26 05 03.00 Record Drawings

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Refer to Record and/or As-built Drawings in Section 01 70 00 (01 72 29.00) – CLOSEOUT SUBMITTALS.

1.3. RECORD OF REVISIONS ON SITE

1.3.1. Print and maintain two complete sets of white prints to mark the project progress, changes and deviations.

1.3.2. Maintain an updated copy of plans and schematics in the digital format for which the project is provided (i.e. AutoCAD or Autodesk Revit MEP) and be capable to produce documents in Adobe PDF upon request.

2. Products

2.1. RECORD DRAWINGS

2.1.1. The Electrical Contractor shall request in writing from the Engineer's Representative all electrical AutoCAD drawings. Contractor to complete attached form and pay the Engineer's Representative directly the costs identified within the form prior to receiving the drawings. After the final as-built drawings have been reviewed, provide multiple copies of the drawings on CD or DVD or sent via electronic transfer. One copy is to be returned to the Engineer's Representative via CD or DVD or electronic transfer for their records and a minimum of one copy on CD or DVD with each set of maintenance manuals. Provide additional copies if required under the General Conditions. The Contractor is to use latest release of AutoCAD software, and provide electronic files saved in a version acceptable to the end user and engineer.

2.1.2. The contractor is to identify the cost of Record Drawings and the Operation and Maintenance Manuals as a separate line item on their progress draw. The following values are to be broken out:

$5,000	For Electrical Contracts up to $250,000
2% of Electrical Contract	For Electrical Contracts from $250,000 to $1,500,000
$30,000	For Electrical Contracts over $1,500,000

2.1.3. The project will remain incomplete and no money will be released until the final versions, both hard and electronic, of the drawings and manuals are received.

2.1.4. Final as-built prints/plots shall not contain markings or corrections by hand (i.e. marker, pen, pencil, etc.). References to the Architect and Engineer must be deleted from the drawings.

2.1.5. Final as-built drawings to include all revisions made to the drawings during construction, including all approved changes. The as-built drawings are to also include the routing of all feeders except for branch circuits, all junction boxes to be shown, drawing legend to be updated to include all symbols and lines used to show as-built conditions, quantity of wires in each conduit, and circuit numbers of wires in each conduit. Include slab layout drawings in as-built drawing package.

2.1.6. CADD Requirements.

.1 A complete list of layer names and brief description of each layer's use shall accompany all files.

.2 Fonts for text shall be AutoCAD standard. Custom fonts, shape files, etc., are not to be used.

.3 Final as-built drawings shall be returned on CD ROM or DVD.

.4 Each CD ROM or DVD shall be clearly labelled with Engineer's Representative and Owner, Contract number, file names and Drawing number. If a complete listing exceeds the label size provide a "readme.txt" file in ASCII format with each CD ROM or DVD. A printed copy of the readme file shall accompany each CD ROM or DVD

.5 All drawings shall be in the same units as issued on Bid Documents.

.6 Provide a complete list of symbol (block) names with a description of each symbol.

.7 Special effort shall be made to ensure that drafting is accurate: i.e. appropriate lines are indeed horizontal and vertical; lines that should intersect do but not over-intersect and ensure that entities are placed on correct layers.

2.1.7. The Electrical Contractor will maintain two sets of white prints on site on which the Electrical Contractor shall clearly mark, as the job progresses, all changes and deviations from that shown on Contract Drawings. After review and approval of service lines in trenches, the Electrical Contractor shall take 'as-built' measurements, including all depths, prior to commencement of backfilling operations. The location of buried electrical ducts and conductors shall be shown on the drawings and dimensioned from fixed points. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include variation orders, field instructions and all other changes.

2.1.8. On completion of the building, the Electrical Contractor shall forward to the Engineer's Representative the two sets of final drawings indicating all such changes and deviations for review by the Engineer's Representative. Each set shall include full size hard copy of the drawings, and electronic copy of the drawings on CD ROM or DVD.

2.1.9. If required, the Engineer's Representative will provide a quotation to this Contractor to transfer "As-Built" information from the mark-up documentation to the acceptable software.

.1 Include a cost of $400.00 per sheet for the transfer of marked up 'As Built' information to AutoCAD and forwarding of the electrical information by the Engineer's Representative to the Owner

2.1.10. The Electrical Contractor may request from the Engineer's Representative the most current electrical drawings in AutoCAD sent via electronic transfer (at a nominal charge of $500.00).

2.1.11. The AutoCAD as-built documents shall meet all the Owner's and Engineer's Representative's requirements.

3. Execution

3.1. NOT USED

END OF SECTION

26 05 04.00 Submittals – Shop Drawings

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.2. RELATED WORK

1.2.1. Comply with Div. 00 for submittal requirements and as amended below.

2. Products

2.1. SHOP DRAWINGS

2.1.1. Shop Drawings shall be organized by Specification Section. Do not combine more than one section into one submission. Incorrect submissions will be returned without review.

2.1.2. Submittals/Shop Drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each Shop Drawing shall give the identifying number of the specific assembly for which it was prepared (e.g. SWBD-1A).

2.1.3. Submit shop drawings electronically, by email, in PDF format. Submissions that are not electronic without prior approval from the Engineer's Representative shall be returned as not reviewed. Provide the following information in the email submission:

.1 S+A project number and Contractor Shop Drawing Identifier in Subject Line

.2 Attachments shall be limited to 10MB

.3 Provide FTP hyperlink for all attachments in excess of 10MB with appropriate information for downloading the file (as required)

.4 Shop Drawing Submission to the following email address:

.1 ContractAdmin.Toronto@smithandandersen.com

.2 ContractAdmin.Halifax@smithandandersen.com

2.1.4. Shop drawings submitted directly to Smith + Andersen personnel (and not copied to the email address provided above) without advanced permission will not be processed nor considered as received.

2.1.5. Each Shop Drawing for non-catalogue items shall be prepared specifically for this project. Shop Drawings and brochures for catalogue items shall be marked clearly to show the items being supplied.

2.1.6. When requested, Shop Drawings shall be supplemented by data explaining the theory of operation – for example: lighting control sequence of operation – the Engineer's Representative may also request that this information be added to the maintenance and operating manual.

2.1.7. Provide a cover sheet with the project name, issue date, issue number, specification section number, and title of section with space for Shop Drawing review stamps for the Contractor and Engineer's Representative.

3. Execution

3.1. SUBMISSION

3.1.1. Each Shop Drawing or catalogue sheet shall be in original PDF format stamped and signed by the Contractor to indicate that he has checked the drawing for conformance with all requirements of the Drawings and Specifications, that he has co-ordinated this equipment with other equipment to which it is attached and/or connected and that he has verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades. Ensure that electrical and mechanical co-ordination is complete before submitting drawings for review.

3.1.2. Scanned PDF versions are not acceptable.

3.1.3. Equipment shall not be released for manufacture until the shop drawing has been reviewed by Engineer's Representative. Contractor shall assume responsibility and cost for field changes. Installation of any equipment shall not start until after final review of Shop Drawings by the Engineer's Representative has been obtained.

3.1.4. As part of the electrical Engineer's Representative's scope of the work, shop drawings shall be reviewed no more than twice. Should three or more reviews be required due to reasons of Contractor omissions causing resubmission requests, the Contractor shall reimburse the electrical Engineer's Representative for time expended in these extra reviews.

END OF SECTION

26 05 05.00 Mounting Heights

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2. Products

2.1. NOT USED

3. Execution

3.1. MOUNTING HEIGHTS

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

3.1.2. If mounting height of equipment is not specified or indicated, verify with the Consultant before proceeding with installation.

3.1.3. Unless indicated otherwise on the drawings or within the specifications, install electrical equipment at following heights.

- .1 Local switches: 1050 mm.
- .2 Wall receptacles:
  - .1 General: 450 mm.
  - .2 Above top of continuous baseboard heater: 200 mm.
  - .3 Above top of counters or counter splash backs: 175 mm.
  - .4 In mechanical rooms: 1200 mm.
  - .5 In equipment storage rooms: 900mm.
- .3 Panelboards: 2000 mm to top of panel.
- .4 Telephone and interphone outlets: 450 mm.
- .5 Wall mounted telephone and interphone outlets: 1050 mm.
  - .1 Fire alarm stations: 1200 mm.
  - .2 Fire alarm stations: 1050 mm.
- .6 Wall Mounted Fire alarm audible devices: 2300 mm.
- .7 Television outlets not mounted behind a wall mounted television: 450 mm.
- .8 Wall mounted speakers: 2100 mm.
- .9 Clocks: 2100 mm.
- .10 Power Door Operator pushbuttons: 1050 mm.
- .11 Wall mounted Exit Signs
  - .1 For 2400 mm to 2500 mm ceiling heights: 2100 mm.
  - .2 For all ceilings heights greater than 2500 mm: 2400 mm.

.12 Wall mounted Battery Packs and Emergency Heads

.1 For 2400 mm to 2500 mm ceiling heights: 2100 mm.

.2 For all ceilings heights greater than 2500 mm: 2400 mm.

.13 Wall mounted occupancy sensors: 1050 mm.

.14 Wall mounted visible signal devices: entire lens shall be no less than 2000 mm and no more than 2400 mm.

.15 Top of remote annunciator and passive graphic panels shall be no more than 1800mm above finished floor.

.16 Wall mounted emergency telephone (Fireman’s Handset): 1350 to 1500mm.

END OF SECTION

26 05 21.00 Wires and Cables 1000V

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. REFERENCES

1.2.1. CSA C22.2 No.0.3, Test Methods for Electrical Wires and Cables, latest edition.

1.2.2. CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables, latest edition.

1.2.3. CSA-C22.2 No. 51, Armoured Cables, latest edition.

1.2.4. CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, latest edition.

1.2.5. CSA-C22.2 No. 96, Portable Power Cables, latest edition.

1.2.6. CSA-C22.2 No. 123, Metal Sheathed Cables, latest edition.

1.2.7. CSA-C22.2 No. 124, Mineral-Insulated Cable, latest edition.

1.2.8. CSA-C22.2 No. 131, Type TECK 90 Cable, latest edition.

1.2.9. CSA-C22.2 No. 174, Cables and Cable Glands for Use in Hazardous Locations, latest edition.

1.2.10. CAN/ULC S139, Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data, and Optical Fibre Cables, latest edition.

1.2.11. UL 2196, Standard for Tests for Fire Resistive Cables, latest edition.

1.2.12. ASTM B800 - Standard Specification for 8000 Series Aluminium Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

2. Products

2.1. BUILDING WIRES

2.1.1. Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

2.1.2. Contractor to provide copper conductors on conductors sizes up to and including #8 AWG. Contractor to provide copper conductors for sizes larger than #8 AWG unless identified as aluminium or NUAL on the drawings.

2.1.3. All conductors to have size as indicated, with insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90 to CSA-C22.2 No.38 rated as follows:

.1 Insulation rated at 1000V for 600V systems that are ungrounded or have a neutral grounding resistor to limit ground fault current

.2 Insulation rated at 600V for the other 600V and 347/600V distribution systems not covered under item #1 above.

.3 Insulation rated at 600V for all systems rated at 480V and less.

2.1.4. All aluminium or NUAL conductors to be an aluminium alloy with CSA certified as an Aluminium conductor material (ACM) and meet the requirements of the Aluminium Association Inc. AA8030 and ASTM B800 standards. Provide an anti-oxidant compound, Ideal NOALOX, on all aluminum conductor terminations.

2.1.5. RWU-90 wiring is to be used for underground installations.

2.2. TECK CABLE

2.2.1. Cables to CSA-C22.2 No.131.

2.2.2. Conductors:

.1 Bonding conductor: copper.

.2 Circuit conductors: copper, size as indicated unless aluminium or NUAL is identified on the drawings. Aluminium or NUAL conductor to be provided as per item 2.1.4.

2.2.3. Insulation:

.1 Chemically cross-linked thermosetting polyethylene type RW90, rated 1000 V.

2.2.4. Inner jacket: polyvinyl chloride material.

2.2.5. Armour: interlocking aluminum.

2.2.6. Overall covering: thermoplastic polyvinyl chloride material rated at a minimum of FT-4. Provide FT-6 jacket when TECK cables are run in return air plenum.

2.3. VARIABLE FREQUENCY DRIVE CABLES

2.3.1. Variable frequency drives are also known as variable speed drives.

2.3.2. Cables to CSA-C22.2 No. 123 and CSA-C22.2 No. 174.

2.3.3. Conductors:

.1 Three (3) bare bonding conductor coppers sized to Table #16 of the electrical code.

.2 Circuit conductors: copper, size as indicated.

2.3.4. Insulation:

.1 Chemically cross-linked thermosetting polyethylene type RW90, rated 1000 V.

2.3.5. Inner jacket: polyvinyl chloride material.

2.3.6. Armour: interlocking aluminum.

2.3.7. Overall covering: thermoplastic polyvinyl chloride (PVC) material rated at a minimum of FT-4.

2.4. MINERAL-INSULATED CABLES

2.4.1. Where two (2) hour fire rating is indicated on the drawings, provide Mineral-Insulated cables.

2.4.2. Conductors: solid bare soft-annealed copper, size as indicated.

2.4.3. Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.

2.4.4. Overall covering: annealed seamless copper sheath, Type M1 rated 600 V, 250 C.

2.4.5. Outer jacket: PVC applied over sheath.

2.4.6. Two (2) hour fire rating.

2.4.7. Conform to requirements of CSA-C22.2 No. 124; and ULC S 139.

2.4.8. All mineral-insulated cable larger than #6 AWG shall be single conductor. For conductors #6AWG and smaller, multi-conductor mineral-insulated cable is acceptable.

2.5. FIRE RATED MC CABLE

2.5.1. Conductors: stranded annealed copper, size as indicated.

2.5.2. Insulation: low smoke silicon rubber.

2.5.3. Armour: continuously welded and corrugated copper sheath,

2.5.4. Outer Jacket: Black low smoke, zero halogen polyolefin, FT4 rated

2.5.5. Two hour fire rating.

2.5.6. Conform to requirements of CSA-C22.2 No. 123; UL 2196 and ULC S 139 with hose stream.

2.6. ARMOURED CABLES

2.6.1. Cables to: CSA-C22.2 No. 51.

2.6.2. Circuit conductors: copper, size as indicated unless aluminium or NUAL is identified on the drawings. Aluminium or NUAL conductor to be provided as per item 2.1.4.

2.6.3. Type: AC90 (BX).

2.6.4. Armour: interlocking type fabricated from aluminium strip.

2.6.5. Type: ACWU90 - PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA-C22.2 No.0.3 with maximum flame travel of 1.2 m.

2.7. ALUMINUM SHEATHED CABLE

2.7.1. Circuit conductors: copper, size as indicated unless aluminium or NUAL is identified on the drawings. Aluminium or NUAL conductor to be provided as per item 2.1.4.

2.7.2. Insulation: type RA90 rated 1000 V.

2.7.3. Sheath: aluminium applied to form continuous corrugated seamless sheath.

2.7.4. Outer jacket of PVC applied over sheath for direct burial or wet locations.

2.8. DIESEL LOCOMOTIVE CABLES (DLO)

2.8.1. Cable: to CSA-C22.2 No. 96 Portable Power Cables, rated to 2000V.

2.8.2. Conductor: stranded tinned annealed copper, size and number as indicated

2.8.3. Separator: Paper or polyester tape separates the conductor from the rubber insulation to aid in stripping.

2.8.4. Insulation: premium grade Ethylene Propylene Rubber (EPR), rated 90 deg. C.

2.8.5. Jacket: Black, heavy duty chlorinated polyethylene (CPE), sunlight resistant, rated at a minimum of FT-4.

2.9. WIRING TERMINATION

2.9.1. Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

2.9.2. Lugs, terminals, screws used for termination of multiple wires must be rated for their intended use.

3. Execution

3.1. GENERAL

3.1.1. Provide a minimum of one bonding conductor for each three ungrounded conductors on all conduit and cable runs. Provide separate bonding conductors for each ground fault circuit interrupter circuits. All bonding conductors to be copper and insulated with a green coloured insulation.

3.1.2. Size bonding conductor to applicable tables of the:

.1 Ontario ElectricalSafety Code.

.2 Canadian Electrical Code.

3.1.3. All equipment, junction boxes, pull boxes, liquid tight flex, etc. to be bonded to ground through bonding conductors.

3.1.4. Provide separate neutral conductor for each 120 volt circuit for all circuits feeding receptacles and power outlets.

3.1.5. Provide a variable frequency drive (VFD) cable from each VFD unit to each motor. Wiring to be installed in accordance with the VFD and motor manufacturer instructions.

3.1.6. All cable terminations to be compression type fittings for wire sizes greater than #8 AWG. All compression type fittings to be two-hole long barrel type with inspection / viewing window. Where mechanical screw type lugs are allowed by the Engineer's Representative, they will be suitable for quantity of parallel runs of wire that are to be terminated under.

3.1.7. Armoured Cable Type AC90 (BX) may only be used for individual drops from slab mounted junction box to recessed mounted light fixtures or where noted on the drawings where wiring is required to be installed within an existing wall. The maximum allowable distance of armoured cable is 3m. Contractor to receive written approval from the Engineer's Representative to run armoured cable further than 3m from junction box. Daisy chaining of fixtures is only acceptable in dry wall ceilings. Wiring in conduit is to be brought to a junction box to allow for the transition to armoured cable. Armoured cable is not to be installed directly into electrical panels or run in walls for receptacles.

3.1.8. Branch circuit wiring to be upsized as follows to address voltage drop when:

.1 The entire length of the circuit wiring exceeds 25 m – branch wiring to be a minimum of No. 10 AWG.

.2 The entire length of the circuit wiring exceeds 40 m – branch wiring to be a minimum of No. 8 AWG.

.3 The entire length of the circuit wiring exceeds 60 m – branch wiring to be a minimum of No. 6 AWG.

3.1.9. Wire Splicing

.1 Splice up to and including No. 6 AWG with nylon insulated expandable spring type connectors.

.2 Splice larger conductors using compression type connectors wrapped in PVC insulation rated at the respective voltage.

3.2. INSTALLATION OF BUILDING WIRES

3.2.1. Install all building wiring in conduit unless otherwise noted. Conduit to be sized to the electrical code unless noted on the drawings or in the specifications.

3.2.2. All conductors are to be colour coded. Provide colour tape at all terminations to identify all conductors in each run.

3.3. INSTALLATION OF TECK90 CABLE, VARIABLE FREQUENCY DRIVE CABLE, ARMOURED CABLE OR ALUMINUM SHEATHED CABLE

3.3.1. Group cables wherever possible on channels.

3.3.2. Terminate cables in accordance with manufacturer's instructions.

3.3.3. Fastenings:

.1 One-hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables.

.3 Galvanized threaded rods: 6 mm dia. minimum to support suspended channels.

3.3.4. Connectors:

.1 Watertight, approved for respective cables.

3.3.5. For single conductor cables, ground the sheath at the upstream (source) panel and provide insulated fibre plate at the load end, so as to prevent circulating sheath currents.

3.4. INSTALLATION OF MINERAL-INSULATED AND FIRE RATED MC CABLES

3.4.1. Handling:

.1 Cable shall be uncoiled by rolling or rotating supply reel. Do not pull from coil periphery or centre.

3.4.2. Bending:

.1 Not less than six (6) times the cable diameter for cable not more than 250 kcmil.

.2 Not less than twelve (12) times the cable diameter for cable diameter for cable more than 350 and 500 kcmil.

3.4.3. Splicing:

.1 All fire rated splices shall be made in the factory. In the event of a field splice is necessary, it must be made in the field by manufacturer's field technician.

3.4.4. Terminations:

.1 Field made terminations shall be made with cable manufacturer's termination kits only. Stripping tools, crimping and compression tools available from the manufacturer shall be used for proper cable termination.

.2 Connections to ferrous cabinets for single conductor cables shall incorporate brass plates. Installed per manufacturer's drawing.

.3 At cable terminations use thermoplastic sleeving over bare conductors.

3.4.5. Sheath induction reduction:

.1 When multi-phase circuits have paralleled single conductors, cables shall be run in groups having one of each phase in each group.

.2 Each set of paralleled conductors shall be separated by at least two single cable diameters.

3.4.6. Exposed or Surface Installations:

.1 Cable shall be secured directly to fire rated building structure using:

.1 Straps: 13 mm wide x 38 mm long by 0.75 mm thick stainless steel or copper straps. Each strap shall contain two 5 mm-holes for securing with 5 mm by minimum 44 mm long steel anchors.

.2 Support 2 hr fire rated cables at 1 m intervals.

3.4.7. Wall or floor penetrations:

.1 Provide approved fire stopping of all penetrations.

.2 Neatly train and lace cable inside boxes, equipment, and panelboards.

.3 Where cables are buried in cast concrete or masonry, sleeve for entry of cables.

.4 When penetrating a fire rated wall or fire rated floor, the cable must extend a minimum of 305mm beyond the fire rated wall or fire rated floor. The 305mm dimension can be in any direction as 305mm of cable length is required to allow for proper heat dissipation such that cable terminations do not overheat.

3.5. FIELD QUALITY CONTROL

3.5.1. Prior to energizing wires/cables, measure insulation resistance of each wire/cable. Ensure readings are acceptable per installation recommendations. Tabulate and submit for approval as a submittal.

3.5.2. All Wires and Cables to be tested on site as defined in Section 26 08 01.00 – TECHNICAL SERVICES DIVISION START-UP SERVICE and herein. Contractor to oversee all testing and correct any deficiencies noted.

3.6. INSTALLATION OF CONTROL CABLES

3.6.1. Install control cables in conduit.

3.6.2. Ground control cable shield.

END OF SECTION

26 05 26.00 Grounding + Bonding

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. REFERENCES

1.2.1. CSA C22.2 No. 41– Grounding and Bonding of Equipment, latest edition.

1.2.2. Ontario Electrical Safety Code, latest edition.

1.2.3. Ontario Buiding Code, latest edition.

1.2.4. CSA C22.1 – Canadian Electrical Code, Part 1, latest edition

1.2.5. National Building Code of Canada, latest edition.

1.2.6. CAN/ULC-S115, Fire Tests of Fire Stop Systems, latest edition.

1.2.7. IEEE Standard 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System, latest edition.

1.3. DESCRIPTION

1.3.1. Provide system grounding to meet requirements of current applicable codes.

1.4. SHOP DRAWINGS AND PRODUCT DATA

1.4.1. Submit shop drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.4.2. Submit shop drawings for ground bars and ground rod inspection wells for engineer’s review prior to manufacture.

1.4.3. Submit main system ground test report as a shop drawing for engineer’s review. Include final reviewed report in the project O&M manuals.

2. Products

2.1. GROUNDING & BONDING EQUIPMENT

2.1.1. Meet standard of CSA C22.2 No. 41 – Grounding and Bonding of Equipment, latest edition.

2.2. CONDUCTORS

2.2.1. Bare or insulated, stranded, soft drawn annealed copper wire, for: ground bus, electrode interconnections, metal structures, ground connections, telephone ground.

2.3. LUGS

2.3.1. All grounding connections to be made with compression type fittings and lugs with inspection / viewing window.

3. Execution

3.1. INSTALLATION

3.1.1. Install complete permanent, continuous, system and circuit, equipment, grounding and bonding systems including, conductors, connectors, and accessories, as indicated, to conform to requirements of local authority having jurisdiction over installation.

3.1.2. Provide main station ground grid as shown on drawing but the ground grid shall consist of a minimum of four (4) driven ground rods.Copper ground rods shall be not less than 3 m long and 19 mm in diameter and where practicable located adjacent to the equipment to be grounded (i.e. main electrical room). Interconnect all ground rods underground with a #2/0 AWG bare ground conductor.

.1 If main ground grid cannot be installed directly below the main electrical room, then provide a remote ground grid by installing the ground rods at the lowest floor level of the building and provide two grounding conductors of a minimum of #4/0 AWG copper to connect the ground grid to the main electrical room equipment. Run the two conductors through separate routes separated by a minimum of 5 m.

3.1.3. Supply and install a new ground bus system consisting of a length of copper bus, 25 mm thick ebony pad with chamfered edges as shown on the drawings. A minimum of two 1200 mm ground bars are to be provided in transformer vault(s), main electrical room(s) and generator room(s). Where a perimeter ground bus is shown on the drawings, supply and install a 50 mm x 6 mm copper bus on all walls attached at 1.5 m intervals on 13 mm standoffs. The perimeter ground bus shall be continuous around the room and shall be continued above or below all openings such as doors and vents.

3.1.4. Interconnect the ground bars to the ground grid with a minimum #2/0 AWG bare copper ground conductor if the ground grid is adjacent to the main electrical room(s). Where the ground grid is remote, connect the ground bars to the remote ground grid as described in 3.1.2.(1) above

3.1.5. Supply and install inspection box for each ground rod. Inspection box is to be suitable for installation in heavy traffic areas and is to come complete with a lockable lid and security key.

3.1.6. Connect to the ground bus all metal equipment enclosures, as well as all other metal parts such as mechanical pipes, ducts, waste lines, door frames, railings, grilles, fences, etc. with minimum #2/0 AWG bare copper conductors.

3.1.7. For solidly grounded systems, transformer neutrals, switchboard neutrals and all similar bonding connections, the bonding conductors shall be sized in accordance with Table 16 of the Electrical Code.

3.1.8. Provide cable grips to receive all grounding conductors. Identify all grounding conductors at the ground pad using lamacoid nameplates. Ground bus system to be provided in rooms as shown.

3.1.9. Terminate the following conductors at the ground bus system:

- Service neutral -as indicated on drawings

- Telecommunications ground -as per EIA/TIA standard 607-A (latest edition)

TBB/GE linear length m (ft)	TBB/GE size (AWG)
less than 4 (13)	6
4 – 6 (14 – 20)	4
6 – 8 (21 – 26)	3
8 – 10 (27 – 33)	2
10 – 13 (34 – 41)	1
13 – 16 (42 – 52)	1/0
16 – 20 (53 – 66)	2/0
20 – 26 (67 – 84)	3/0
26 – 32 (85 – 105)	4/0
32 – 38 (106 – 125)	250 kcmil
38 – 46 (126 – 150)	300 kcmil
46 – 53 (151 – 175)	350 kcmil
53 – 76 (176 – 250)	500 kcmil
76 – 91 (251 – 300)	600 kcmil
Greater than 91 (301)	750 kcmil

where,
TBB = Telecommunications Bonding Backbone

- Main system ground -#2/0 AWG or 2 x # 4/0 AWG for remote ground grids
- Bonding conductor -as per Table 16 of CSA C22.1

3.1.10. Ground all metallic water, gas, and waste systems with a minimum #2/0 AWG copper in accordance with code requirements.

3.1.11. Install bonding connections to typical equipment included in, but not necessarily limited to, following list: frames of motors, starters, control panels, building steel work, elevators, distribution panels and outdoor lighting.

3.1.12. Commission an approved certified testing Agency to perform a main system ground test. Submit the main system ground test report as a shop drawing for engineer's review. Provide a copy of the report in the maintenance manual. (Refer to Part 3.2).

3.1.13. Install connectors in accordance with manufacturer's instructions.

3.1.14. Ground rods to be interconnected by grounding grid conductors (sized as per sections above) and buried to a maximum depth of 600 mm below the rough station grade and a minimum depth of 150 mm below the finished station grade.

3.1.15. Protect exposed grounding conductors from mechanical damage.

3.1.16. Install bonding conductor for flexible conduit and connect at both ends to grounding bushing with solderless lug, clamp or cup washer and screw. Neatly cleat bonding conductor to exterior of flexible conduit.

3.1.17. Provide separate, insulated bonding conductor within each feeder and branch circuit raceway.

3.1.18. Interface with the lightning protection system, if one is installed for this building.

3.2. TESTING

3.2.1. The contractor shall pay for the testing and verification of the entire building ground system using a certified testing Agency. Tests shall include main ground grid and ground rods, and grounding connections between all electrical and communication rooms. The agency shall provide complete test reports indicating test methodology and results. All costs shall be included in contract bid.

3.2.2. Following are acceptable methods of testing the ground grid. Testing shall be in accordance with IEEE Standard 81 (latest edition).

.1 Two-Point Method

.2 Three-Point Method

.3 Ratio Method

.4 Staged Fault Tests

.5 Fall-of-Potential Method

END OF SECTION

26 05 29.00 Hangers and Supports

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. SHOP DRAWINGS AND PRODUCT DATA

1.2.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2.2. Conduit and equipment provided under the Electrical division shall be complete with all necessary supports and hangers required for a safe and workmanlike installation.

2. Products

2.1. MATERIALS

2.1.1. Provide “U” type support Strut as manufactured by Unistrut.

3. Execution

3.1. INSTALLATION

3.1.1. The Contractor to supply anchor bolts and base diagrams of equipment showing exact location for anchor bolts.

3.1.2. It shall be the responsibility of the electrical division to supply the Contractor with anchor bolts and base diagrams of equipment showing exact location of anchor bolts.

3.1.3. All drilling for hangers, rod inserts and work of similar nature shall be done by this Division.

3.1.4. Auxiliary structural members shall be provided under the electrical section concerned where conduits or equipment must be suspended between the joists or beams of the structure, or where required to replace individual hanger to allow for installation on new services. Submit details for review as requested.

3.1.5. Depending on type of structure, hangers shall be either clamped to steel beams or joists, or attached to approved concrete inserts.

3.1.6. Approved type expansion shields and bolts may be used for conduit up to 100 mm diameter where the pre-setting of concrete inserts is not practical. Submit Shop Drawings.

3.1.7. Suspension from metal deck shall not be allowed unless specifically accepted by the Engineer’s Representative. Drawings of the proposed method of suspension must be submitted for review.

3.1.8. Hangers, hanger rods and inserts in all parking and ramp areas shall meet the requirements of CAN/CSA-S413 – Parking Structures (latest edition) and shall be of corrosion-resistant material or have an effective, durable corrosion resistant coating. Submit samples for approval.

3.1.9. Suspending one hanger from another shall not be permitted.

3.1.10. All hangers, supports, brackets and other devices used outside the building wall shall be galvanized. If galvanized components cannot be used submit samples of proposed substituted for review before installation.

3.2. HORIZONTAL RUNS ON THE ROOF

3.2.1. Where conduit or cables are run horizontally across a roof, conduit or cable shall be supported from pre-manufactured UV resistant sleepers with closed cell foam base.

3.2.2. Sleepers shall be “E-Z Sleeper” product from Pipe-Ease Inc. or approved equivalent.

3.2.3. Wood Blocks are not acceptable.

END OF SECTION

26 05 31.00 Splitters, Junction, Pull Boxes and Cabinets

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.3. Section 26 05 53.00 – IDENTIFICATION.

1.1.4. Section 26 05 63.00 – ACCESS DOORS AND ACCESSIBILITY.

1.2. REFERENCE

1.2.1. Ontario Electrical Safety Code, latest edition.

1.2.2. Ontario Buiding Code, latest edition.

1.2.3. CSA C22.1 – Canadian Electrical Code, Part 1, latest edition.

1.2.4. National Building Code of Canada, latest edition.

1.2.5. CAN/ULC-S115, Fire Tests of Fire Stop Systems, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit shop drawings and product data for cabinets in accordance with specification Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

2. Products

2.1. SPLITTERS

2.1.1. Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Provide CSA Type 1 enclosures in non-sprinklered environments and CSA Type 4/12 in sprinklered environments.

2.1.2. Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

2.1.3. At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2. JUNCTION AND PULL BOXES

2.2.1. Welded steel construction with screw-on flat covers for surface mounting.

2.2.2. Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.3. CABINETS

2.3.1. Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

2.3.2. Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm plywood backboard for surface or flush mounting. The plywood backboard is to have a fire-resistant coating on the front. Do not paint over plywood fire rating certification stamp.

3. Execution

3.1. SPLITTER INSTALLATION

3.1.1. Install splitters and mount plumb, true and square to the building lines.

3.1.2. Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2. JUNCTION, PULL BOXES AND CABINETS INSTALLATION

3.2.1. Install pull boxes in inconspicuous but accessible locations.

3.2.2. Mount cabinets with top not higher than 2000 mm above finished floor.

3.2.3. Install terminal block as indicated in Type T cabinets.

3.2.4. Only main junction and pull boxes are indicated. Install pull boxes as follows:

.1 A conduit run exceeds 30 m and;

.2 360 degree of combined bends between pull boxes for power conduits or 180 degree of combined bends between pull boxes for communication and low voltage conduits.

3.3. IDENTIFICATION

3.3.1. Provide equipment identification in accordance with Section 26 05 53.00 – IDENTIFICATION.

3.3.2. Install identification labels indicating system name, voltage, and phase.

END OF SECTION

26 05 32.00 Outlet Boxes, Conduit Boxes and Fittings

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.2. REFERENCES

1.2.1. Ontario Electrical Safety Code, latest edition.

1.2.2. Ontario Building Code, latest edition.

1.2.3. CSA C22.1 – Canadian Electrical Code, Part 1, latest edition

1.2.4. National Building Code of Canada, latest edition.

1.2.5. CAN/ULC-S115, Fire Tests of Fire Stop Systems, latest edition.

2. Products

2.1. OUTLET AND CONDUIT BOXES GENERAL

2.1.1. Size boxes in accordance with the electrical code.

2.1.2. Square or larger outlet boxes as required for special devices.

2.1.3. Gang boxes where wiring devices are grouped.

2.1.4. Blank cover plates for boxes without wiring devices.

2.1.5. 347V outlet boxes for 347 V switching devices.

2.1.6. Combination boxes with barriers where outlets for more than one system are grouped.

2.2. SHEET STEEL OUTLET BOXES

2.2.1. Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 75 mm x 50 mm x 38 mm or as indicated. 100 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

2.2.2. Provide cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles connected to rigid conduit.

2.2.3. Provide electro-galvanized steel utility boxes for surface mounted boxes connected to surface-mounted EMT conduit, minimum size 100 mm x 54 mm x 48 mm.

2.2.4. Square or octagonal outlet boxes for lighting fixture outlets.

2.2.5. Square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3. MASONRY BOXES

2.3.1. Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4. CONCRETE BOXES

2.4.1. Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5. FLOOR BOXES

2.5.1. Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.

2.5.2. Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12.7 mm and 19 mm conduit. Minimum size: 73 mm deep.

2.6. OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

2.6.1. Electro-galvanized, sectional, screw ganging steel boxes, minimum size 75 mm x 50 mm x 63.5 mm with two double clamps to take non-metallic sheathed cables.

2.7. FITTINGS - GENERAL

2.7.1. Bushing and connectors with nylon insulated throats.

2.7.2. Knock-out fillers to prevent entry of debris.

2.7.3. Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

2.7.4. Double locknuts and insulated bushings on sheet metal boxes.

2.8. SERVICE FITTINGS

2.8.1. 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for duplex receptacles. Bottom plate with two knockouts for centered or offset installation.

2.8.2. Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate Amphenol jack connectors.

3. Execution

3.1. INSTALLATION

3.1.1. Support boxes independently of connecting conduits.

3.1.2. Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

3.1.3. For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

3.1.4. Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

3.1.5. Non-combustible electrical outlet boxes that penetrate a fire separation or a membrane forming part of an assembly required to have a fire-resistance rating, do not require fire stops provided,

.1 they do not exceed:

.1 100 cm^2 each in area, AND

.2 an aggregate area of 650 cm^2 in any 9.3 m^2 of surface area, AND

.2 The annular space between the membrane and the box does not exceed 3 mm.

3.1.6. Where the conditions of clause 3.1.5 are not met, provide fire stops for the outlet boxes.

3.1.7. Opposing outlets on non-fire rated partition walls shall have a minimum 150 mm horizontal separation. Outlets shall not be mounted back to back.

3.1.8. Conform to the fire stopping requirements of the building code: unless provided with a fire stop in accordance with CAN/ULC-S115, “Fire Tests of Fire Stop Systems”, electrical outlet boxes on opposite sides of a vertical fire separation required to have a fire-resistance rating shall be separated by a horizontal distance of not less than 600 mm, or be installed in adjacent stud cavities.

END OF SECTION

26 05 34.00 Conduits, Conduit Fasteners and Fittings

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 31.00 – SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

1.1.3. Section 26 05 32.00 – OUTLET BOXES, CONDUIT BOXES AND FITTINGS

1.2. REFERENCES

1.2.1. CAN/CSA C22.2 No.18- Outlet Boxes, Conduit Boxes, and Fittings, latest edition.

1.2.2. CSA C22.2 No.45.1- Electrical Rigid Metal Conduit - Steel, latest edition.

1.2.3. CSA C22.2 No.56- Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, latest edition.

1.2.4. CSA C22.2 No.83- Electrical Metallic Tubing, latest edition.

1.2.5. CSA C22.2 No.211.2- Rigid PVC (Unplasticized) Conduit, latest edition.

1.2.6. CAN/CSA C22.2 No.227.3- Flexible Non-metallic Tubing, latest edition.

1.2.7. CSA C22.2 No.227.1 - Electrical Non-Metallic Tubing, latest edition.

2. Products

2.1. CONDUITS

2.1.1. Electrical rigid metal conduit: to CSA C22.2 No.45.1, galvanized steel or aluminum threaded.

2.1.2. Epoxy coated conduit: to CSA C22.2 No.45, with zinc coating and corrosion resistant epoxy finish inside and outside.

2.1.3. Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings.

2.1.4. Rigid PVC conduit: to CSA C22.2 No.211.2.

2.1.5. Flexible metal conduit: to CSA C22.2 No.56, steel or liquid-tight flexible metal.

2.1.6. Electrical non-metallic tubing (ENT): to CSA C22.2 No. 227, with couplings.

2.2. CONDUIT FASTENINGS

2.2.1. One-hole steel straps to secure surface conduits NPS 2 and smaller. Two-hole steel straps for conduits larger than NPS 2.

2.2.2. Beam clamps to secure conduits to exposed steel work.

2.2.3. Channel type supports for two or more conduits at 1 m oc.

2.2.4. Hot dipped galvanized threaded rods, 6 mm dia. minimum, to support suspended channels.

2.3. CONDUIT FITTINGS

2.3.1. Fittings: manufactured for use with conduit specified. Coating: same as conduit.

2.3.2. Factory 90 degree elbow where 90 bends are required for 1” and larger conduits when a hydraulic bender is not used.

2.3.3. Connectors, and couplings for EMT conduit are to be set-screw steel type. Below the level of suspended ceilings, in a sprinklered environment, provide watertight fittings and “O” rings on all conduit runs and when conduit is terminated at any piece of electrical equipment.

2.3.4. Provide plastic bushings for all connectors, rigid nipples and rigid conduit 32mm or larger.

2.4. EXPANSION FITTINGS FOR RIGID CONDUIT

2.4.1. Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

2.5. FISH CORD

2.5.1. Fish cord to be made of polypropylene.

3. Execution

3.1. INSTALLATION

3.1.1. All conduits on project to be surface mounted. No conduits in cast in-place concrete or in slab conduits will be allowed unless written consent is received from the Engineer’s Representative and Owner. Only once approved by the Engineer’s Representative and Owner do the clauses contained within this section and the respective sections relating to conduits in cast in-place concrete or in slab conduits apply.

3.1.2. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.1.3. Conceal conduits except in mechanical and electrical service rooms or in unfinished areas. Conduits to have their own support system and are to be supported independently of the ceiling grid or ceiling support system.

3.1.4. Where vertically run conduit passes through a slab, Contractor to provide a 100mm high concrete pad with the pad extending 100mm on all sides of the conduit.

3.1.5. Use electrical metallic tubing (EMT) conduit except where specified otherwise.

3.1.6. Use epoxy coated conduit in corrosive areas.

3.1.7. Use rigid galvanized steel threaded conduit where conduit is subject to mechanical damage.

3.1.8. Use rigid PVC conduit underground or in corrosive areas and where indicated.

3.1.9. Use flexible metal conduit for connection to motors or vibrating equipment in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.

3.1.10. Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations. Use only liquid tight fittings when using liquid tight flexible metal conduit. Liquid tight flexible metal conduit to have a jacket with an FT6 rating when used in plenums otherwise provide a minimum FT4 rating.

3.1.11. Use explosion proof flexible connection for connection to explosion proof motors.

3.1.12. Install conduit sealing fittings in hazardous areas. Fill with compound.

3.1.13. Minimum conduit size for lighting and power circuits: NPS 21mm, unless otherwise noted on the drawings.

3.1.14. Install EMT conduit from a raised floor branch circuit panel to outlet boxes located in sub floor.

3.1.15. Install EMT conduit from a raised floor branch circuit panel to junction box in sub-floor. Run flexible metal conduit from junction box to outlet boxes for equipment connections in sub-floor.

3.1.16. Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

3.1.17. Mechanically bend steel conduit over 19 mm dia.

3.1.18. Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

3.1.19. Install fish cord in empty conduits.

3.1.20. Run two 27mm spare conduits up to ceiling space and two 27mm spare conduits down to sub-floor space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes or in case of an exposed concrete slab, terminate each conduit in flush concrete or surface type box.

3.1.21. Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

3.1.22. Dry conduits out before installing wire.

3.1.23. All cutting and patching of masonry/concrete floors, walls, and roof for electrical services shall be by this Division. Obtain approval from the Landlord and/or structural Engineer's Representative before cutting any structural walls or floors. Cutting and drilling shall only be at times allowed by the Landlord. Check and verify the location of existing mechanical and electrical services in walls and below the floor slab in all areas requiring core drilling and cutting. Protect all tenant areas where core drilling occurs. Carefully chip top and bottom of slab to expose rebar to minimize cutting of rebar when core drilling. Provide x-ray study before drilling or cutting where required by the Landlord and/or structural Engineer's Representative.

3.1.24. Provide sleeves for all new conduit passing through floor and roof slabs, beams, concrete walls and slab to slab partitions, etc.

3.1.25. Where cables and conduits pass through partitions and through floors that are not fire rated, provide an air-tight seal around the cables and conduits.

3.1.26. Where cables and conduits pass through floors and fire rated walls, pack space between conduit (or cable) and sleeve with an approved fire stop as specified in Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

3.1.27. Prior to installation of any wire or cable in the ducts, pull through each duct a flexible mandrel not less than 300 mm long and size for the internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Notify the engineer's representative no less than 48 hours prior to the event, so that the engineer's representative may witness.

3.2. SURFACE CONDUITS

3.2.1. Run parallel or perpendicular to building lines.

3.2.2. Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

3.2.3. Run conduits in flanged portion of structural steel.

3.2.4. Group conduits wherever possible on suspended or surface mounted channels.

3.2.5. Do not pass conduits through structural members, except as indicated.

3.2.6. Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.2.7. Conduits must not be used to support other conduits.

3.3. CONCEALED CONDUITS

3.3.1. Run parallel or perpendicular to building lines.

3.3.2. Do not install horizontal runs in masonry walls.

3.3.3. Do not install conduits in terrazzo or concrete toppings.

3.4. CONDUITS IN CAST-IN-PLACE CONCRETE

3.4.1. Locate to suit reinforcing steel. Install in centre one third of slab.

3.4.2. Protect conduits from damage where they stub out of concrete.

3.4.3. Install sleeves where conduits pass through slab or wall.

3.4.4. Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

3.4.5. Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

3.4.6. Encase conduits completely in concrete with minimum 25 mm concrete cover.

3.4.7. Organize conduits in slab to minimize cross-overs.

3.5. CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

3.5.1. Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.6. CONDUITS UNDERGROUND

3.6.1. Slope conduits to provide drainage.

3.6.2. For all non-PVC conduits run underground, provide waterproof joints with heavy coat of bituminous paint.

END OF SECTION

26 05 44.00 Installation of Cables in Trenches and in Ducts

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 08 01.00 – TECHNICAL SERVICES DIVISION START-UP SERVICES.

1.1.3. Section 33 71 19.00 - CONCRETE ENCASED DUCT BANKS AND MAINTENANCE CHAMBERS.

2. Products

2.1. CABLE PROTECTION

2.1.1. Protect existing cables in manholes and trenches with 38 mm x 140 mm planks pressure treated with 5% pentachlorophenol solution, water repellent preservative.

2.2. MARKERS

2.2.1. Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

3. Execution

3.1. CABLE INSTALLATION IN DUCTS

3.1.1. Install cables as indicated in ducts.

3.1.2. Pull a steel mandrel through each duct less than 300 mm long and of a diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.

3.1.3. Install a polypropylene pull string in each duct if one does not exist. Pull string to remain after cable has been installed.

3.1.4. Do not pull spliced cables inside ducts.

3.1.5. Install multiple cables in duct simultaneously.

3.1.6. Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

3.1.7. To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

3.1.8. Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

3.1.9. After installation of cables, seal duct ends with duct sealing compound.

3.2. MARKERS

3.2.1. Mark cable every 150 m along cable or duct runs and changes in direction.

3.2.2. Mark underground splices.

3.2.3. Where markers are removed to permit installation of additional cables, reinstall existing markers.

3.2.4. Lay concrete markers flat and centered over cable with top flush with finish grade.

3.3. FIELD QUALITY CONTROL

3.3.1. Perform tests in accordance with Section 26 08 01.00 – TECHNICAL SERVICES DIVISION START-UP SERVICES.

END OF SECTION

26 05 53.00 Identification

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. REFERENCES

1.2.1. Ontario Electrical Safety Code.

1.2.2. Ontario Buiding Code.

1.2.3. CSA C22.1 – Canadian Electrical Code, Part 1, latest edition

1.2.4. National Building Code of Canada, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

2. Products

2.1. EQUIPMENT IDENTIFICATION

2.1.1. Identify electrical equipment with nameplates as follows:

.1 Lamacoid 3 mm thick plastic engraved sheet, black or red face, white core, mechanically attached with self-tapping screws or rivets.

.2 White letters 12 mmhigh for major switchboards, panelboards and power transformers.

.3 White letters 12 mm high for terminal boxes, junction boxes, grid boxes, splitter boxes, disconnect switches starters and contactors.

.4 Allow for an average of fifty (50) to one hundred (100) letters per nameplate.

.5 Identification to be in English.

.6 Black nameplates for normal power.

.7 Red nameplates for emergency power.

.8 Blue nameplates for UPS Power.

.9 Sample:

SWITCHBOARD AA

3000A, 600/347V, 3 PH, 4W, 50kA

FED FROM SWITCHBOARD AAA

MANUFACTURED IN MM/YYYY; SERIAL NUMBER ##-####

.10 Wording on nameplates to be approved by Engineer's Representative prior to manufacture.

.11 Nameplates for splitters, terminal cabinets, grid boxes, pull boxes, and junction boxes are to indicate the system and/or voltage characteristics.

.12 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.13 Transformers: indicate capacity, primary and secondary voltages, and upstream source where Transformer is fed from.

.14 Mechanical equipment: indicate equipment name and full circuit number including panel board identification.

.15 Switchboards, Distribution Panels, and Panelboards: Name designation, rated ampacity, voltage, number of phases, and number of wires, if neutral is rated for 200%, interrupting capacity in units of kA, upstream source from which panelboard is fed, month and year manufactured, and serial number.

.16 Automatic Transfer Switches (ATS): Name designation, rated ampacity, voltage, transfer switch arrangement (e.g. 3 pole with no neutral, 3 pole with solid neutral, 3 pole with overlapping neutral, 4 pole), withstand rating in units of kA, upstream normal power source from which ATS is fed, upstream emergency power source from which ATS is fed, month and year manufactured, and serial number.

.17 Generators:

.1 Indicate kW rating, kVA rating, voltage, number of phases, number of wires, generator neutral grounding arrangement, year and month manufactured, and engine and alternator serial number.

.2 Indicate Maximum Site Design Load (as defined in CSA C282) in units of kW; engineering firm responsible for Maximum Site Design Load calculation; drawing number, issuance title (e.g. Issued for Construction, Electrical Contactor As-Built, Issued for CCN-E01,etc.), and issuance date which Maximum Site Design Load is based on. It is very important for future renovations and load additions that it is clear when the Maximum Site Design Load is from and what drawing it is based on.

.3 Sample nameplate:

Generator G1

600 kW / 750 kVA

600/347V, 3 PH, 4W, Wye solidly grounded

Connected to ATS-PHXA

MANUFACTURED IN MM/YYYY; SERIAL NUMBER ##-####

Maximum Site Design Load 420 kW

.18 Provide nameplates on all electrical equipment including:

.1 Splitters, terminal cabinets, grid boxes, pull boxes, and junction boxes

.2 Disconnects, starters and contactors, and Mechanical equipment

.3 Transformers

.4 Switchgear, Switchboards, Distribution Panels, and Panelboards

.5 Automatic Transfer Switches

.6 Generators

.7 UPS equipment

.8 Lighting control systems

2.1.2. Labels:

.1 A printed label, similar to a Brady label 6 mm high letters unless specified otherwise, for internal components, such as relays, fuses, terminal blocks.

2.2. WIRING IDENTIFICATION

2.2.1. Identify wiring with permanent legible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

2.2.2. Maintain phase sequence and colour coding throughout.

2.2.3. Colour code: in conformance with the electrical code.

2.2.4. Use colour coded wires in communication cables and control wiring, matched throughout system.

2.3. CONDUIT AND CABLE IDENTIFICATION

2.3.1. Colour code conduits, boxes and metallic sheathed cables.

2.3.2. Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

2.3.3. Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour:

.1 up to 250 V Normal Power = Green

.2 up to 600 V Normal Power = Blue

.3 up to 250 V Emergency Power = Black

.4 up to 600 V Emergency Power = Orange

.5 High Voltage, greater than 750 V = Large independent label clearly identifying the voltage

.6 Telephone/Data = White

.7 Fire alarm = Red

.8 Other security systems = Yellow

.9 Controls = Purple

2.4. RECEPTACLE IDENTIFICATION

2.4.1. All receptacles including systems furniture receptacles and whip connections are to be labelled with the respective circuit numbers with a printed label, similar to a Brady label, with 12mm characters. Circuit number to include full circuit number including panel board identification.

2.4.2. Label to be placed on wall above cover plate or on cover plate. Location of label to be consistent throughout project.

2.5. MANUFACTURERS AND CSA LABELS

2.5.1. Visible and legible after equipment is installed.

2.6. WARNING SIGNS

2.6.1. Provide warning signs, as specified, and/or to meet the requirements of the Inspection Authorities.

2.7. FUSE SIZE LABELLING

2.7.1. Contractor to install a label on all equipment with fuses to identify the fuse sizes and class that are installed in the respective equipment.

2.7.2. Contractor to also install a label on all equipment with fuses to identify the maximum allowable fuse size based on the size of the respective feeders.

3. Execution

3.1. NOT USED

END OF SECTION

26 05 73.00 Electrical Power System Studies

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. REFERENCES

1.2.1. CSA Z462 – Workplace Electrical Safety, latest edition.

1.2.2. IEEE 1584 – IEEE Guide for Performing Arc Flash Hazard Calculations, latest edition.

1.2.3. NFPA 70E – Standard for Electrical Safety in the Workplace, latest edition.

1.3. SUMMARY

1.3.1. The electrical power system studies for the project shall be performed by an approved electrical power systems contractor. The type and content of each study is specified in the following articles.

1.3.2. The extent of the power systems studies shall include from the main utility connection down to the branch circuit panels. All relays and fuse sizes to be included to ensure the best operation of the entire system. The studies shall also be performed to include the operation of the emergency power generation system.

1.3.3. Contractor to label and re-label with the appropriate Client approved label all equipment that is new or the calculated values have changed from what is currently shown.

1.4. SHOP DRAWINGS AND PRODUCT DATA

1.4.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.4.2. Completed electrical power system studies shall be bound and submitted to the Engineer. The study must be stamped and signed by a professional engineer in the applicable jurisdiction of the project.

1.4.3. Contractor providing electrical power systems study to allow for revisions/adjustments based on review and actual transformer impedances.

1.4.4. Provide a minimum of three (3) bound coloured copies to Owner and Engineer for review. Modify studies based on comments received and continue to re-issue until a final version is agreed upon.

1.4.5. Provide a copy of the working electronic file on a CD/USB Flash Drive along with each of the final copies of the studies. Identify what software was used to complete the studies. The information contained within the project file remains the property of the owner and can be used by the Owner for future system modifications.

1.4.6. Provide samples of the proposed arc flash labels. All labels to match the Owners standard labels.

1.4.7. Contractor shall submit power system study at the same time as shop drawings for electrical distribution equipment, such that the Engineer can review the adequacy of equipment interrupting capacity or withstand ratings, prior to equipment being released for manufacture. In situations where the entire study cannot be submitted with the electrical distribution shop drawings, contractor shall submit at a minimum a preliminary short circuit study for review.

2. Product

2.1. ELECTRICAL POWER SYSTEM STUDIES

2.1.1. The power study software must be Etap. The ETAP as-built power study software modelling files and library used to complete this study shall be submitted to City of Brampton in native ETAP format in USB/cloud at the end of the project.

2.1.2. Short-Circuit Analysis

.1 Calculation of maximum RMS symmetrical three-phase short-circuit and single line to ground fault current at each significant location in the electrical system shall be made using a digital computer.

.2 Appropriate motor short-circuit contribution shall be included at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment will be subjected to under fault conditions.

.3 A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment.

.4 The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

.5 Include a computer printout identifying the maximum available short-circuit current in RMS symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.

.6 The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.

.7 A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for the improvements to the system.

.8 The contractor shall be responsible for supplying conductor information (lengths, types, number per phase, etc.) in a timely manner to allow the short-circuit analysis to be completed prior to final installation.

.9 Any inadequacies shall be called to the attention of the engineer (architect) and recommendations made for improvements as soon as they are identified.

2.1.3. Protective Device Time-Current Coordination Analysis

.1 The time-current coordination analysis shall be performed with the aid of a digital computer and will include the determination of settings, ratings, or types for the over-current protective devices supplied.

.2 A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current

characteristics of series connected over-current devices and other pertinent system parameters.

.3 Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

.4 The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable over-current protective devices, the equipment where the device is located, and the device number corresponding to the device on the system one-line diagram.

.5 A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

.6 A discussion section which evaluates the degree of system protection and service continuity with over-current devices, along with recommendations as required for increasing system protection or device coordination.

.7 Significant deficiencies in protection and/or coordination shall be called to the attention of the engineer (architect) and recommendations made for improvements as soon as they are identified.

2.1.4. Arc Flash/Incident Energy Study

.1 An Arc Flash/Incident Energy Study shall be performed to determine the incident energy and arc flash protection boundary at each piece of electrical equipment and to identify the level of PPE required by people working on that respective equipment.

.2 All equipment rated at 208V fed from a transformer less than 125kVA are not required to be included in the study. Equipment not included in the study is to receive a common arc-flash label that does not include equipment specific data.

.3 The study shall take into account all the information set forth in the short circuit study and the coordination study. Contractor to use the minimum and maximum fault currents provided by the utility to determine the worst incident energy levels. Provide two columns in your arc flash summary sheet identifying the current at both fault levels. Contractor to revisit the coordination study and revise coordination to provide the minimum incident energy levels as possible. Provide recommendations to reduce the incident energy levels even further at the risk of affecting the coordination to allow Owner and Engineer's Representative to review options and provide feedback.

.4 Calculate the arc flash hazard, incident energy level and the flash protection boundary as per IEEE 1584. PPE level recommendations as per NFPA 70E / CSA Z462.

.5 All electrical equipment to be identified with the incident energy, flash protection boundary and level of PPE required.

.6 Purpose made labels to be provided on all electrical equipment. All equipment where levels were not calculated are to be provided with a standard warning label. Label samples to be submitted for review by Owner and Engineer's Representative.

2.2. APPROVED ELECTRICAL POWER SYSTEMS CONTRACTORS

2.2.1. The power system studies shall be completed by qualified and experienced personnel.

2.2.2. The specified electrical power system studies shall be performed by:

.1 G.T. Wood.

.2 K-Line – K-Tek.

.3 Schneider-Electric Services.

.4 Eaton - Cutler-Hammer Service Group.

.5 Pelikan Inc.

.6 General Electric (GE).

.7 Eastenghouse.

.8 AC Tesla.

.9 Brosz Technical Services.

.10 Enkompass Power and Energy Corp.

3. Execution

3.1. GENERAL

3.1.1. Contractor to include for all on site surveys and investigations in order to obtain all the relevant information to complete all the studies.

3.1.2. The relays and equipment will be set up on site by the Technical Start-Up Services Contractor. Coordinate with this Contractor to ensure information is relayed accordingly.

3.1.3. Review work on site to ensure equipment has been set up as per the coordination study. Have the Technical Services Start-up Contractor test systems at random to ensure the coordination study has been adhered to.

3.1.4. Submit a report and a letter reporting to the Engineer and Owner that the coordination study information has been followed.

3.1.5. Contractor to revise fuse sizes as identified in the report and modify the drawings to represent as-built conditions.

3.2. LABELLING

3.2.1. Install arc flash labels on all equipment. Coordinate with the electrical contractor.

3.3. TRAINING

3.3.1. Provide one day of in-depth training on arc-flash safety detailing the industry and code requirements including the details of the specific project for the Owner and the Owner’s representatives.

END OF SECTION

26 05 83.00 Sleeves

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Sleeves passing through stud partitions shall be 0.75 mm 22 US Gauge steel.

2.1.2. Sleeves passing through masonry walls shall be Schedule 40 steel pipe.

2.1.3. Sleeves passing through floors in finished areas and concealed spaces may be sheet metal or factory fabricated reusable type.

2.1.4. Where a housekeeping pad cannot be installed, sleeves passing through floors with waterproof membrane shall have a flashing collar, 50 mm wide at the membrane level. Flashing collar shall be continuously welded to sleeve. Sleeves shall extend 50 mm above the finished floor and shall be Schedule 40 steel pipe.

2.1.5. Where conduits pass through exterior foundation walls 6 mm thick steel sleeve of inside diameter not less the 75 mm greater than the outside diameter of the pipe shall be used and shall be complete with anchor collar. Thunderline Link-Seal wall seal or approved equal shall be used for the annular space between the sleeve and the conduit. A reinforced concrete bridge shall be installed between the wall and the adjacent undisturbed soil.

2.1.6. Provide adequate bracing for support of sleeves during concrete and masonry work.

2.1.7. Unless otherwise specified on the drawings, sleeves passing through the roof shall be liquid tight flexible conduit flashing consisting of a gooseneck shaped aluminum flashing sleeve with an integral deck flange, EPDM end cap seal and EPDM base seal.

3. Execution

3.1. INSTALLATION

3.1.1. Arrange for all chases and formed openings in walls and floors as required by the Electrical Division for the Electrical services. These chases and openings shall not be larger than necessary to accommodate the equipment and services. Advise on these requirements well in advance, before the concrete is poured and the walls are built. All necessary sleeves and inserts shall be supplied by this Division.

3.1.2. Chases and openings not located in accordance with the above provisions shall be made at the expense of this Division. Cutting of structural members shall not be permitted without specified written acceptance of the Engineer’s Representative.

3.1.3. Provide sleeves for all service penetrations through walls, partitions, floor slabs, plenums and similar barriers. At non-rated barriers fill the annular space between the service and the sleeve with fire rated insulation as specified for rated separations and caulk around the edges with a minimum 12 mm thick of fire rated compound or acoustic non-setting mastic.

3.1.4. Through all fire or smoke separations, after testing, the annular space between conduit sleeves shall be fire stopped.

3.1.5. Where-holes are to be installed in existing structure, contractor is to core drill the-holes required. Contractor is required to scan all areas prior to coring and confirm layout with structural engineer prior to completing work. When installing sleeves in existing structures, sleeves shall be provided as specified complete with a combination puddle/anchor flange bolted to the floor. Seal watertight between the flange and the floor.

3.1.6. All sleeves are to extend 150mmabove finished floor to accommodate a 100mm concrete pad. Contractor to pour the concrete pad with the pad extending 100mm on all sides of the sleeve.

END OF SECTION

26 05 88.00 Cutting and Patching

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. All services and materials used for the cutting and patching shall meet all requirements specified in Div. 00, and Section 26 05 01.00, and shall be carried out by experienced workers.

2.1.2. Include for all cutting and patching for all Electrical services.

3. Execution

3.1. INSTALLATION

3.1.1. Cut all openings no larger than is required for the services. Core drill for individual services.

3.1.2. Obtain approval from the structural Engineer's Representative before cutting or core drilling any openings or-holes in slabs or structural elements.

3.1.3. Locate all openings in structure elements requiring cutting and patching, and x-ray the structure to obtain Structural Engineer's Representative's approval prior to cutting or core drilling of existing structure. Make adjustments to location of openings as required to minimize cutting of rebar, and completely avoiding electrical conduit.

.1 Cut-holes through slabs only.

.2 Do not cut-holes through beams.

.3 Holes to be cut are 200 mm (Diameter) or smaller only.

.4 Maintain at least 100 mm clear from all beam faces. Space at least 3-hole diameters on Centre.

.5 For-holes that are required closer than 25% of slab span from the supporting beam face, use cover meter above the slab to clear slab top bars.

.6 For-holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars.

3.1.4. X-ray scanning: Source of information; concretexray.ca, and A&A concrete x-ray and coring

.1 X-rays shall be performed by a qualified technician, in a safe manner and in accordance with all applicable regulations governing this activity. The company shall be licensed by the Canadian Nuclear Safety Commission (CNSC), and all radiography work shall be performed in accordance with the Nuclear Safety and Control Act.

.2 Follow any safety requirements stipulated by the property manager.

.3 Minimum requirements: All people must be evacuated within a radius of 10 m from each exposure location. Prior to conducting exposures verify this "safe zone". If the 10 m radius includes public areas such as a sidewalk, lobby, or elevator, these areas must be

controlled (e.g. elevators shut down or prevented from stopping on floors at which exposures are taking place). In addition, if exposure locations are near the walls of adjacent tenants, ensure the notification and evacuation of people within the 10 m radius. The 10 m radius applies to the camera floor and the floor directly below only. The qualified technician shall ensure adequate precautions for the additional floors above and below the camera floor.

3.1.5. Patch all openings after services have been installed to match the surrounding finishes.

3.1.6. In existing areas all cutting, and core drilling for individual services except where specifically noted, is part of this division work.

3.1.7. The cost of x-ray scanning, cutting, patching and finishing is included in this division contract.

END OF SECTION

26 08 01.00 Technical Services Division Startup Service

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 73.00 – ELECTRICAL POWER SYSTEM STUDIES.

1.1.3. Section 26 05 14.00 – POWER CABLE AND OVERHEAD CONDUCTORS

1.1.4. Section 26 05 21.00 – WIRES AND CABLES 1000V

1.1.5. Section 26 05 26.00 – GROUNDING AND BONDING

1.1.6. Section 26 09 24.00 – LIGHTING CONTROL EQUIPMENT – LOW VOLTAGE

1.1.7. Section 26 11 02.00 – UNIT SUBSTATIONS TO 15kV

1.1.8. Section 26 12 13.00 – LIQUID FILLED, MEDIUM VOLTAGE TRANSFORMERS

1.1.9. Section 26 12 16.00 – DRY TYPE POWER TRANSFORMERS

1.1.10. Section 26 12 19.00 – PAD MOUNTED, LIQUID FILLED, MEDIUM VOLTAGE TRANSFORMERS

1.1.11. Section 26 13 13.00 – METAL CLAD SWITCHGEAR

1.1.12. Section 26 13 17.00 – METAL ENCLOSED SWITCHGEAR

1.1.13. Section 26 23 00.00 – SECONDARY SWITCHGEAR

1.1.14. Section 26 24 02.00 – SERVICE ENTRANCE BOARD

1.1.15. Section 26 24 13.00 – SWITCHBOARDS

1.1.16. Section 26 24 19.00 – MOTOR CONTROL CENTRES

1.1.17. Section 26 25 00.00 – BUSWAYS

1.1.18. Section 26 27 02.00 – SURGE PROTECTION DEVICE

1.1.19. Section 26 28 17.00 – AIR CIRCUIT BREAKERS

1.1.20. Section 26 28 18.00 – GROUND FAULT EQUIPMENT PROTECTION

1.1.21. Section 26 33 53.00 – UNINTERRUPTIBLE POWER SYSEMS - STATIC

1.1.22. Section 26 28 21.00 – MOULDED CASE CIRCUIT BREAKERS

1.1.23. Section 26 32 14.00 – POWER GENERATION – DIESEL

1.1.24. Section 26 36 23.00 – AUTOMATIC LOAD TRANSFER EQUIPMENT

1.2. REFERENCE

1.2.1. ANSI/NETA MTS-2007 - Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems, latest edition.

1.3. OVERVIEW

1.3.1. As part of this project, start-up services will be performed on the electrical distribution and control equipment as specified. This specification is intended as a part of the electrical portion of this project.

1.3.2. The start-up service company must follow jobsite electrical safety requirements, installation standards and electrical testing standards.

1.3.3. Documentation of all procedures performed shall be provided. 3 copies shall be provided and forwarded to the engineer. Written documentation must contain recorded test values of all electrical tests performed per the individual product specification.

1.3.4. Include a copy of all procedures and test results in the operating and maintenance manual.

1.3.5. Start-up service scheduling must be available through a 24 hour, toll free national dispatch system.

1.3.6. The start-up service company shall be present when the distribution equipment is energized. Jobsite and equipment access must be provided by the electrical contractor.

1.3.7. The contractor shall supply a power source, specified by the start-up service company, for on-site test equipment.

1.3.8. The contractor is to attend all factory witness testing required within the respective specification sections. The contractor is responsible to cover all their costs and include them in their bid.

1.3.9. The contractor is to set-up and test all devices as defined in the reports produced under specification Section 26 05 73.00 – ELECTRICAL POWER SYSTEM STUDIES.

2. Product

2.1. GENERAL

2.1.1. Conduct the following tests, at time suitable to Engineer, with Engineer present as witness.

2.1.2. Perform tests using qualified personnel. Provide necessary instruments and equipment.

2.2. INSPECTION AND TEST PROCEDURES

2.2.1. Perform all testing identified in the ANSI/NETA MTS-2007 standard in addition to the following tests.

2.2.2. Wires and Cables 1000V

.1 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 mega-ohms.

.2 Insulation resistance is checked phase-to-phase, phase-to-ground, and across open contacts at 1000 VDC.

.3 Tabulate a list of all feeders and test results, and submit for approval.

2.2.3. Switchgear and Switchboard Assemblies

.1 Visual and Mechanical Inspection

.1 Assemblies shall be inspected for physical damage.

.2 Bussing compartment inspection shall include the following:

.1 Check tightness of accessible bolted bus joints by torque wrench method.

.2 Check insulators for cracks and contamination.

.3 All electrical, key, and mechanical interlock systems shall be verified for correct operation.

.4 Closure shall be attempted on locked open devices. Opening/withdrawal attempt shall be made on locked closed devices.

.5 Mechanical operations of circuit breaker in cell shall be checked and auxiliary devices activated.

.6 Draw-out trays, contact alignment, ease of operation, proper grounding, and interlocks shall be checked.

.7 Circuit breaker cell shall be inspected for contamination, physical damage, loose hardware, shutter mechanism, control plug, guide rail, floor nameplates, ground bus, auxiliary contacts, and linkages.

.8 Circuit breaker shall be inspected for contamination, physical damage, main finger/stab penetration and secondary connections.

.2 Electrical Tests

.1 Insulation resistance of each bus section shall be measured phase-to-phase and phase-to-ground.

.2 Over-potential test shall be performed for each bus section, phase-to-phase and phase-to-ground for medium voltage equipment,

.3 Electrical operation of the circuit breaker shall be checked in the test and connected position.

.4 The control power source shall be checked.

.5 The circuit breaker control scheme shall be tested.

.6 A phasing check shall be made on double-ended and/or emergency source switchgear at tie points to ensure correct bus phasing.

.3 Test Values

.1 Bolt torque levels are checked in accordance with manufacturer's specifications.

.2 Insulation resistance testing is to be performed in accordance with the manufacturer's recommendations.

2.2.4. Circuit Breaker-Low Voltage Draw-out, Or Fixed Insulated Case

.1 Visual and Mechanical Inspection

.1 Inspect physical condition, cleanliness and nameplate compliance with single-line diagram.

.2 Check draw-out mechanism, lubrication and grounding (if applicable).

.3 Check all indicating devices for proper operation.

.4 Check cell fit and element alignment.

.5 Check primary stab penetration (if applicable).

.6 Check secondary connections with the circuit breaker in the connected and test positions (if applicable).

.7 Bolt torque levels are checked on all accessible hardware in accordance with manufacturer's specifications.

.2 Electrical Tests

.1 Contact resistance is to be measured.

.2 Insulation resistance is checked phase-to-phase, phase-to-ground, and across open contacts at 1000 VDC.

.3 Minimum long-time pick-up current is determined when possible; delay time determined at 300% of pick-up by secondary injection.

.4 Short-time pickup and time delay is determined by secondary injection.

.5 Instantaneous pickup current is determined by secondary injection.

.6 Ground fault pickup current and time delay is determined by secondary injection.

.7 Trip unit reset characteristics are verified.

.8 Final settings are made in accordance with customer's prescribed settings.

.9 Auxiliary devices, such as under voltage relays, blown main fuse detector, shunt close, shunt trip, spring charging motor, and auxiliary contacts are activated to ensure operation as applicable.

.10 Secondary Current Injection shall be performed on the power circuits.

2.2.5. Circuit Breaker-Low Voltage (Molded Case)

.1 Visual and Mechanical Inspection.

.1 Circuit breaker is checked to insure smooth operation.

.2 The case is inspected for cracks or other defects.

.3 Bolt torque levels are checked in accordance with CSA Standards or manufacturer's specifications.

.2 Electrical Tests on Breakers of 100 Amps or Larger

.1 Contact resistance is to be measured.

.2 Insulation resistance is checked at 1000 VDC for one minute from pole to pole and from each pole to ground and across open contacts of each phase.

.3 Test trip release on each circuit breaker.

.4 Minimum long-time pick-up current is determined when possible. Long-time delay is determined by secondary current injection method at 300% of rating.

.5 Instantaneous pick-up current determined by secondary injection using run-up or pulse method.

2.2.6. Power and Insulated Case Circuit Breakers-Low Voltage

.1 Visual and Mechanical Inspection.

.1 Check mechanical operation.

.2 Cell fit and element alignment is to be checked.

.3 Bolt torque levels are checked in accordance with CSA Standards or manufacturer's specifications.

.4 Check arc chutes for foreign matter, cracks and secure installation.

.5 Clean primary contact surfaces and lubricate if required.

.2 Electrical Tests

.1 Contact resistance is to be measured.

.2 Insulation resistance is checked at 1000 VDC for one (1) minute from pole to pole and from each pole to ground and across open contacts of each phase.

.3 Minimum long-time pick-up current is determined when possible; delay time is determined at 300% of pick-up by secondary injection.

.4 Short-time pick-up and time delay is determined by secondary injection.

.5 Instantaneous pick-up current is determined by secondary injection.

.6 Ground-fault pick-up current and delay is determined by secondary injection.

.7 Trip unit reset characteristics are verified.

.8 Final settings are made in accordance with Engineer's prescribed settings.

.9 Auxiliary devices, such as under voltage relays, blown main fuse detector, shunt close, shunt trip, spring charging motor and auxiliary contacts are activated to ensure operation as applicable.

.10 All functions of the trip units will be tested with test kits.

.11 Secondary Current Injection shall be performed on the power circuits.

2.2.7. Air Switches - Low and Medium Voltage

.1 Visual and Mechanical Inspection

.1 Inspect the switch for physical damage, proper installation, anchorage, and grounding.

.2 Inspect interior insulation arc chutes and interphase barriers.

.3 Perform mechanical operator tests. Clean and lubricate as necessary.

.4 Check blade alignment and arc interrupter operation.

.5 Check the fuse linkage and element for proper holder and current rating. Record the fuse data.

.6 Check key interlock for safe operation and proper key distribution.

.2 Electrical Tests

.1 Over-potential test voltages are applied phase-to-phase and phase-to-ground.

.2 Contact resistance is measured across each switch blade and fuse line, measured in micro-ohms.

.3 Perform insulation resistance test on each phase-to-ground and from phase-to-phase.

2.2.8. Protective Relays

.1 Visual and Mechanical Inspection

.1 Inspect relays for physical damage, presence of foreign material and moisture.

.2 Check conditions of spiral spring, disc clearance and corrosion (if present). Inspect cover glass interior and relay components.

.3 Check for mechanical freedom of movement, proper travel and alignment, and tightness of mounting hardware and tap screws.

.2 Electrical Tests

.1 This test is only performed on wiring to non-solid state relays

.2 The following tests are performed at settings specified by the Engineer:

.1 Pickup parameters on each operating element.

.2 Timing at three (3) points on the time dial curve.

.3 Pickup target and seal in units.

.4 Operation of restraint, directional, and other elements are checked as required.

.3 Phase angle and magnitude contribution tests are performed on all differential and directional type relays, once energized, to prove proper polarity and connection.

2.2.9. Instrument Transformers

.1 Visual and Mechanical Inspection

.1 Inspect for physical damage and compliance with single-line diagram.

.2 Check mechanical clearance and proper operation of all disconnecting and grounding devices.

.3 Verify proper operation of grounding or shorting devices.

.2 Electrical Tests

.1 Current transformer ratio is measured by primary current injection, or voltage method.

.2 Potential transformer ratio is measured.

.3 Insulation resistance is measured primary to ground, secondary to ground, and primary to secondary.

.4 Secondary wiring connections are verified by secondary current injection.

.5 Transformer polarity markings are verified.

2.2.10. Grounding Systems

.1 Visual and Mechanical Inspection.

.1 Inspect ground system for compliance with plans and specifications.

.2 Electrical Tests.

.1 The fall of potential test is performed per IEEE Standard No. 81, Section 9.04 on the main ground electrode or system.

.2 The two (2) point method test is performed per IEEE Standard No. 81, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.

2.2.11. Ground Fault Systems

.1 Visual and Mechanical Inspection.

.1 Monitor panels (if present) shall be manually operated for both trip test and no trip test.

.2 Electrical Tests.

.1 System neutral insulation resistance is measured to insure no shunt ground paths exist. The neutral ground disconnect link is removed, neutral insulation resistance measured and the link replaced.

.2 The relay pickup current is determined by primary injection at the sensor and the circuit interrupting device operated.

.3 The relay timing is tested by injecting one hundred fifty percent (150%) and three hundred percent (300%) of pickup current into sensor. Total trip time is electrically monitored.

.4 Zone interlock systems are tested by simultaneous sensor current injection and monitoring zone blocking function.

.5 Verify that system will operate at 57% rated control voltage (if applicable).

.3 Test Parameters.

.1 System neutral insulation resistance will be a minimum of preferably one (1) mega-ohm or greater.

.2 Relay pickup current will be within ten percent (10%) of device dial or fixed setting, and in no case greater than twelve hundred (1200) amperes.

.3 Relay timing will be in accordance with published time-current characteristic curves, but in no case longer than one (1) second.

2.2.12. Metering and Instrumentation.

.1 Visual and Mechanical Inspection.

.1 Verify meter connections in accordance with single-line meter and relay diagram.

.2 Inspect for physical damage.

.2 Electrical Tests.

.1 Ammeter accuracy is checked using current injection.

.2 Voltmeter accuracy checked.

2.2.13. Motor Control Centers

.1 Visual and Mechanical Inspection.

.1 Inspect the MCC for physical damage, proper anchorage and grounding.

.2 Compare equipment nameplate data with design plans.

.3 Compare overload heaters with motor full load current for proper size.

.4 Bolt torque levels are checked in accordance with manufacturer's or CSA Standards specifications.

.2 Electrical Tests.

.1 The following insulation tests are performed:

.2 Insulation resistance of each bus section is measured phase-to-phase and phase-to-ground for one (1) minute.

.3 Insulation resistance of each starter section is measured phase-to-phase and phase-to-ground with the starter contacts closed and the protective device open.

.4 Insulation resistance of each control circuit is measured with respect to ground.

.3 Control devices are initiated to check proper operation.

.4 Motor overload units are to be tested by injecting secondary current through the overload unit and monitoring trip time.

2.2.14. Transformers-Dry Type

.1 Visual and Mechanical Inspection.

.1 Verify the operation of auxiliary devices, such as fans, pumps, sudden pressure device, indicators, tap changer, and gas pressurization system.

.2 Bolt torque levels are checked in accordance with CSA Standards or manufacturer's specifications.

.3 Inspect primary and secondary connections for tightness and for signs of overheating.

.4 Inspect and clean bushings and insulators.

.5 Check fuses for correctness of type and size.

.6 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

.2 Tests shall be conducted in accordance with the provisions of ANSI C57.12.91.

.3 As a minimum perform the following tests:

.1 Resistance Measurements

.2 Turns ratio test is performed between windings for all tap positions.

.3 Polarity and phase rotation.

.4 Excitation Current and no load losses on rated voltage and 110% of rated voltage.

.5 Impedance and load loss.

.6 Applied potential.

.7 Induced potential.

.8 Pressure test.

.9 Core insulation test.

.10 Insulation power factor test.

.11 Insulation resistance tests are performed winding to winding and winding to ground.

.4 Carry out following insulation tests using a 1,000V megger with 20,000 mega-ohm scale and resulting insulation resistance corrected to base of 20 deg. C. (68 deg. F.).

.1 High voltage to ground with secondary grounded for duration of test.

.2 Low voltage to ground with primary grounded for duration of test.

.3 High to low voltage.

.5 Summarize all results in a report.

2.2.15. Transformer-Liquid Filled.

.1 Visual and Mechanical Inspection.

.1 Verify the operation of auxiliary devices, such as fans, pumps, sudden pressure device, indicators, tap changer, and gas pressurization system.

.2 Bolt torque levels are checked in accordance with CSA Standards or manufacturer’s specifications.

.3 Check all liquid in tank and bushings for proper level.

.4 Inspect primary and secondary connections for tightness and for signs of overheating.

.5 Inspect and clean bushings and insulators.

.6 Check oil level and temperature indicators.

.7 Check fuses for correctness of type and size.

.8 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

.2 Tests shall be conducted in accordance with the provisions of ANSI C57.12.90.

.3 As a minimum perform the following tests:

.1 Resistance Measurements

.2 Turns ratio test is performed between windings for all tap positions.

.3 Polarity and phase rotation.

.4 Excitation Current and no load losses on rated voltage and 110% of rated voltage.

.5 Impedance and load loss.

.6 Applied potential.

.7 Induced potential.

.8 Pressure test.

.9 Core insulation test.

.10 Insulation power factor test.

.11 Insulation resistance tests are performed winding to winding and winding to ground.

.12 A sample of the insulation oil to be forward to a laboratory and tested. The results are to be included with the testing reports for the transformer and are to be included in the manuals.

.4 Carry out following insulation tests using a 10,000V megger with 20,000 mega-ohm scale and resulting insulation resistance corrected to base of 20 deg. C. (68 deg. F.).

.1 High voltage to ground with secondary grounded for duration of test.

.2 Low voltage to ground with primary grounded for duration of test.

.3 High to low voltage.

.5 Summarize all results in a report.

2.2.16. Metal Enclosed Bus Duct - Low And High Voltage

.1 Visual and Mechanical Inspection.

.1 Inspect the bus for physical damage and proper connection in accordance with single-line diagram.

.2 Inspect for proper bracing, suspension alignment, and enclosure ground.

.3 Bolt torque levels are checked in accordance with CSA Standards or manufacturer's specifications.

.2 Electrical Tests

.1 Measure insulation resistance of each bus run phase-to-phase and phase-to-ground for one (1) minute.

.2 Over potential test voltages are applied on each bus run phase-to-phase and phase-to-ground.

.3 Phase rotation and phase cross voltage tests are performed on each bus tie section energized by separate sources. (Must be performed when bus sections are de-energized from their permanent sources.)

2.2.17. Cables - High Medium Voltage

.1 Visual and Mechanical Inspection

.1 Inspect exposed cable section for tracking corona or physical damage.

.2 Inspect shield grounding, cable support, and termination.

.3 Apply grounds upon completion to drain all absorbed potential to zero volts.

.2 Pre-acceptance tests:

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 10000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.3 Verify phasing of cabling.

.3 Acceptance Tests:

.1 Electrical Tests (New continuous cable i.e. Not spliced to old cable)

.1 A dc hi-potential to be applied in at least five (5) equal increments until maximum test voltage is reached. DC leakage current to be recorded at each step after a constant stabilization time, consistent with system charging current delay.

.2 Perform shield continuity test.

.3 Terminations to be corona suppressed by guard ring, field reduction sphere or other suitable methods.

.4 Each conductor to be individually tested with all other conductors grounded. All shields are to be grounded.

.5 Perform dc hi-potential test using step voltage method. Maximum test voltage shall be in accordance to the ICEA and manufacturer's recommended levels.

.2 Existing Cables

.1 Existing cables insulation resistance to be tested using a 10kV megger before cables are cut into for splicing and again after splicing of new cables is complete prior to being re-energized.

2.2.18. Adjustable Frequency Drives

.1 Visual and Mechanical Inspection.

.1 Inspect controller for physical damage.

.2 Inspect for proper grounding.

.3 Check customer cables, power wiring and control wiring to insure correct installation.

.4 Check for proper heaters used in ISO/Bypass unit.

.5 Check transformer taps for proper connection.

.6 Check all terminal wiring.

.7 Verify motor and drive sizing.

.2 Electrical Tests.

.1 Verify input voltages.

.2 Verify all transformer output voltages.

.3 Test all pilot devices, e.g., lights, speed pots, meters.

.4 Check DIP switches for proper setup.

.5 Calibrate max speed.

.6 Set up acceleration and deceleration potentiometers to application.

.7 Set up hand minimum speed.

.8 Calibrate all meters.

.9 Align drive to customer's automatic control signal.

.10 Assist in proper connection of alarm, smoke detectors, and remote devices.

.11 Check for proper motor rotation.

.12 Set up all option cards.

.13 Operate drive at all allowable speed and load conditions.

.14 Configure snip out resistors.

.15 Confirm ISO/Bypass unit operation.

2.3. INFRARED SCANNING

2.3.1. Two months after the occupancy of the building by the Owner the Contractor is to infrared scan the entire electrical distribution system up to and including all panelboards.

2.3.2. Contractor to re-scan the entire electrical distribution system up to and including all panelboards two months prior to the completion of the warranty period.

2.3.3. Contractor to use current infrared detection technology.

2.3.4. Contractor is to provide a complete report, identifying areas of concern. Contractor to provide copies of all infrared video taken on DVDs to the Owner for their records.

2.3.5. Electrical Contractor is to repair any loose connection/terminations or replace any faulty equipment under warranty.

2.4. REPORTS

2.4.1. Provide Engineer's Representative with list of test results showing location at which each test was made, circuit tested and result of each test.

2.4.2. Technical Start-up Contractor shall submit to the consultant a report, in addition to the test reports, summarizing their acceptance that all tests were completed to the satisfaction of the Technical Start-up Contractor following each factory witness test and each on-site test. Append all factory test repots as an appendix to this report.

2.4.3. Manufacturer is responsible to cover all costs incurred due to failure of equipment during factory testing, including but not limited to, additional travel and accommodation expenses and extra time to witness tests.

2.4.4. Assemble all testing results into a common binder and organize based on specification sections. Include all manufacturer testing results. Submit 3 copies of this manual along with the Operation and Maintenance manuals.

2.5. ACCEPTABLE CONTRACTORS

2.5.1. The Technical Services Start-up Contractor shall have a minimum of 5 years of experience in performing similar services.

2.5.2. The work in this section is to be performed by:

.1 Schneider Services.
.2 Eaton Electrical Services & Systems.
.3 Siemens Services.
.4 GT Wood.
.5 Pelikan.
.6 Rondar.
.7 Eastenghouse.
.8 AC Tesla.
.9 Brosz Technical Services.
.10 Enkompass.

3. Execution

3.1. NOT USED

END OF SECTION

26 12 17.00 Dry Type Transformers – 600V Primary

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.3. Section 26 05 53.00 – IDENTIFICATION.

1.2. REFERENCE

1.2.1. CSA C22.2 No. 47, Air-Cooled Transformers (Dry-Type), latest edition.

1.2.2. CSA C802.2, Minimum Efficiency Values for Dry Type Transformers, latest edition.

1.2.3. U.S. Department of Energy (DOE) “DOE 2016 Efficiency”, latest edition.

1.2.4. Natural Resource Canada Regulation SOR/2018-2001 (NRCAN 2019), latest edition.

.1 Electricity Act, 1998 Regulation 509/18 Energy and Water Efficiency – Appliances and Products, latest edition.

1.2.5. CSA C9, Dry-Type Transformers, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.4. STORAGE

1.4.1. Store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect from potential damage from weather and construction operations. Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable storage or service conditions.

1.4.2. Handle transformer using proper equipment for lifting and handling, use necessary lifting eye and/or brackets provided for that purpose.

1.5. WARRANTY

1.5.1. The transformer shall carry a 1 year warranty from the time of substantial completion.

2. Products

2.1. TRANSFORMERS

2.1.1. Use transformers of one manufacturer throughout project.

2.1.2. Design

.1 Type: ANN. All transformers to be delta-wye configuration unless otherwise noted on the drawings. Scott T constructed transformers will not be accepted.

.2 3 phase, kVA and voltages as indicated on the plans, 60 Hz.

.3 Provide voltage taps of 2 ± 2 ½% FCAN (full capacity above normal) & FCBN (full capacity below normal).

.4 Insulation: Class 220 deg. C (former designation: Class H), 150 deg. C. or less temperature rise.

.5 All windings are to be copper unless stated otherwise on the contract documents.

.6 Basic Impulse Level (BIL): standard.

.7 Hipot: standard.

.8 Average sound level to comply with the latest edition of CSA C9 for the appropriate voltage class.

.9 Impedance at 60Hz: 3.0% to 5.0% (up to 75 kVA), 4.0% to 6.0% (112.5kVA and above).

.10 Provide minimum K-4, K-rated transformers unless otherwise indicated on the drawings.

.11 Enclosure: Type 2 sprinkler proof, removable metal front panel.

.12 Mounting: floor or wall, as indicated.

.13 Transformer to meet energy efficiency requirements of the energy efficiency standards referenced in this specification, whichever is more stringent, at35% of rated load unless shown otherwise on drawings.

.14 Finish: in accordance with Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2.2. ACCESSORIES

2.2.1. Provide analogue type winding temperature indicator with 2 sequence contacts for transformers of 225kVA and larger. Provide sensor in the centre winding to monitor the temperature.

2.2.2. Grounding terminal: inside enclosure.

2.2.3. External vibration pads equal to Mason Super ‘W’.

2.2.4. Nameplate shall be stainless steel. Remove if the building is not identified as needing any seismic restraints

2.3. EQUIPMENT IDENTIFICATION

2.3.1. Provide equipment identification in accordance with Section 26 05 53.00 – IDENTIFICATION.

2.3.2. Label size: 6 mm letters.

2.4. FINISH

2.4.1. Finish enclosure exterior in accordance with Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2.4.2. Transformer to be painted ANSI-61 grey.

2.5. MANUFACTURERS

2.5.1. The following are acceptable manufacturers:

.1 Hammond Power Solutions

.2 Delta Transformers

.3 Schneider-Electric

.4 Eaton Cutler-Hammer

.5 Rex Power Magnetics

.6 STI Power

3. Execution

3.1. INSTALLATION

3.1.1. Mount dry type transformers as indicated. Transformers larger than 75kVA are to be floor mounted unless identified otherwise. Where a transformer larger than 75kVA is shown as mounted off the floor, the Contractor is to provide an engineered structure from the floor and wall to support the transformer. Structure to be stamped and signed by a professional engineer and submitted as a shop drawing. Design of structure to take into account the building structure within the respective room.

3.1.2. Provide external vibration isolation pads under transformer.

3.1.3. Ensure adequate clearance around transformer for ventilation. Install transformer to meet ventilation clearance requirements given by transformer manufacturer. Where transformer manufacturer does not have requirements, follow clearances required by the local electrical code.

3.1.4. Install transformers in level upright position.

3.1.5. Remove shipping supports only after transformer is installed and just before putting into service.

3.1.6. Loosen isolation pad bolts until no compression is visible.

3.1.7. Make primary and secondary connections with flexible conduit and in accordance with wiring diagram.

3.1.8. Energize transformers after installation is complete.

END OF SECTION

26 24 13.00 Switchboards

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.3. Section 26 05 53.00 – IDENTIFICATION.

1.1.4. Section 26 08 01.00 – TECHNICAL SERVICES DIVISION START-UP SERVICE.

1.1.5. Section 26 28 21.00 – MOULDED CASE CIRCUIT BREAKERS.

1.1.6. Section 26 28 14.00 – FUSES LOW VOLTAGE.

1.2. REFERENCE

1.2.1. CAN/CSA C22.2 No. 31 – Switchgear Assemblies, latest edition.

1.2.2. Seismic compliance: International Building Code (IBC) and California Building Code (CBC), latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit shop drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.3.2. Indicate on Shop Drawings:

.1 Floor or wall anchoring method and foundation template.

.2 Dimensioned cable entry and exit locations.

.3 Dimensioned position and size of bus.

.4 Overall length, height and depth.

.5 Dimensioned layout of internal and front panel mounted components.

1.3.3. Provide certificates of compliance with the requirements as stated within the IBC and CBC and demonstrated the ability to function after the test.

1.4. MAINTENANCE DATA

1.4.1. Submit 3 copies of the maintenance data for the complete assembly including components, and include in the project operating and maintenance manuals.

1.5. MAINTENANCE MATERIALS

1.5.1. Include:

1.6. SOURCE QUALITY CONTROL

1.6.1. Submit 3 copies of certified test results, and include in the project operating and maintenance manuals.

2. Products

2.1. SWITCHBOARD

2.1.1. Ratings as identified on the drawings and/or schedules.

2.1.2. Switchboard breakers to have a minimum short circuit current rating of 22kA at 600V. Fused sections to have a minimum short circuit current rating of 100kA at 600V. Switchboard busing to be rated at a minimum of 65kA.

2.1.3. Enclosures to be dead-front, CSA Type 2 sprinklerproof enclosure, size as indicated.

2.1.4. Hinged access panels with captive knurled thumb screws.

2.1.5. Bus bars and main connections: copper.

2.1.6. Bus from load terminals of main breaker via metering section to main lugs of distribution section.

2.1.7. Identify phases with colour coding.

2.1.8. Provide two-hole long barrel compression lugs with inspection / viewing window for the main feeder terminations. Size as per the drawings.

2.1.9. Breakers and/or fuse sections shall be bolt-on.

2.1.10. Make provisions to extend the main bus to future cubicles on each end of the switchboard.

2.2. CIRCUIT BREAKERS

2.2.1. Circuit breakers to be supplied as per Section 26 28 21.00 – MOULDED CASE CIRCUIT BREAKERS.

2.2.2. All breakers to be factory installed and tested.

2.3. FUSIBLE DISCONNECTS AND FUSES

2.3.1. Fusible horsepower rated disconnect switch sized as indicated.

2.3.2. Provision for padlocking in on-off position by three padlocks.

2.3.3. Mechanically interlocked door to prevent opening when handle is in the ON position.

2.3.4. Fuse: size as indicated, class J, current limiting in fuse holders without adapters. Fuses to be supplied as per Section 26 28 14.00 – FUSES LOW VOLTAGE.

2.3.5. Quick-make, quick-break action.

2.3.6. ON-OFF switch position indication on switch enclosure cover.

2.4. GROUNDING

2.4.1. Copper ground bus extending full width of cubicles and located at bottom.

2.4.2. Provide two-hole long barrel compression lugs with inspection / viewing window for the ground cable terminations. Size as per the drawings.

2.5. INFRARED WINDOWS

2.5.1. Provide infrared windows in the switchboard main incoming section in sufficient sizes and quantities, to provide view of the main feeder terminations.

2.5.2. The window lens shall be compatible with most popular IR cameras, fusion capable and shall transmit electromagnetic radiation in:

.1 Short, Mid and Long Wave Infrared

.2 Visual

.3 UVA and UVB Ultraviolet

2.5.3. Label each window to provide the thermographer with full information necessary to properly set, and aim the infrared camera and correctly interpret readings. The information shall include but not be limited to:

.1 IR window location and number:

.2 Lens material, range and the effective wavelength:

.3 Lens Transmission Rate and proper compensation values:

.4 Target(s): name, location (in respect to window) and target(s) emissivity.

2.5.4. Infrared windows shall be CSA approved to C22.2 No. 14 latest edition, UL/cUL listed, comply with IEEE Std. C37.20.2. Range, size, NEMA/IP and voltage rating suitable for the application. Infrared windows with plastic or polymer components shall also comply with UL746C.

2.5.5. Acceptable manufacturers;

.1 Hawk IR International Limited / Fluke,

.2 FLIR,

.3 Lumasense Technologies Inc.

.4 IRISS Inc.

2.6. FINISHES

2.6.1. Apply finishes in accordance with Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2.6.2. Switchboard to be painted: baked grey enamel.

2.7. EQUIPMENT IDENTIFICATION

2.7.1. Provide equipment identification in accordance with Section 26 05 53.00 – IDENTIFICATION.

2.7.2. Label all branch feeders with names as indicated on drawings.

2.8. FACTORY TESTING

2.8.1. Testing shall be witnessed by the Technical Service Start-Up Services Contractor.

2.8.2. Include in your bid for the complete cost of two people to attend the factory witness testing for the equipment. Cost to include but not limited to all travel, food and lodging costs.

2.9. MANUFACTURERS

2.9.1. The switchboards shall be manufactured by:

.1 Schneider Electric.

.2 Eaton Cutler-Hammer.

.3 Siemens.

3. Execution

3.1. INSTALLATION

3.1.1. Locate switchboard and secure in position. Install floor mounted switchboards on a 100 mm concrete housekeeping pad.

3.1.2. Connect main incoming feeder to line terminals of main breaker, if applicable.

3.1.3. Connect load terminals of distribution switches or breakers to feeders.

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

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

3.2. TESTING

3.2.1. Contractor to review and test that all wiring has been connected as per the manufacturer drawings.

3.2.2. Switchboard to be tested on site as defined in Section 26 08 01.00 – TECHNICAL SERVICES DIVISION START-UP SERVICE. Contractor to oversee all testing and correct any deficiencies noted.

END OF SECTION

26 24 17.00 Panelboards – Breaker Type

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.3. Section 26 05 05.00 – MOUNTING HEIGHTS.

1.1.4. Section 26 05 53.00 – IDENTIFICATION.

1.2. REFERENCES

1.2.1. CSA C22.2 No. 29 – Panelboards and Enclosed Panelboards, latest edition.

1.2.2. CSA C22.2 No. 5 – Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.3.2. Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2. Products

2.1. PANELBOARDS

2.1.1. Panelboards: product of one manufacturer.

2.1.2. Install circuit breakers in panelboards before shipment.

2.1.3. In addition to CSA requirements manufacturer's nameplate must show fault current that the panel including all breakers have been built to withstand.

2.1.4. Panelboards to have the following minimum ratings for interrupting capacity or as indicated on the drawings or panel schedules.

.1 120/208V panelboards – 10kA

.2 347/600V panelboards – 22kA

2.1.5. Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

2.1.6. Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated. Provide an additional 20% of space within each panelboard in addition to what is shown on the drawings when a separate panel schedule is not provided for a specific panelboard.

2.1.7. Two keys for each panelboard and key panelboards alike.

2.1.8. Panelboards to be copper bus unless identified otherwise.

2.1.9. Where identified on the drawings or schedules, provide a copper neutral bus sized to 200% of the mains rating for panels.

2.1.10. Mains: suitable for bolt-on breakers.

2.1.11. Trim with concealed front bolts and hinges.

2.1.12. Trim and door finish: baked grey enamel.

2.1.13. Enclosure to be CSA Type 2 sprinkler proof.

2.1.14. Surge Protection Device as required.

2.1.15. Series ratings may be acceptable. Panels to be labeled as such. Manufacturing to supply supporting data.

2.2. MOULDED CASE CIRCUIT BREAKERS

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

2.2.2. Common-trip breakers: with single handle for multi-pole applications.

2.2.3. Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.2.4. Main breaker, where indicated: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.2.5. Lock-on devices for 10 % of 15 to 30 A breakers installed. Turn over unused lock-on devices to Owner.

2.2.6. Where breakers are identified to feed high intensity discharge (HID) lighting, provide breakers that are rated and designed for use with HID lighting.

2.2.7. Provide one breaker per designated breaker space. Multiple breakers contained in one housing or twin breakers are not acceptable.

2.3. EQUIPMENT IDENTIFICATION

2.3.1. Provide equipment identification in accordance with Section 26 05 53.00 – IDENTIFICATION.

2.3.2. Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4. MANUFACTURERS

2.4.1. The following are acceptable manufacturers:

.1 Schneider Electric

.2 Eaton Cutler-Hammer

.3 Siemens

3. Execution

3.1. INSTALLATION

3.1.1. Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

3.1.2. Install surface mounted panelboards on galvanized unistrut stand-offs or on fire rated plywood backboards. The plywood backboards are to be as per Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

3.1.3. Mount panelboards at height specified in Section 26 05 05.00 – MOUNTING HEIGHTS.

3.1.4. Connect loads to circuits.

3.1.5. Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

26 27 26.00 Wiring Devices

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.3. Section 26 05 05.00 – MOUNTING HEIGHTS.

1.1.4. Section 26 05 53.00 – IDENTIFICATION.

1.1.5. Section 26 51 13.00 – LIGHTING EQUIPMENT.

1.2. SHOP DRAWINGS AND PRODUCT DATA

1.2.1. Submit shop drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

2. Products

2.1. SWITCHES

2.1.1. 20 A, single pole, double pole, three-way, or four-way specification grade switches. Voltage rating of the switch to be as per the contract documents.

2.1.2. Manually-operated general purpose switches with following features:

.1 Terminal-holes approved for No. 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 Decora Style specification grade Rocker switch.

.6 Colour to be selected by Architect/Engineer’s Representative.

2.1.3. Toggle operated locking fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

2.2. RECEPTACLES

2.2.1. All receptacles to be specification grade.

2.2.2. Duplex specification receptacles, Decora style CSA type 5-15 R, 125 V, 15 A, U ground, with following features:

.1 Thermoplastic with impact-resistant nylon face moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Triple wipe contacts and riveted grounding contacts.

2.2.3. Hospital grade receptacles:

.1 Hospital grade with green dot symbol, tamper-resistant, extra heavy duty, modular plug-in type, 15 ampere, 125 V, 2-pole, 3-wire U-ground duplex receptacles complete with front circuit identification area.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Triple wipe contacts and riveted grounding contact.

2.2.4. Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Thermoplastic moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

2.2.5. Other receptacles with ampacity and voltage as indicated.

2.2.6. Receptacles to be coloured as follows:

.1 Normal Power – Colour to be selected by Architect/Engineer's Representative.

.2 Emergency/Essential Power – Red.

.3 Isolated Ground – Orange.

.4 Switched – Gray.

.5 UPS – Blue.

2.2.7. All dwelling receptacles of CSA configuration 5-15R and 5-20R shall be tamper resistant receptacles and shall be so marked; receptacles dedicated for microwaves, refrigerators, freezers or those receptacles located in an attic or crawl space shall not be required to be tamper-resistant.

2.2.8. Electrical Contractor shall coordinate with furniture supplier to identify switched circuits prior to installation.

2.3. MANUFACTURERS

2.3.1. The switches and wiring devices shall be of one manufacturer throughout the project.

2.3.2. The following are acceptable manufacturers:

.1 Legrand.

.2 Hubbell.

.3 Cooper.

.4 Leviton.

2.4. DIMMERS

2.4.1. Dimmers shall be 600W, 1500W, 2000W.

.1 Full range, continuously variable control of light intensity.

.2 Vertical slider allowing the light level to be set by the user.

.3 Slide to Off.

.4 Capable of operating at rated capacity.

.5 Power failure memory.

.6 Dimmers shall be available for direct control of incandescent, magnetic low voltage, electronic low voltage, fluorescent, and LED.

2.4.2. Incandescent dimmers.

.1 Direct control of up to a full 20A lighting circuit.

2.4.3. Electronic (solid-state) Low Voltage (ELV) transformer dimmers (incandescent).

.1 Circuitry designed to control the input of Electronic (solid state) Low Voltage transformers.

.2 Control up to 600W of Electronic Low Voltage load.

.3 Reset-able overload protection when capacity is exceeded.

2.4.4. Magnetic Low-Voltage (MLV) transformer dimmers.

.1 Designed to control and provide a symmetrical AC wave form to input of magnetic low voltage transformers per UL 1972 section 5.11.

.2 Direct control of up to 1500VA of Magnetic Low Voltage load.

.3 Dimmer shall be suitable to control dimming ballast as specified in Section 26 51 13.00 – LIGHTING EQUIPMENT.

2.4.5. LED dimmers.

.1 Slide to Off only. Must match driver and LED requirements.

2.4.6. Manufacturers

.1 Lutron Maestro Series.

.2 Leviton True Touch Series.

2.5. SPECIAL WIRING DEVICES

2.5.1. Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic lens flush type.

2.6. COVER PLATES

2.6.1. Cover plates for wiring devices.

2.6.2. Cover plates from one manufacturer throughout project.

2.6.3. Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

2.6.4. Provide stainless steel cover plates, suitable for the respective device, for all devices mounted in flush-mounted outlet boxes located in finished areas.

2.6.5. Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

2.6.6. Weatherproof rain tight while-in-use metal cover, complete with gaskets for duplex receptacles located outside or as indicated.

2.6.7. Weatherproof rain tight while-in-use metal cover, complete with gaskets for single receptacles or switches located outside or as indicated.

3. Execution

3.1. INSTALLATION

3.1.1. Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height specified in Section 26 05 05.00 – MOUNTING HEIGHTS or as indicated.

3.1.2. Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height specified in Section 26 05 05.00 – MOUNTING HEIGHTS or as indicated.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Install hospital grade receptacles in all patient care areas in healthcare applications.

3.1.3. Dimmers:

.1 Install dimmers as indicated. Provide suitable clearances in multi-gang boxes as recommended by the manufacturer to maintain the dimmer rating.

.2 Coordinate the dimmer selection with the ballast/driver to be controlled, to ensure compatibility.

3.1.4. Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.1.5. Labelling

.1 Provide labels with panel name and circuit number on all receptacles in conformance with Section 26 05 53.00 – IDENTIFICATION.

END OF SECTION

26 28 14.00 Fuses Low Voltage

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. REFERENCES

1.2.1. CSA C22.2 No. 248, Low Voltage Fuses, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit shop drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.3.2. Submit fuse performance data characteristics for each fuse type and size above 100 A. Performance data to include: average melting time-current characteristics, I2t (for fuse coordination), and peak let-through current.

1.4. MAINTENANCE MATERIALS

1.4.1. Three spare fuses of each type and size installed 600 A. and above.

1.4.2. Six spare fuses of each type and size installed up to and including 400 A.

1.5. DELIVERY AND STORAGE

1.5.1. Ship fuses in original containers.

1.5.2. Do not ship fuses installed in switchboard.

1.5.3. Store fuses in original containers in moisture free location.

2. Products

2.1.1. Fuses GeneralFuses: product of one manufacturer.

2.1.2. Fuses to have an indicating window to identify when the fuse has been blown.

2.2. FUSE TYPES

2.2.1. Class L fuses.

.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type L2, fast acting.

2.2.2. Class J fuses.

.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type J2, fast acting.

2.2.3. Class R fuses. For UL Class RK1 fuses, peak let-through current and I2t values not to exceed limits of CSA C22.2 No. 248.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.2.4. Class C fuses.

2.2.5. Fuses for Motors:

.1 All fuses for motor loads are to be time-delay type.

2.3. FUSE STORAGE CABINET

2.3.1. Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door, B-LINE model 243012 + 2 shelves FCS2412, finished in accordance with Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2.4. FUSE PULLER

2.4.1. Provide a fuse puller for each size of fuse to be located in the fuse storage cabinet. Fuse puller to be clearly labelled for the appropriate building and fuse cabinet. Fuse puller to be equal to the Ideal Safe-T-Grip Fuse Puller.

2.5. MANUFACTURERS

2.5.1. The following are acceptable manufacturers:

.1 Mersen

.2 Cooper-Bussman

.3 Littelfuse

3. Execution

3.1. INSTALLATION

3.1.1. Install fuses in mounting devices immediately before energizing circuit.

3.1.2. Ensure correct fuses fitted to physically match mounting devices.

.1 Install Class R rejection clips for Class R fuses.

3.1.3. Ensure correct fuses fitted to assigned electrical circuit.

3.1.4. Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

END OF SECTION

26 28 21.00 Moulded Case Circuit Breakers

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. REFERENCES

1.2.1. CSA C22.2 No. 5 – Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS

1.3.2. Include time-current characteristic curves for breakers with ampacity of 400 A and over or with interrupting capacity of 22,000 A symmetrical (RMS) and over at system voltage.

2. Products

2.1. BREAKERS GENERAL

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

2.1.2. Common-trip breakers: with single handle for multi-pole applications.

2.1.3. Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

2.1.4. Circuit breakers with interchangeable trips as indicated.

2.2. THERMAL MAGNETIC BREAKERS

2.2.1. Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3. MAGNETIC BREAKERS

2.3.1. Moulded case circuit breakers to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4. FUSED THERMAL MAGNETIC BREAKERS

2.4.1. Fused thermal magnetic breakers with current limiting fuses internally mounted. Time current limiting characteristics of fuses coordinated with time current tripping characteristics of circuit breaker. Coordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker. Fuses individually removable and interlocked with breaker. The removal of fuse cover, blowing of a fuse or removal of a fuse, shall trip the breaker.

2.5. SOLID STATE TRIP BREAKERS

2.5.1. Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition and long time, short time, instantaneous tripping for phase and ground fault short circuit protection.

2.6. ACCESSORIES

2.6.1. Include:

.1 shunt trip, when electrically operated or when indicated.

.2 auxiliary switches, when electrically operated or when indicated.

.3 motor-operated mechanism, when electrical operation indicated.

.4 on-off locking device.

.5 handle mechanism.

.6 Where a breaker serves a fire pump, the breaker is to come complete with auxiliary contacts that are to be monitored by the fire alarm system.

2.7. MANUFACTURERS

2.7.1. The following are acceptable manufacturers:

.1 Schneider Electric

.2 Eaton Cutler-Hammer

.3 Siemens

3. Execution

3.1. INSTALLATION

3.1.1. Install circuit breakers as indicated.

3.1.2. Contractor to wire any neutral CT’s to the breaker trip unit where required by the breaker ground fault detection system or as otherwise required by the manufacturers instructions.

END OF SECTION

26 28 23.00 Disconnect Switches – Fused and Non-Fused

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.3. Section 26 05 53.00 – IDENTIFICATION.

1.2. REFERENCE

1.2.1. CSA C22.2 No. 4 – Enclosed Switches, latest edition.

1.2.2. CSA C22.2 No. 39 – Fuse-holder Assemblies, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

2. Products

2.1. DISCONNECT SWITCHES

2.1.1. Fusible or non-fusible, horsepower rated disconnect switch in NEMA 3R sprinkler proof enclosure, size as indicated.

2.1.2. Provision for padlocking in on-off switch position by three locks.

2.1.3. Mechanically interlocked door to prevent opening when handle in ON position.

2.1.4. Fuses: size as indicated, class J, current limiting, in accordance with Section 26 28 14.00 – FUSES - LOW VOLTAGE.

2.1.5. Fuse-holders: suitable without adaptors, for type and size of fuse indicated.

2.1.6. Quick-make, quick-break action.

2.1.7. ON-OFF switch position indication on switch enclosure cover.

2.2. EQUIPMENT IDENTIFICATION

2.2.1. Provide equipment identification in accordance with Section 26 05 53.00 – IDENTIFICATION.

2.2.2. Indicate name of load controlled on nameplate.

2.2.3. Provide a Lamacoid nameplate that indicates the replacement fuse size as well as the maximum allowable fuse size for that disconnect based upon the sizing of the feeder.

2.3. MANUFACTURERS

2.3.1. The following are acceptable manufacturers:

.1 Schneider Electric.

.2 Eaton Cutler-Hammer.

.3 Siemens.

3. Execution

3.1. INSTALLATION

3.1.1. Install disconnect switches complete with fuses if applicable.

END OF SECTION

26 51 13.00 Lighting Equipment

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 01 00.00 – OPERATING AND MAINTENANCE INSTRUCTIONS.

1.1.2. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.3. Section 26 05 04.00 – SUBMITTALS – SHOP DRAWINGS.

1.1.4. Section 26 05 21.00 – WIRES AND CABLES 1000V.

1.1.5. Section 26 06 05.16 – LUMINAIRE SCHEDULE.

1.2. REFERENCES

1.2.1. CSA C22.2 No. 74 – Equipment for Use with Electric Discharge Lamps, latest edition.

1.2.2. The Consortium of Energy Efficiency (CEE) guidelines, latest edition.

1.2.3. IESNA LM-79 – Approved Method: Electric and Photometric Measurements of Solid-State Lighting Products, latest edition.

1.2.4. IESNA LM-80 – Approved Method: Measuring Lumen Maintenance of LED Light Sources, latest edition.

1.2.5. The Certified Ballast Manufacturers Association (CBM) standards, latest edition.

1.2.6. NEMA 410 – Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts, latest edition.

1.3. SUBSTITUTION

1.3.1. The lighting equipment for this project and specified herein has been carefully selected for its ability to meet the project's luminous environment requirements. Manual and computer calculations have been performed to ensure that the lighting equipment that has been specified complies with established criteria. The Engineer's Representative reserves the right not to accept any alternates or substitutions. If alternates or substitutions are entertained, then it is the responsibility of the Contractor/Supplier to provide all information required herein and detailed layouts and lighting calculations demonstrating that the performance of the alternate luminaire meets or exceeds the original lighting design while not consuming any additional energy. The Contractor/Supplier is responsible to ensure the light levels provided in the alternate submittal package will achieve the design light levels. Where the light levels are not achieved, the Contractor is responsible to replace the luminaire with a luminaire that will meet the required levels with no increase in energy use at no cost to the Owner. Rather than replacing the luminaires, the Engineer's Representative may accept the installation of additional luminaires by the Contractor at no cost to the Owner in order to achieve the required light levels.

1.3.2. Accompanying the request for a luminaire or lamp substitution, the contractor shall submit a complete lighting calculation report with photometric modeling of the space showing light levels including average, maximum, minimum and max to min values.

1.4. SHOP DRAWING AND PRODUCT DATA

1.4.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.4.2. Submit a shop drawing for each luminaire specified, including lamp.

1.4.3. Luminaire submittals are to consist of a physical description, manufacturer's specification sheets, dimensioned drawings, and complete photometric data from an independent test laboratory in the form of IES computer files of the equipment being submitted and hard copy of the photometric report. Coordinate ceiling types to ensure proper supports and luminaire framing.

1.4.4. Lamp submittals are to consist of manufacturer's technical data with respective luminaire shop drawing. Submittal to include operating wattage, rated life, colour temperature, base type, lamp shape, CRI, voltage and mercury content.

1.4.5. LED submittals are to consist of manufacturer's technical data for diodes and drivers with respective luminaire shop drawing. Submittal to include operating wattage, voltage, maximum distance from drivers, wiring diagrams and lumen output at time of delivery.

1.4.6. Ballast submittals are to consist of manufacturer's technical data with respective luminaire shop drawing. Submittal to include operating wattage, input voltage, ballast efficiency, maximum distance for remote ballasts, power factor, and operating temperature.

1.4.7. Where samples are indicated on the luminaire schedule, they are to be provided with shop drawings at time of shop drawing submittals unless noted otherwise.

1.4.8. Where luminaires consist of multiple field assembled components, include manufacturer supplied installation manual detailing the assembly procedure.

1.5. OPERATION AND MAINTENANCE DATA

1.5.1. Provide operation and maintenance data for lighting equipment in accordance with Section 26 01 00.00 – OPERATING AND MAINTENANCE INSTRUCTIONS for incorporation into the manual.

1.5.2. Operation and maintenance instructions shall include documentation related to warranty claim process.

1.6. FIXED PER UNIT COST LUMINAIRES

1.6.1. Listed in the luminaire schedule are a fixed per unit cost for certain luminaire types. Electrical contractor is responsible for completing a take-off of the drawings to determine quantity of each luminaire type and use the listed fixed unit price to calculate the total cost per luminaire type. The total cost for all luminaires shall be carried in the bid for the electrical contract. Provide a breakdown of the total cost, per luminaire type, that is carried under the electrical contract. All luminaires are to be included in the electrical contract including all luminaires identified with fixed unit costs. The electrical contractor is to include fixed per unit cost luminaires in Light Fixtures – Materials in the standard progress draw breakdown defined in Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.6.2. The fixed per unit cost excludes applicable taxes and includes lamps and distributor markups. Electrical Contractor is responsible to include in the base bid for delivery, scheduling, receiving, storage, partial assembly, installation, wiring, aiming, cleaning and warranties for all fixed per unit cost luminaires. Show the applicable taxes as a separate line item.

1.7. CASH ALLOWANCE LUMINAIRES

1.7.1. Listed in the luminaire schedule are 'cash allowance' fixtures for certain luminaire types. A complete take-off of the drawings has been done to determine the quantity of each 'cash allowance' luminaire type and the total cost has been carried in the Div-0/1 cash allowance value. The total cost for all 'cash allowance' luminaires are NOT to be carried in the bid for the electrical contract.

1.7.2. After tender award to the successful Electrical Contractor, the Consultant shall provide the Electrical Contractor the exact manufacturer/model number(s) of all 'cash allowance' luminaires and the Electrical Contractor shall be responsible for purchasing the fixtures through the monies from the cash allowance.

1.7.3. Provide a breakdown of the total cost, per luminaire type, that is carried under the base electrical contract. All luminaires are to be included in the base electrical contract excluding all luminaires identified as 'cash allowance' luminaires. However the Electrical Contractor is to include 'cash allowance' luminaires in Light Fixtures – Materials in the standard progress draw breakdown defined in Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS once the Consultant provides the Electrical Contractor with the exact manufacturer/model number(s).

1.7.4. The cash allowance value carried excludes applicable taxes and includes lamps and distributor markups. Electrical Contractor is responsible to include in the base bid for delivery, scheduling, receiving, storage, partial assembly, installation, wiring, aiming, cleaning and warranties for all 'cash allowance' luminaires. Show the applicable taxes as a separate line item.

1.8. WARRANTY

1.8.1. The manufacturer shall provide a warranty against defects in material and workmanship, starting at substantial completion. Parts warranty shall be 5 years and labour warranty shall be 1 year.

1.8.2. LED's, Drivers, Lamps and ballasts showing signs of premature failure shall be replaced at no cost to the owner.

1.8.3. LED Drivers must have a 5 year warranty.

2. Product

2.1. GENERAL

2.1.1. All products must be CSA or CUL approved.

2.2. LED LIGHTS

2.2.1. All Lamps are to meet the standards of the Consortium of Energy Efficiency (CEE) guidelines.

2.2.2. Refer to luminaire schedule for project specific details, and lamps required.

2.2.3. All lamps are to be new and are to be from the same manufacturing batch to avoid colour differences. Replace all lamps that exhibit colour shift, or exhibit premature lumen intensity decline, at no cost to the owner.

2.2.4. Light Emitting Diodes (LED)

.1 LEDs shall meet the standards of IESNA LM-79 and LM-80.

.2 All LED drivers shall be tested and comply with the maximum in-rush current limits as stated in NEMA 410.

.3 LED's shall be manufactured by Luxeon or equal. Colour temperature shall be as indicated on the luminaire schedule. Lamps are to be binned with no visible colour variance (+/- 100K from specified colour temperature). Rated life for 1 watt white LED shall be 50,000 hours. Lumen output to be maximum based on latest technology at time of delivery.

.4 All LED luminaires that present signs of failure on site, within the warranty period, must be replaced at no cost to the owner. If temporary luminaires are required to replace any failed LED luminaires, during the waiting time for parts (i.e. drivers, boards, heat sinks, etc.), the labour cost including installation, temporary luminaire supply, temporary luminaire removal and reinstallation of the LED luminaire must be provided at no cost of the owner. Additional electrical costs, associated with higher Wattage temporary luminaires, must be reimbursed with interest to the owner by the manufacturer.

.5 In case of failure of an LED luminaire, complete or part thereof, an independent third party testing Laboratory (approved by Smith + Andersen) shall be commissioned by the manufacturer or vendor to perform tests on samples taken from the failed luminaires installed on corresponding site. All reporting including the test results must be submitted to Smith + Andersen for evaluation and final approval.

.6 Any additional time involved by Smith + Andersen will be billed at our hourly rates to the manufacturer or vendor.

2.3. DRIVERS

2.3.1. All drivers are to be tested and comply with maximum in-rush current limits within NEMA 410 standards. This is to be clearly indicated on shop drawing submittal.

2.3.2. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.

2.3.3. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

2.3.4. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.

2.3.5. No visible change in light output with a variation of plus/minus 10 percent line voltage input.

2.3.6. Total Harmonic Distortion less than 20% percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

2.3.7. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:

.1 Adjustment of forward LED voltage, supporting 3V through 55V.

.2 Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA

.3 Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.

2.3.8. Driver must be able to operate for a (+/- 10%) supply voltage of 120V through 277VAC at 60Hz.

2.3.9. Driver must be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.

2.3.10. Driver shall include ability to provide no light output when the analog control signal drops below 0.5 V, or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.

2.3.11. Over the entire range of available drive currents, driver shall provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0% relative light output, or 100 – 1% light output and step to 0% where indicated. Driver shall respond similarly when raising from 0% to 100%

.1 Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.

2.3.12. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels

2.3.13. Drivers to track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.

2.3.14. Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:

.1 LED dimming driver shall provide continuous step-free, flicker free dimming similar to incandescent source.

.2 Base specification: Flicker index shall less than 5% at all frequencies below 1000 Hz.

.3 Preferred specification: Flicker index shall be equal to incandescent, less than 1% at all frequencies below 1000 Hz.

2.3.15. Control Input

.1 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers

.1 Must meet IEC 60929 Annex E for General White Lighting LED drivers

.2 Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.

2.3.16. Must meet ESTA E1.3 for RGBW LED drivers

2.4. BALLASTS

2.4.1. All Ballasts shall comply with CSA C22.2 No. 74 and are to meet or exceed the standards of the Certified Ballast Manufacturers Association (CBM).

2.4.2. All ballasts shall be tested and comply with maximum in-rush current limits as stated in NEMA 410.

2.4.3. Not all ballasts could be used, refer to luminaire schedule for project specific details.

2.4.4. All ballasts shall be manufactured by Osram/Sylvania, Philips, Advance, GE, Lutron or Magnetek unless indicated otherwise. Ballasts shall operate at voltage and control lamps as noted in the Luminaire Schedule.

2.4.5. Ballasts for T5 and T8 lamps will be programmed rapid start, will start at minimum 0 deg. C. (indoors) and minus 29 deg. C. (outdoors). Ballasts shall meet ANSI C62.41 Category A transient voltage protection requirements. PF shall be greater than .95, and shall meet FCC Class A specifications for EMI/RFI. The maximum case temperature will not exceed 70 deg. C.

2.4.6. Ballasts for compact fluorescent lamps to be universal input type electronic with end-of-lamp sensing. PF shall be greater than .98, BF shall be greater than .98, THD < 10%. Ballasts shall meet FCC Class A specifications for EMI/RFI.

2.4.7. Ballasts for HID lamps will be suitable for operation in 40 deg. C. temperatures, with a minimum starting temperature of minus 30 deg. C. at 90 % of line voltage. They shall be encapsulated in a steel enclosure. Insulation is to be Class H (minimum 180 deg. C.) vacuum impregnated with silica filled polyester compound. Coils are to be precision or bobbin wound. Sound rating is to be minimum class B. Continuous operation for 60,000 hours at maximum rated load and temperature. Ballast factor of 1.0, .95 minimum power factor, 1.8 minimum crest factor.

2.4.8. Electronic dimming ballasts for T5 and T8 lamped fluorescent luminaires are to be compatible with lamp type and quantity and shall meet the following requirements:

.1 Dimming range from 100% to 1% illuminance level with continuous, flicker free output with ambient noise level ≤ 27dB over the entire dimming range.

.2 Maximum lead length from ballast to lamp socket is seven feet for T-8 lamps, and 3 feet for T-5 lamps.

.3 PF > .95.

.4 BF ≥ .85.

.5 THD < 10% at full light output.

.6 Lamp crest factor ≤ 1.6.

.7 Inrush current to be internally limited to not exceed 3 amps at 347V or 7A at 120V.

.8 Preheating of lamp cathodes before applying arc voltage.

.9 Withstand 4000V surges as per ANSI C62.41.

.10 Improper line voltage and control wiring shall not damage ballast. Each ballast is to be tested at low, medium and high end of range by manufacturer.

.11 Meet FCC Class A specifications for EMI/RFI.

2.4.9. Electronic dimming ballasts for compact fluorescent luminaires are to be compatible with lamp type and quantity and shall meet the following requirements:

.1 Dimming range from 100% to 1% illuminance level with continuous, flicker free output over the entire dimming range.

.2 Maximum lead length from ballast to lamp socket is 3 feet.

.3 PF > .95.

.4 BF ≥ .93.

.5 THD < 10% at full light output.

.6 Lamp crest factor ≤ 1.6.

.7 Inrush current to be internally limited to not exceed 3 amps at 120V.

.8 Preheating of lamp cathodes before applying arc voltage.

.9 Withstand surges as per ANSI C62.41.

.10 Improper line voltage and control wiring shall not damage ballast. Each ballast is to be tested at low, medium and high end of range by manufacturer.

.11 Meet FCC Class A specifications for EMI/RFI.

.12 Minimum starting temperature of 10 deg. C.

2.4.10. Ballasts shall contain no PCB’s and audible rating will be class A or better.

2.4.11. Racks are to be provided for remote ballasts.

2.4.12. Ballasts with unacceptable noise levels are to be replaced at no cost to the owner.

2.5. LUMINAIRES

2.5.1. All luminaires are to be complete with mounting brackets, transformers, supports, trims, louvers, lenses and other accessories as required to make luminaire operational and allow it to be installed in the respective location.

2.5.2. Luminaires shall be suitable for the environment where installed, include seals and gaskets, and corrosion resistant baked-on finish as required and as specified.

2.5.3. Louvers, lenses and diffusers must be of suitable thickness to prevent sagging.

2.5.4. Where drawings show luminaires mounted end-to-end, luminaires shall be suitable for continuous, seamless and tandem mounting.

2.5.5. Fluorescent luminaires designed for continuous, seamless and tandem mounting shall only be constructed with four foot lamps. Two and three foot lamps are not acceptable unless indicated on drawings or luminaire schedule.

2.5.6. All poles are to come complete with internal vibration dampeners to accommodate wind conditions to avoid damage due to wind-induced vibrations.

2.5.7. All concrete bases for poles and bollards shall be designed to accommodate the height, weight, etc. of the pole/bollard and its accessories for the soil conditions for which it is installed. Engineered shop drawings shall be provided that is signed by a structural engineer registered in the local jurisdiction.

2.5.8. Where cameras are shown to be installed on poles, the poles shall be stiffened to reduce vibration and sway, and shall be rated for video recording cameras.

2.5.9. The supply and installation of fixed per unit cost and ‘cash allowance’ luminaires shall comply with all standards set forth in Electrical Specifications. Electrical Contractor is responsible to include in the base bid for delivery, scheduling, receiving, storage, partial assembly, installation, wiring, aiming, cleaning and warranties for all fixed per unit cost and ‘cash allowance’ luminaires.

2.5.10. The following is a list of generic type designation for luminaires. The project specific luminaire schedule is to be referenced for the specific types and designations and the respective specifications.

.1 Designations beginning with the letter ‘C’ denote compact fluorescent type.

.2 Designations beginning with the letter ‘D’ denote incandescentor halogen type.

.3 Designations beginning with the letter ‘F’ denote fluorescent type.

.4 Designations beginning with the letter ‘H’ denote high intensity discharge type.

.5 Designations beginning with the letter ‘L’ denote LED type.

.6 Designations beginning with the letter ‘J’ denote Induction type.

.7 Designations beginning with the letter ‘X’ denote exit sign.

3. Execution

3.1. INSTALLATION

3.1.1. It is the responsibility of the contractor to obtain the information related to the luminaire and luminaire trim finishes/colours from the Interior Designer or Architects prior to the fabrication of luminaires. The Contractor shall provide adequate time for the design team to review and comment on luminaire and luminaire trim finishes

3.1.2. The contractor will provide, receive, unload, uncrate, store, protect and install lamps, luminaires, and other related lighting equipment as specified herein. Lamps for all equipment will be provided and installed by the contractor according to equipment manufacturer's instructions.

3.1.3. The Electrical Contractor shall be responsible for the supply and installation of all concrete bases for poles and bollards. Unless otherwise shown on the drawings, concrete bases to be ArtForm style or Approved Equal and shall extend a minimum 900mm above grade in parking lots and a minimum 150mm above grade in pedestrian walkways.

3.1.4. Poles and bollards are to be installed on independent concrete bases unless indicated otherwise on the drawings or schedules. Coordinate brackets for cameras and supports for banners with pole manufacturer.

3.1.5. Install remote ballasts in racks and wire luminaires to ballasts in conduit. Provide wiring as per manufacturer's recommendations.

3.1.6. Locate luminaires in accordance with the Architect's Drawings. Coordinate exact locations on site. Refer to Architect's drawings for dimensions of coves and valences. Fluorescent staggered coves must have a minimum of two inches overlap.

3.1.7. Install in accordance with Manufacturer's Instructions, Local Codes, Electrical Division Drawings and Specifications.

3.1.8. All suspended luminaires shall have cables and support stems vertically aligned.

3.1.9. Suspend luminaires in mechanical rooms after all the mechanical equipment and ductwork are installed. Luminaires are not to be suspended from mechanical pipes, ductwork or other building services.

3.1.10. All luminaires shall be installed underneath other services located within ceiling space. Contractor is responsible for interference drawings to ensure all services in ceiling are coordinated.

3.1.11. Any dimensions provided in the drawings or schedules are intended as general guidelines. For exact dimensioning refer to the Architectural drawings. The detailed information shall be cross referenced with the electrical specifications and the Luminaire Schedule applying the most stringent requirement.

3.1.12. It is the responsibility of the Electrical Contractor to coordinate luminaire trims and mounting system with ceiling finishes. Luminaires delivered on site with the wrong ceiling mounting system shall be replaced without additional costs for the owner. Restocking fees will not be accepted.

3.1.13. For suspended ceiling installations support luminaires from structural slab in accordance with local inspection requirements.

3.1.14. Where luminaires are mounted in tandem, align luminaires mounted in continuous rows to form straight uninterrupted line.

3.1.15. Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.1.16. Ensure light leakage does not occur from openings and trim rings. Contractor is responsible to repair the ceiling at no cost to the Owner if cut-out is too large.

3.1.17. Connect luminaires to lighting circuits.

3.1.18. Provide all wiring in conduit with junction boxes on a grid pattern to limit the run of flexible armoured cable drops from the ceiling mounted junction box to each luminaire to a maximum of 3 m in length unless approved otherwise in writing from the Engineer's Representative.

3.1.19. Modular wiring systems shall be employed only where indicated or with approval of the Engineer's Representative.

3.1.20. Luminaires are not to be used as temporary construction lighting. After being tested to ensure acceptable operation, luminaires will not be used until substantial completion unless permission is received from the owner, architect or Engineer's Representative.

3.1.21. Lamps are to be installed after luminaire is cleaned. All fluorescent lamps shall be run through a minimum of 12 hours initial start to increase the lamp life and all lamps shall be run through a minimum of 100 hours initial start prior to any dimming.

3.1.22. Clean all luminaires, inside and out at time of substantial completion. Replace all scratched or damaged luminaires, lenses, louvers and diffusers at no cost to the owner.

3.1.23. Installation of exit signs

.1 Rough-in and installation of exit signs shall be carefully coordinated on site such that after installation of all equipment/services, including equipment/services from other trades (i.e. sprinkler lines, plumbing pipes, way-finding signs, etc.), shall not interfere with the line-of-sight visibility of the exit sign(s) from approach of the intended egress pathway(s).

.2 If exit sign(s) have been installed and do not meet the satisfaction of the Engineer's Representative/Architect, the Contractor shall lower, raise or relocate the exit sign(s) such that proper and adequate visibility of the exit sign(s) is achieved at no additional cost to the Owner.

END OF SECTION

33 05 23.00 Excavation and Backfill for Electrical Work

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.1.3. Section 31 00 00.00 – EXCAVATION/EARTHWORKS.

1.2. SCOPE

1.2.1. This Section governs requirements for all excavating and backfilling Work required for the installation of buried power and communication services and backfill.

1.2.2. Assume that material to be excavated is earth. When rock is encountered during construction, payment will be made on unit price basis to the extent of net difference in cost between dry earth excavation and solid rock excavation, all as indicated in Contract Documents.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.3.2. Provide Shop Drawings indicating proposed method of bedding and backfilling.

2. Products

2.1. SOILS

2.1.1. To the requirements for Granular “A”, “B” (Type 1), “M” and “Select Subgrade Material”.

2.1.2. Requirements for Pea Gravel: Granular, well-graded clean rounded pea gravel or stone with not more the 2% material that will pass 75 um (No. 200) sieve, maximum 6 mm (1/4 in.), containing no other deleterious material, and subject to testing that specified density can be achieved without compaction.

2.1.3. Requirements for Sand Fill: Uniform quality and unwashed river sand or any clean sand containing less than 5% organic materials, clay or silt (passing 125 um sieve) is acceptable. It can contain a limited amount of small stones or rocks as it comes from the pit. Sharp, clean, coarse sand, water washed, free from clay, salts and organic matter, and in accordance with CSA A179 – Mortar and Grout for Unit Masonry, for masonry sand is also acceptable.

3. Execution

3.1. INSTALLATION

3.1.1. All excavation and backfilling for all services shall be in accordance with Site Work Division.

3.1.2. Protection:

.1 Provide protection to existing structures and services. Be responsible for rectifying any damage to existing structures and services resulting from this operation.

3.1.3. Excavation in Soil:

.1 Excavation carried below the correct inverts shall be backfilled with 2000 psi (13.5 mPa) concrete to the underside of the pipe lines, unless otherwise directed in writing.

3.1.4. Excavation in rock:

.1 All excavation in rock is included under separate Section, (the Site Work Division Section 31 00 00.00 – EXCAVATION/EARTHWORKS) and is taken to a minimum of 150 mm below the correct pipe invert. This Division shall use a bedding material to the correct trench invert.

3.1.5. Backfilling

.1 Backfill with sand from the bottom of the trench or excavation up to a point 300 mm above the top of service line or appurtenance.

.2 Backfill duct trenches with sand to a depth 300 mm above the ducts. The sand shall be thoroughly tamped around and over the pipes in 150 mm layers.

.3 Backfill the remainder of trench or excavation up to top of subgrade or bottom of floor slabs on-grade.

END OF SECTION

33 71 19.00 Concrete Encased Duct Banks and Maintenance Chambers

1. General

1.1. WORK INCLUDED

1.1.1. Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.1.2. Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2. REFERENCES

1.2.1. Canadian Standards Association (CSA)

.1 CAN/CSA-A5, Portland Cement, latest edition.

.2 CSA-A23.1, Concrete Materials and Methods of Concrete Construction, latest edition.

.3 CSA G30.3, Cold-Drawn Steel Wire for Concrete Reinforcement, latest edition.

.4 CSA G30.5, Welded Steel Wire Fabric for Concrete Reinforcement, latest edition.

.5 CSA G30.18, Billet-Steel Bars for Concrete Reinforcement, latest edition.

1.2.2. American Society for Testing and Materials (ASTM)

.1 ASTM D 1056, Specification for Flexible Cellular Materials - Sponge or Expanded Rubber, latest edition.

1.3. SHOP DRAWINGS AND PRODUCT DATA

1.3.1. Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.3.2. Submit Shop Drawings for precast maintenance chambers.

1.3.3. Submit Shop Drawings for ground rod details for cable rack grounding.

2. Products

2.1. PVC DUCTS

2.1.1. PVC ducts, type DB1, encased in reinforced concrete.

2.2. PVC DUCT FITTINGS

2.2.1. Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.

2.2.2. Expansion joints.

2.2.3. Rigid PVC 5 degree angle couplings.

2.3. PRECAST CONCRETE MAINTENANCE CHAMBERS

2.3.1. Precast concrete maintenance chambers and auxiliary sections shall be fabricated in steel forms.

2.3.2. Aggregates: to CSA-A23.1.

2.3.3. Cement: to CAN/CSA-A5, Type 30.

2.3.4. Steel welded wire fabric mesh reinforcing: to CSA G30.3.

2.3.5. Pulling inserts and bolts for racks integrally cast in concrete.

2.3.6. Neoprene gasket seals between maintenance chamber sections: to ASTM D 1056.

2.3.7. Precast concrete maintenance chambers to come complete with a well in the bottom of the maintenance chamber with a breakout section in the bottom to allow for natural drainage. Well to be used for sump pump where one is identified on the drawings.

2.3.8. Precast concrete maintenance chambers to come complete with concrete knockout duct sections in each wall of the duct bank. Provide a minimum of 18 duct knockouts on each face of the maintenance chamber. Provide additional knockouts as required to suit the contract documents. Rebar is only to encircle all the duct knockouts and no rebar is to be run between duct knockouts.

2.4. DRAINAGE

2.4.1. Provide floor drain fittings in maintenance chamber consisting of floor drain, back water valve, trap and pipe connection to drainage system.

2.4.2. Provide a storm sewer connection: cast iron service saddle consisting of oil resistant gasket, stainless steel clamp and oil resistant O-ring.

2.4.3. Provide a sump pit with dimensions of 300 x 300 x 125 mm.

2.5. MAINTENANCE CHAMBER NECKS

2.5.1. Shall be constructed of concrete brick and mortar.

2.6. MAINTENANCE CHAMBER FRAMES AND COVERS

2.6.1. Provide cast iron maintenance chamber frames and covers.

2.6.2. Provide bolted on covers to prevent unauthorized entry.

2.7. GROUNDING

2.7.1. Ground rods: Provide ground rod detail, as indicated for cable rack grounding.

2.8. CABLE RACKS

2.8.1. Hot dipped galvanized cable racks and supports.

2.8.2. Cable racks to be a minimum of 300mm deep with a universal clamping means to secure the cable to the cable rack.

2.8.3. Provide all required hardware and supports to allow for the installation of the cable racks.

2.9. CABLE PULLING EQUIPMENT

2.9.1. Pulling iron: galvanized steel rods, size and shape as indicated.

2.9.2. Pull rope: 6 mm stranded polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.10. MARKER TAPE

2.10.1. Use of red plastic marker tape with black letters “DANGER – HIGH VOLTAGE” identifying the underground electrical installation.

3. Execution

3.1. INSTALLATION GENERAL

3.1.1. Install underground duct banks and maintenance chambers including formwork.

3.1.2. Build duct bank and maintenance chambers on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.

3.1.3. Open trench completely between connected maintenance chambers before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

3.1.4. Prior to laying ducts, construct "mud slab" not less than 75 mm thick.

3.1.5. Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.

3.1.6. Install base spacers at maximum intervals of 1.5 m leveled to grades indicated for bottom layer of ducts.

3.1.7. Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 40 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. Encase duct bank with 75 mm thick concrete cover. Use galvanized steel conduit for sections extending above finished grade level.

3.1.8. Make transpositions, offsets and changes in direction using angle sections.

3.1.9. Use bell ends at duct terminations in maintenance chambers or buildings.

3.1.10. Use conduit to duct adapters when connecting to conduits.

3.1.11. Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.

3.1.12. Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.

3.1.13. Allow concrete to attain 50% of its specified strength before backfilling.

3.1.14. Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.

3.1.15. Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.

3.1.16. Install a minimum of four 3 m lengths of 15 mm reinforcing rods, one in each corner of duct bank when connecting duct to maintenance chambers or buildings. Wire rods to 15 mm dowels at maintenance chamber or building and support from duct spacers. Protect existing cables and equipment when breaking into existing maintenance chambers. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.

3.1.17. Prior to installation of any wire or cable in the ducts, pull through each duct a flexible mandrel not less than 300 mm long and size for the internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Notify the engineer’s representative no less than 48 hours prior to the event, so that the engineer’s representative may witness.

3.1.18. Install a polypropylene pull string in each duct. Secure the pull string at each end of the duct.

3.1.19. Install red “DANGER – HIGH VOLTAGE” warning tape across the entire width of the ductbank in the soil half way between the duct bank and grade.

3.1.20. Mark location of duct runs under hard surfaced areas not terminating in maintenance chamber with railway spike driven flush in edge of pavement, directly over run.

3.1.21. Where markers are removed to permit installation of additional duct, reinstall existing markers.

3.1.22. Provide As-Built Drawings showing locations of markers.

3.2. MAINTENANCE CHAMBERS

3.2.1. Install precast maintenance chambers.

3.2.2. Provide 115 mm deep window to facilitate cable bends in wall at each duct connection. Terminate ducts in bell-end fitting flush with window face. Provide four 10 mm steel dowels at each duct run connection to anchor duct run. On runs of 16 ducts and over, support concrete duct encasement on a 700 mm wide by 75 mm thick concrete pier poured against maintenance chamber wall between slab and bottom of duct run, provide dowels for anchoring.

3.2.3. Alternately connect large duct runs by leaving square opening in wall, later pouring duct run and wall opening in one pour, and install 10 mm x 3 m reinforcing rods in duct run at maintenance chamber connection.

3.2.4. Build up concrete maintenance chamber neck to bring cover flush with finished grade in paved areas and 40 mm above grade in unpaved areas.

3.2.5. Install maintenance chamber frames and covers for each chamber. Set frames in concrete grout onto chamber neck.

3.2.6. Drain floor towards sump with 1 to 48 slope minimum and install drainage fittings as indicated.

3.2.7. Provide two levels of cable racks around the entire perimeter of each maintenance chamber. Provide anchor bolts and pulling irons on all four sides of the maintenance chamber.

3.2.8. Grout frames of maintenance chambers. Cement grout to consist of two parts sand and one part cement and sufficient water to form a plastic like slurry.

3.2.9. Ensure filling of voids in joint being sealed. Plaster with cement grout the walls, ceiling and neck.

3.2.10. Spray paint an "X" on ceiling of maintenance chamber above floor drain or sump pit.

3.3. REVIEWS

3.3.1. Review of duct and duct clean out will be witnessed by the Engineer’s Representative prior to placement of concrete.

END OF SECTION

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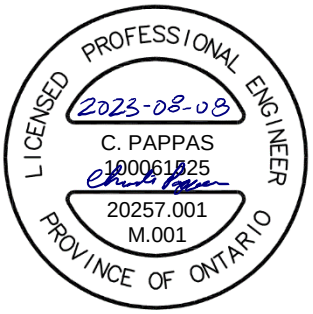

MECHANICAL SPECIFICATION

PROJECT NAME:
PROFESSOR'S LAKE RECREATION CENTRE ELEVATOR UPGRADE
1660 NORTH PARK DRIVE
BRAMPTON, ON

OUR PROJECT NUMBER:
20257.001.M.003

DATE:
2024.01.24

ISSUED / REVISION:
ISSUED FOR TENDER

20 00 00.00 Index

END OF SECTION

20 05 00.00 General Instructions for Mechanical Sections

1. General

1.1. WORK INCLUDED

1.1.1. Conform to the requirements of Division 1, which applies to and forms part of all sections of the Work.

1.1.2. The Specification is divided into Sections which are not intended to identify contractual limits between Subcontractors nor between the Contractor and their Subcontractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.

1.1.3. Provide mechanical components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications, but are required to ensure complete and operational systems.

1.2. INTENT

1.2.1. Mention in the Specifications or indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.

1.2.2. The Specifications are an integral part of the accompanying Drawings. Consider any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, as properly and sufficiently specified.

1.2.3. Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective material, equipment and part of equipment and repair related damages.

1.3. SECTIONS AFFECTED

1.3.1. These instructions apply to and form a part of all Division 20, 21, 22, and 23 Sections referred herein as Mechanical.

1.4. DEFINITIONS

1.4.1. Where used on the Drawings or in the Specifications, the following words are given the meanings below.

.1 Provide: means supply, install, connect and test.

.2 Existing to Remain: existing items that are not removed and that are not otherwise indicated as being removed, removed and salvaged (turned over to Owner), or removed and reinstalled.

1.5. REGULATIONS

1.5.1. Perform Work in accordance with codes, rules, regulations, by-laws and requirements of the authorities having jurisdiction.

1.5.2. Provide materials and assemblies with flame-spread ratings and smoke developed classifications in conformance with CAN/ULC-S102 “Test for Surface Burning Characteristics of Building Materials and Assemblies.” Compliance with ASTM E84 “Surface Burning Characteristics of Building Materials” in lieu of CAN/ULC-S102 is not acceptable.

1.5.3. These Specifications are supplementary to the requirements above.

1.5.4. Drawings and Specifications should not conflict with the above regulations but where there are apparent discrepancies, notify the Engineer’s Representative.

1.5.5. Where equipment utilizing refrigerants is provided, comply with regulatory refrigerant phase out requirements and dates applicable in the jurisdiction where the Project is taking place. Where equipment not meeting refrigerant phase out requirements or dates is supplied to site, provide revised unit(s) operating on a new refrigerant at no additional cost to the Owner; cover all costs of any electrical, structural, mechanical, architectural, etc. changes required to accommodate the new refrigerant.

1.6. PERMITS, FEES AND INSPECTIONS

1.6.1. Obtain all permits, make submissions, pay all fees and arrange for all inspections required for the Work of this Division.

1.7. EXAMINATION OF SITE

1.7.1. Before submitting Bids, examine the site to determine the conditions which may affect the proposed Work. No claims for extra payment will be considered because of failure to fulfil this condition.

1.8. DRAWINGS, CHANGES AND INSTALLATION

1.8.1. The Drawings show the general character and scope of the Work and not the exact details of the installation. Install all equipment and systems complete with all accessories required for a complete and operational installation.

1.8.2. The location, arrangement and connection of equipment and material as shown on the Drawings represents a close approximation to the intent and requirements of the Work. The right is reserved by the Engineer’s Representative to make reasonable changes required to accommodate conditions arising during the progress of the Work, at no additional cost.

1.8.3. Install equipment in accordance with the manufacturer's written installation requirements. In the event of conflicts between the Drawings or Specifications and the manufacturer's written installation requirements, notify the Engineer’s Representative for resolution.

1.8.4. The location and size of existing services shown on the Drawings are based on the best available information. Site verify the actual location of existing services before commencing Work.

1.8.5. Make changes and modifications necessary to ensure co-ordination and to avoid interference and conflicts with other Trades, or to accommodate existing conditions, at no additional cost.

1.8.6. Allow adequate space and provisions for servicing of equipment, with minimum inconvenience to the operation of systems.

1.8.7. Where equipment is shown to be ‘roughed-in only,’ obtain accurate information from the Engineer’s Representative before proceeding with the Work.

1.8.8. Prepare dimensioned layouts of each room prior to rough-in for review by the Architectural Consultant. Do not proceed with any Work until the Engineer’s Representative has reviewed the layout.

1.9. BID FORM AND SUBMISSIONS OF BIDS

1.9.1. Submit with the bid, all information called for on the Bid Form. Bids not completed in full may, at the discretion of the Owner, be rejected.

1.9.2. Where only one name appears in the Specification, include the specified equipment in the Bid.

1.9.3. Where two or more names are shown in the Specifications as alternatives or equal to, this Division can select which manufacturer is to be carried, provided the choice is shown on the Bid Form. Where the choice is not indicated, supply the equipment described in the Specification or first named on the Bid Form.

1.9.4. Substitute equipment may be offered as a price deduction to the Bid price. Acceptance of substitute equipment is at the discretion of the Owner whose decision is final.

1.9.5. Only propose alternative and/or substitute equipment that is equal in performance and quality to that specified.

1.9.6. The Owner reserves the right to accept or reject any substitution without question.

1.10. MATERIALS

1.10.1. Make and quality of materials used in the construction of this Work are subject to the approval of the Engineer's Representative.

1.10.2. Supply only new materials and equipment, free from defects and as specified by the manufacturer's name and catalogue reference.

1.10.3. Where a manufacturer's equipment has been specified by name and/or model number, ensure that the performance and quality of equipment provided by an acceptable manufacturer, meets the specified equipment performance, is inclusive of all standard and specified optional features, and can be installed in the planned location with access and maintenance clearances in accordance with the manufacturer's written installation recommendations. Provide all required piping and electrical connections at no additional cost.

1.11. CO-OPERATION WITH ENGINEER'S REPRESENTATIVE

1.11.1. To assist in the successful execution of the Project, the Contractor will receive an initial job report that summarizes the expectations of the Engineer's Representative and the Contractor. This job report covers topics such as progress billings, shop drawing requirements, Change Order pricing, the commissioning process, installation drawings, the Specifications, as-built drawings and operations and maintenance manuals, along with a number of other items. This job report is intended to reiterate key items from the Contract Documents and is not intended to impose new requirements.

1.11.2. At the appropriate time during construction, submit the applicable documentation listed below. The Engineer's Representative will review the information and identify when the information is complete. The Engineer's Representative's general review letter (required for building occupancy) will only be issued when the information requested below is submitted by the Contractor and deemed to be complete by the Engineer's Representative.

1.11.3. For mechanical systems financial close, provide the following additional documents to the Engineer's office for review:

.1 Operating and maintenance manual

.2 Warranty letter

1.12. WARRANTY

1.12.1. Should any material or workmanship supplied under this contract prove defective within a period of one year from the date of the Owner's acceptance, the Contractor shall immediately repair, replace the material or work at no cost or disruption to the owner and shall be liable for and compensate the Owner for any damages to the owner's property resulting from such defected or repairs.

1.13. CO-OPERATION WITH OTHER DIVISIONS

1.13.1. Pay particular attention to the proximity of electrical conduit and cable to mechanical piping and equipment.

1.13.2. Do not allow Electrical conduits to touch or be supported from piping or ductwork.

1.13.3. Supply all items to be built in ample time for rapid progress of the Work. Schedule and proceed with Work as required to satisfy the construction schedule.

1.13.4. Confirm the available voltage for all single phase and three phase motors or other similar electrically driven equipment with the Electrical Division prior to ordering the equipment. Report any discrepancy between the requirements identified within the Contract Documents and those of the Electrical Division to the Engineer's Representative and supply equipment to suit the appropriate power requirements. Bear all costs associated with failure to perform this coordination prior to ordering of the motors or equipment.

1.14. STATEMENT OF PRICES

1.14.1. For the purpose of progress applications, submit a summary statement of estimated prices for the various portions of the Work, including labour, materials and equipment shown separately. The total price of all portions of the Work must equal the total price of the Work covered under Divisions 20, 21, 22 and 23.

1.14.2. Submit the summary of Work for this Contract to the Engineer's Representative for review and approval. Provide sufficient detail in the summary to enable the Engineer's Representative to evaluate the progress of Work and identify all major equipment, components and sub trades.

1.15. METRIC CONVERSIONS

1.15.1. Take particular care with imperial versus SI metric conversions. This applies to all services including, but not limited to, equipment, pipes, ductwork and site services in both new and existing installations.

1.15.2. Conform to CAN/CSA-Z234.1 "Metric Practice Guide."

1.16. ALTERNATIVE AND IDENTIFIED PRICES

1.16.1. If alternative and unit prices have been requested, include on the Bid Form. Prices not on the Bid Form at time of submission will not be accepted. Refer to the Specifications and the Drawings for details.

1.17. SCHEDULE, ACCESS, PROTECTION AND CLEAN-UP

1.17.1. The construction schedule places restrictions on the duration of construction within areas and the duration of shut-down of equipment. There may be access restrictions to the site (location, time of day, days of week). Refer to Front End Specifications for more information and conform to all requirements stated within.

1.17.2. Refer to the security and protection requirements in the General Conditions and conform to all requirements. In particular:

.1 No open flames without prior written approval of the Owner.

.2 No smoking.

.3 Keep the site clean at all times.

1.18. ASHRAE 90.1

1.18.1. Provide mechanical equipment that complies with the minimum efficiency standards set out in ASHRAE 90.1 “Energy Standard for Buildings Except Low-rise Residential Buildings” and the National Energy Code of Canada for Buildings. Submit all necessary information to substantiate conformance.

1.19. INTELLECTUAL PROPERTY

1.19.1. The Contractor acknowledges, represents, warrants and agrees that the Owner, its Consultants, and the Engineer’s Representative are not responsible, and are hereby indemnified against any action as a result of patent infringement made through the review, acceptance, or receipt of materials, equipment, Work, etc. provided by the Contractor or any of their Suppliers or manufacturers in the execution of this Contract.

1.20. MATERIALS AND EQUIPMENT

1.20.1. Use new materials and equipment as specified or shown that are free from defects that impair strength, durability, or aesthetics.

1.20.2. Manufacture in Canada wherever possible.

1.20.3. Labelled and/or Listed as required by the Authority Having Jurisdiction or Code.

1.20.4. Mechanical systems are designed and coordinated based on the manufacturer and model number and/or parameters indicated on the Equipment Schedules. Accept all costs for differences in physical properties or performance between scheduled equipment and acceptable alternative equipment manufacturers or models identified in these Specifications.

.1 Electrical coordination: accept all extra costs to revise the electrical provisions, including but not limited to feeder/wiring sizes, breaker sizes, fuse sizes, starters and equipment, to supply power to the non-basis of design piece of equipment.

1.20.5. Be responsible for all design costs associated with differences between scheduled equipment and alternate manufacturers or models identified in these Specifications.

1.21. VALUATION OF CHANGES

1.21.1. Further to Contract requirements, use the following method in determining the value of a change to the Work, by either Change Order or Change Directive:

.1 Estimate and acceptance in a lump sum, unless the Engineer’s Representative otherwise determines that the method shall be unit prices set out in the Contract.

1.21.2. Provide the Engineer’s Representative with a detailed cost analysis of the proposed change.

1.21.3. Where a proposed change includes both credits and extras, only price the net new materials and net new labour that are required for the proposed change.

1.21.4. Utilize equal per unit labour and material costs for credits and additions.

END OF SECTION

20 05 01.00 Abbreviations

1. General

1.1. ABBREVIATIONS

1.1.1. The following list of common abbreviations and acronyms may be utilized in the Contract Documents or in the execution of the Work. The list is considered general in nature and all abbreviations or acronyms identified may not apply to the specific Work required to be completed. The list is not exhaustive and some abbreviations or acronyms may be the same however represent different denotation (e.g. BHP - Boiler Horsepower and BHP - Brake Horsepower) and must be read in the context of the Section the abbreviation or acronym is written in. A Section may define alternative abbreviations or acronyms that take precedence in the execution of the Work of that Section.

AABC	-	Associated Air Balance Council
AAP	-	Alarm Annunciator Panel
ABMA	-	American Boiler Manufacturers Association
ABSA		Alberta Boilers Safety Association
AC	-	Alternating Current
ACO	-	Acid Resistant Cleanout
AD	-	Acid Resistant Drains
AFD	-	Acid Resistant Floor Drain
AFF	-	Above Finished Floor
AGA	-	American Gas Association
AMCA	-	Air Movement and Control Association
ANSI	-	American National Standards Institute
AHRI	-	Air-Conditioning, Heating and Refrigeration Institute
ASCE	-	American Society of Civil Engineers
ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AV	-	Acid Resistant Vent
AWG	-	American Wire Gauge
AWS	-	American Welding Society
AWWA	-	American Water Works Association
BHP	-	Boiler Horsepower or Brake Horsepower
Btu/hr	-	British Thermal Units per Hour
BWG	-	British Wire Gauge
CAD	-	Computer Aided Drafting
CAFV	-	Controllable Air Flow Venturis
CAP	-	College of American Pathologists
CBC	-	California Building Code
CCA	-	Chromated Copper Arsenate
CEMA	-	Canadian Electrical Manufacturer’s Association
CEMS	-	Central Energy Management System

CCF	-	Central Computer Facility
CCMC	-	Canadian Construction Materials Centre
cfm	-	Cubic Feet per Minute
CGA	-	Canadian Gas Association
CGSB	-	Canadian General Standards Board
CI	-	Cast Iron
CIMJ	-	Cast Iron Mechanical Joint
CPU	-	Central Processing Unit
CRN	-	Canadian Registration Number
CSA	-	Canadian Standards Association
cu.ft.	-	Cubic Feet
cu.m.	-	Cubic Meter
c/w	-	Complete with
db	-	Dry Bulb
dB	-	Decibel
dBA	-	A-weighted Decibel
DC	-	Direct Current
DDC	-	Direct Digital Control
DegC	-	Degrees Celsius
DegF	-	Degree Fahrenheit
dia.	-	Diameter
DPDT	-	Double Pull Double Throw
DPTX	-	Differential Pressure Transmitters
EAP	-	Excess Exhaust Alarm Panel
EDR	-	Equivalent Direct Radiation
EF	-	Exhaust Fan
EEMAC	-	Electrical Equipment Manufacturers Association of Canada
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
EMT	-	Electrical Metallic Tubing
EP	-	Electric Pneumatic
EPDM	-	Ethylene Propylene Diene-Rubber
EPROM	-	Electrically Programmable Read Only Memory
ERW	-	Electric Resistance Welded
FACP	-	Fire Alarm Control Panel
FDA	-	Food and Drug Administration
FHC	-	Fume Hood Controller or Firehose Cabinet
FLA	-	Full Load Amps
fpm	-	Feet per Minute
fps	-	Feet per Second
FM	-	Factory Mutual
ft.	-	Foot or Feet
ga	-	Gauge
gal	-	Gallons

GFD	-	Gallons per Square Feet per Day
GPD	-	Gallons per Day
GPH	-	Gallons per Hour
GPM	-	Gallons per Minute
GS	-	Galvanized Steel
GSG	-	Galvanized Sheet Gauge
GSS	-	Galvanized Sheet Steel
h-cu.ft.	-	Hour-cubic foot HCFCs - Hydrochlorofluorocarbons
HEPA	-	High Efficiency Particulate Air
HOA	-	Hand/Off/Auto
HOT	-	Hand Held Operator Terminal
HSS	-	Hollow Steel Sections or Hollow Structural Sections
HTK	-	Hood Termination Kit
hp	-	High Pressure or Motor Horsepower
Hz	-	Hertz
IAO	-	Insurers' Advisory Organization
IAOC	-	Insurers' Advisory Organization of Canada
IBC	-	International Building Code
ICU	-	Intensive Care Unit
(I)GPH	-	(Imperial) Gallons per Hour
(I)GPM	-	(Imperial) Gallons per Minute
in.	-	Inch or Inches
in. WG	-	Inches of Water Gauge
IRMA	-	Inverted Roof Membrane Assembly
kg	-	Kilogram
kg/cu.m.	-	Kilogram per cubic meter
kPa	-	Kilopascals
kVa	-	Kilovolt-amps
kW	-	Kilowatts
lbs/cu.ft.	-	Pounds per cubic foot
lbs/hr.	-	Pounds per Hour
L	-	Litre
L/s	-	Litres per Second
LFC	-	Laminar Flow Cabinets
LEDs	-	Light Emitting Diodes
LCP	-	Laboratory Control Panel
LTF	-	Linear foot
LM	-	Linear meter
mA	-	Milliamps
MAC	-	Make-up Air Controller
mADC	-	Milliamps Direct Circuit
MBH	-	1000 British Thermal Units per Hour
MCC	-	Motor Control Centre

mm	-	Millimetre
m	-	Metre
m/s	-	Metres per Second
mL	-	Millilitre
MCP	-	Motor Control Panel
MJ	-	Mechanical Joint
MOV	-	Motor Overvoltage
mPa	-	Millipascals
MSC	-	Master Summing Controller
MSG	-	Manufacturers' Standard Gauge
NADCA	-	National Air Duct Cleaners Association
NBS	-	National Bureau of Standards
NC	-	Noise Criterion as Defined by Graph in ASHRAE
NCCLS	-	National Committee for Clinical Laboratory Standard
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NIM	-	Network Interface Module
NIST	-	National Institute of Standards and Technology
NIOSH	-	National Institute of Occupancy Safety and Health
NPS	-	American National Standard Straight Pipe Thread
NPSH	-	Net Positive Suction Head
NPT	-	American National Standard Taper Pipe Thread
No.	-	Number
NST	-	National Standard Thread
NVLAP	-	National Voluntary Laboratory Accreditiation Program
OAT	-	Outside Air Temperature
OC	-	On Centre
OCP	-	Operator Control Panel
OPSS	-	Ontario Provincial Standard Specification
OS&Y	-	Outside Screw and Yoke
OWRA	-	Ontario Water Resources Act
oz.	-	Ounce or Ounces
PCU	-	Personal Computer Unit
PE	-	Pneumatic Electric
PIT	-	Portable Interface Terminal
ph	-	Hydrogen Ion Concentration
ppm	-	Part per Million
psf	-	Pounds per Square Foot
psi	-	Pounds per Square Inch
psia	-	Pounds per Square Inch Absolute
psig	-	Pounds per Square Inch Gauge
PWM	-	Pulse Width Modulation
PVC	-	Polyvinyl Chloride

qt.	-	Quart
RAH	-	Return Air Humidity
RH	-	Relative Humidity
RO	-	Reverse Osmosis
rpm	-	Revolutions per Minute
RPU	-	Remote Processing Unit
RPU-TU	-	Remote Processing Unit for Terminal Units
SCFH	-	Standard Cubic Feet per Hour
SCMH	-	Standard Cubic Meters per Hour
SCR	-	Silicone Controlled Rectifier
SI	-	International System of Units
SMACNA	-	Sheet Metal and Air Conditioning Contractors' National Association
sp. in. wg.	-	Static Pressure, Inches Water Gauge
SPDT	-	Single Pull Double Throw
SPS	-	Sash Position Sensor
SS	-	Stainless Steel
SF	-	Supply Fan
SPWM	-	Sine-Coded Pulse Width Modulated
SSPC	-	Steel Structures Painting Council (The Society of Protective Coatings)
sq.m.	-	Square Meter
STC	-	Supply/Exhaust Tracking Controller or Sound Transmission Class
SWS	-	Sidewall Velocity Sensors
TDS	-	Totally Dissolved Solids
TEFC	-	Totally Enclosed Fan Cooled
TIG	-	Tungsten Inert Gas
TKV-TWA	-	Threshold Limit Value - Time Weighted Average
UACU	-	Unitary Air Conditioning Units
UL	-	Underwriter's Laboratories
ULC	-	Underwriter's Laboratories of Canada
Ohm	-	Ohm
USP	-	United States Pharmacopeia
USG	-	United States Gallons
USGPH	-	United States Gallons per Hour
USGPM	-	United States Gallons per Minute
UV	-	Ultraviolet
VAC	-	Volts Alternating Current
VDC	-	Volts Direct Current
VFD	-	Variable Frequency Drive
VSC	-	Variable Speed Controllers
VSCFH	-	Closed Loop Variable Frequency Drives For Dedicated Exhaust Hoods
VSD	-	Variable Speed Drives
W	-	Watt
W/cu.m.	-	Watts per Cubic Meter

W/ft.	-	Watts per Foot
W/m	-	Watts per Meter
W/sq.in.	-	Watts per Square Inch
W/sq.m.	-	Watts per Square Meter
WC	-	Water Closet
wb	-	Wet Bulb
wg	-	Water Gauge
WHMIS	-	Workplace Hazardous Material Information System
WSP	-	Working Steam Pressure
WOG	-	Water, Oil, Gas

END OF SECTION

20 05 03.00 Shop Drawings

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Comply with Section 01 33 00.00 (01 33 23.00) for Submittals except as amended below.

2. Products

2.1. SHOP DRAWINGS

2.1.1. Submit Shop Drawings electronically, by email, in PDF format. Submissions that are not electronic without prior approval from the Engineer's Representative shall be returned as not reviewed. Provide the following information in the email submission:

.1 S+A Project number and Contractor Shop Drawing Identifier in Subject Line

.2 Shop Drawing Submission to the following email address:

.1 ContractAdmin.Toronto@smithandandersen.com

2.1.2. Shop drawings submitted directly to Smith + Andersen personnel (and not copied to the email address provided above) without advanced permission will not be processed nor considered as received.

2.1.3. Shop Drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance.

2.1.4. Provide a cover sheet with the Project name, issue date, issue number, Specification section number, title of section and with space for Shop Drawing review stamps for the Contractor and Engineer's Representative.

3. Execution

3.1. SUBMISSIONS

3.1.1. Each Shop Drawing shall be in original PDF format stamped and signed by the Contractor to indicate that they have checked the submission for conformance with all requirements of the Drawings and Specifications, that they have co-ordinated this equipment with other equipment to which it is attached and/or connected and that they have verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the Work of other trades. Ensure that electrical co-ordination is complete before submitting Shop Drawings for review.

3.1.2. Manufacturing of equipment, installation of equipment or connecting services shall not start until after final review of Shop Drawings by the Engineer's Representative has been completed.

END OF SECTION

20 05 29.00 Hangers and Supports

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Piping and equipment provided under the Mechanical Division shall be complete with all necessary supports and hangers required for a safe and workpersonlike installation.

1.1.3. Hangers, supports, anchors, guides, and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment.

1.2. SUBMITTALS

1.2.1. Submit Shop Drawings in accordance with Section 20 05 03.00 – SHOP DRAWINGS.

2. Products

2.1. MATERIALS

2.1.1. Provide hangers and supports manufactured by Anvil ASC Engineered Solutions, Taylor Pipe Supports, or E. Myatt & Co.

2.1.2. All pipe hangers and supports shall be manufactured to the latest requirements of ANSI MSS-SP-58 “Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.”

2.1.4. All hangers, supports, brackets and other devices installed exterior to the building or in humid environments shall be galvanized to prevent failure from surface corrosion. If galvanized components cannot be used submit samples of proposed substitute for review prior to installation.

3. Execution

3.1. INSTALLATION

3.1.1. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent undue stress to building structural components.

3.1.2. Piping shall be supported from walls, beams, columns, and slabs using approved structural attachments. Damage or modification to the building structure through welding, cutting, or drilling shall not be permitted if it reduces the integrity of the building structure as deemed by the Structural Engineer’s Representative.

3.1.3. All drilling for hangers, rod inserts and Work of similar nature shall be done by this Division.

3.1.4. Depending on the type of structure, hangers shall be either clamped to steel beams or joists, or attached to approved concrete inserts.

3.1.5. Suspension from metal deck shall not be allowed unless specifically accepted by the Engineer’s Representative. Drawings of the proposed method of suspension must be submitted for review.

3.1.6. Hanger rods shall be subject to tensile loading only. Suspended piping shall be supported by adjustable hanger rods sized as follows:

Pipe Size	Hanger Rod Diameter
50 mm (2 in.) and under	9 mm (3/8 in.)

3.1.7. Unless otherwise specified or shown, hanger spacing for all services shall be as follows:

Nominal Pipe Diameter	Maximum Span
Up to and including 38 mm (1-1/2 in.)	2.1 m (7 ft.)

3.1.8. Suspending one hanger from another shall not be permitted.

3.1.9. For all refrigerant piping 25 mm (1 in.) and smaller, install a section of high density insulation complete with continuous vapour barrier between the pipe and the hanger. Refer to Section 20 07 00.00 - INSULATION.

3.1.10. For all refrigerant piping larger than 25 mm (1 in.), use a galvanized steel shield between the insulation and the hanger. Between the shield and the pipe, install a section of high density insulation complete with continuous vapour barrier. Refer to Section 20 07 00.00 - INSULATION.

3.1.11. Secure wall mounted equipment to metal framing or masonry, with steel toggle or expansion fasteners, machine screws or sheet metal screws as applicable. Plastic, fibre or soft metal inserts shall not be acceptable. Wall mounted equipment shall not exceed 45.5 kg (100 lbs) in weight or 250 mm (10 in.) in depth unless reviewed or detailed by the Engineer’s Representative. Where framing does not permit direct attachment, provide metal strut sub-framing or minimum 19 mm (3/4 in.) fire retardant treated plywood backboards, unpainted, attached to the framing.

END OF SECTION

20 05 48.00 Vibration and Noise Control

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Concrete Work on grade or cast integrally with a floor is provided under Division 3.

1.3. SUBMITTALS

1.3.1. Shop Drawings: Supply Shop Drawings of the vibration and noise control equipment being supplied in accordance with Section 20 05 03.00 - SHOP DRAWINGS.

1.4. PERFORMANCE REQUIREMENTS

1.4.1. Adequately isolate all equipment to maintain acceptable noise levels in the occupied area of the building as specified below. Take noise measurements over the complete audible frequency range above and beside Mechanical Equipment Rooms, and where indicated by the Engineer’s Representative. Noise levels due to mechanical equipment shall not exceed sound pressure levels in all 8 octave bands corresponding to the NC levels per ASHRAE handbook as indicated.

2. Products

2.1. MATERIALS

2.1.1. All equipment provided for vibration isolation or noise control shall be new and manufactured specifically for the purpose intended.

2.1.2. All vibration isolation devices shall be Vibro-Acoustics, Kinetics Noise Control, VMC Amber Booth, or Mason Industries and shall be one manufacturer throughout the Project.

2.1.3. Provide vibration isolation devices for all equipment with motors.

2.2. VIBRATION ISOLATION

2.2.1. Type EP (Elastomeric Pad) - Vibro-Acoustics Model N, Kinetics Model NPD, Mason Industries Model W or Super W, or ISOTECH Model IR or ISOPAD.

.1 Type EP shall be 8 mm thick ribbed or waffle neoprene pads. Isolator pads shall be selected for less than 80 % maximum rated load.

.2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

2.2.2. Grout: Non-shrink, self-levelling grout having ability to withstand thermal, vibratory and impact stresses.

2.2.3. Acoustic Sealant: Non-hardening, non-skinning permanently flexible, to CAN/CGSB-19.21 “Sealing and Bedding Compound, Acoustical.” Tremco, CGC Acoustic Sealant or approved equivalent.

3. Execution

3.1. INSTALLATION

3.1.1. Obtain one copy of all Shop Drawings of equipment to be isolated showing weights, support centres and equipment dimensions.

3.1.2. On system start-up, inspect the complete installation and provide a report in writing.

3.1.3. Piping, conduit or mechanical equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.

3.1.4. All wiring connections to mechanical equipment on isolators shall be made with a flexible conduit installed in a slack “U” shape.

3.1.5. Elastomeric isolators that will be exposed to temperatures below 0 deg. C. (32 deg. F.) shall be fabricated from natural rubber instead of neoprene.

3.1.6. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.

3.1.7. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

3.2. EQUIPMENT ISOLATION

3.2.1. Suspend all piping in Mechanical Rooms on Type SPH or SPNH isolators as required. Where piping is supported from the floor, weld brackets to the piping and support on Type SPNM isolators. Isolators do not replace constant support hangers or mounts.

END OF SECTION

20 05 83.00 Sleeves

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Sleeves passing through concrete or masonry partitions shall be Schedule 40 steel pipe.

2.1.2. Firestopping and smoke seal systems shall be in accordance with CAN/ULC-S115 “Standard Method of Fire Tests of Firestop Systems,” CAN/ULC-S101 “Standard Methods of Fire Endurance Tests of Building Construction and Materials,” ASTM E119 “Standard Test Methods for Fire Tests of Building and Construction Materials” and ASTM E814 “Standard Test Method for Fire Tests of Penetration Firestop Systems.”

.1 Unless noted otherwise “F” and “T” ratings are required.

.2 Systems shall be asbestos free and maintain an effective barrier against flame, smoke, and gases in accordance with CAN/ULC-S115 and shall not exceed opening sizes for which they are intended.

.3 Firestopping and smoke seals at openings around mechanical services shall be an elastomeric seal for sound and vibration control.

.4 Fire resistance rating of firestopping assembly shall not be less than the fire resistance rating of surrounding floor or wall assembly.

.5 Service penetration assemblies shall be ULC certified in accordance with CAN/ULC-S115 and listed in ULC Guide No. 40 U19.

.6 Service penetration firestop components shall be ULC certified in accordance with CAN/ULC-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15.

.7 Firestopping and smoke seals shall be by Hilti, Tremco/Royal Quickstop, STI Firestop or 3M.

.8 Firestop Products shall be mold and mildew resistant.

3. Execution

3.1. INSTALLATION

3.1.1. Provide sleeves for all service penetrations through walls, partitions, floor slabs, plenums and similar barriers.

3.1.2. Sleeves shall be sized to maintain insulation and vapour barrier around all pipes and ducts for all service penetrations. Coordinate thickness requirements with Section 20 07 00.00 - INSULATION.

3.1.3. For sleeves through barriers without a fire resistance rating, for non-insulated pipe, fill the annular space between the service and the sleeve with insulation as specified in Section 20 07 00.00 - INSULATION and caulk around the edges with sealant.

3.1.4. Firestopping and smoke seal material and components shall be installed in accordance with the ULC Listing and manufacturer's written instructions. Examine the sizes and conditions of the cavities to be filled to determine the correct thicknesses and installation of materials. All substrates and surfaces in contact with firestopping materials shall be dry and prepared in accordance with the Manufacturer's written instructions at appropriate ambient conditions.

3.1.5. Where holes are core drilled in existing structures, sleeves shall be provided as specified.

END OF SECTION

20 05 88.00 Cutting and Patching

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Openings required for mechanical services for new construction shall be in accordance with Section 20 05 83.00 - SLEEVES AND ESCUTCHEONS. This Section shall apply for openings required in existing construction or where sleeves for mechanical services have been omitted in new construction in error.

1.1.3. Include for all cutting and patching for all mechanical services for holes and openings with dimensions up to 200 mm (8 in.) in size and related patching. Perform cutting and patching Work in accordance with requirements of Section 01 60 00.00 - PROJECT FORMS.

1.1.4. Cutting and Patching shall be in accordance with Section 01 60 00.00 - PROJECT FORMS.

2. Products

2.1. MATERIALS

2.1.1. All services and materials used for the cutting and patching shall meet all requirements specified in Section 01 60 00.00 - PROJECT FORMS, and shall be carried out by professional workers experienced in the cutting and patching Work to be done.

3. Execution

3.1. INSTALLATION

3.1.1. Locate all openings in non-structural elements requiring cutting and patching in cooperation with the applicable Trades in a timely manner to avoid unnecessary cutting. All openings shall be shown on drawings and submitted to the Engineer’s Representative for review. No holes through structure shall be permitted prior to review by the Structural Engineer’s Representative.

3.1.2. Core drilling for individual services shall be by this Division. Cut all openings no larger than is required for the services.

3.1.3. Locate all openings in structural elements requiring cutting and patching (concrete walls or floors) and x-ray the structure to obtain Structural Engineer’s Representative’s approval prior to cutting or core drilling of structure. Make adjustments to location of openings as required to minimize cutting of rebar and completely avoid electrical conduit.

.1 Cut holes through slabs or walls only.

.2 Do not cut holes through beams.

.3 Holes to be cut are 200 mm (8 in.) diameter or smaller only.

.4 Maintain at least 100 mm (4 in.) clear from all beam faces. Space at least 3 hole diameters on Centre.

.5 For holes that are required closer than 25% of slab span from the supporting beam face, use cover meter above the slab to clear slab top bars.

.6 For holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars.

3.1.4. Obtain written approval from the Landlord and the Structural Engineer's Representative before cutting or core drilling openings or holes.

3.1.5. Patch all openings after services have been installed to match the surrounding finishes.

END OF SECTION

20 07 00.00 Insulation

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.2.1. Provide Shop Drawings with technical data on all types of insulation to be installed, in accordance with Section 20 05 03.00 – SHOP DRAWINGS.

1.2.2. Provide two samples of each type of insulation indicating where each is to be used, and a sample of a typical vapour barrier dam, where vapour barrier dams are called for: in Part 3 or on the Drawings. Samples shall be mounted on boards. One shall be kept at the Contractor's site office and the other shall be turned over to the Engineer's Representative.

2. Products

2.1. GENERAL

2.1.1. Provide insulation and jacket systems that are fire retardant, with a flame-spread rating not to exceed 25 and a smoke developed classification not to exceed 50, when tested in accordance with CAN/ULC S102 "Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies."

2.1.2. For indoor applications, provide insulation systems (insulation, jackets, adhesives, coatings, etc.) that are Certified under the UL GREENGUARD Certification Program for low chemical and particle (volatile organic compounds (VOC)) emissions.

2.2. PIPE INSULATION

2.2.1. Type P3 - Closed cell flexible elastomeric:

.1 To ASTM C534 "Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form."

.2 Preformed, with self closing adhesion strips.

.3 Suitable for temperature range of pipe application in question.

.4 UV resistant with protective jacket/cladding where used outdoors.

.5 Adhesive for both surfaces to be joined.

.6 Acceptable manufacturers:

.1 Armacell

2.3. JACKETS

2.3.1. All service jacket (ASJ)

.1 As indicated in insulation types above.

2.3.2. Polyvinyl Chloride (PVC) jacket:

.1 Pre-moulded PVC covers.

.2 Pre-moulded PVC elbows and fittings.

.3 Minimum thickness: 20 mil.

.4 Colour: white or coloured as chosen at Shop Drawing stage.

.5 Tape: vinyl, pressure sensitive, colour matched.

.6 Sealed with adhesive.

2.4. SECUREMENT

2.4.1. Banding

.1 Aluminum or Stainless steel.

2.4.2. Tie Wire

.1 Stainless steel.

.2 Minimum 1.3 mm (16 gauge).

.3 Twisted ends.

2.4.3. Corner beads and channels at floor line:

.1 Minimum 0.4 mm (28 gauge) galvanized sheet metal.

2.4.4. As per insulation / jacket manufacturer’s written installation instructions.

2.5. CEMENTS AND ADHESIVES

2.5.1. Where cements or adhesives are required, provide those that are compatible with insulation and jacket, per insulation and jacket manufacturer’s written recommendations / instructions.

2.5.2. Fire retardant lagging coating:

.1 Chil Seal CP-50A by Childers Products Company or Henry equivalent.

2.5.3. Vapour barrier dam:

.1 CHIL-PERM CP-30 with fibreglass cloth reinforcing.

3. Execution

3.1. INSTALLATION

3.1.1. Install insulation in accordance with the manufacturer’s written installation instructions unless noted otherwise.

3.1.2. Insulation thicknesses and conductivities shall meet or exceed the minimum standards set out in ASHRAE 90.1 “Energy Standard for Buildings except Low-rise Residential Buildings” and in National Energy Code of Canada for Buildings (NECB), (refer to Table 2 below), and as specified herein for the services covered.

3.1.3. Apply insulation to clean, dry surfaces only while ambient temperature is at least 10 Deg. C. (50 Deg. F.).

3.1.4. Commence application of insulation following required testing of piping, ductwork, and apparatus where such items are to be covered. Do not commence insulation installation until testing report is submitted to Engineer’s Representative and is reviewed by Engineer’s Representative without requesting a resubmit.

3.1.5. Where pipes and ducts are specified to be insulated, insulate complete piping system and duct system with no gaps in insulation.

3.1.6. Protect insulation and pipe from moisture ingress where insulation is installed exterior to the building.

3.1.7. Utilize oversized hangers and pipe supports where pipes are installed exterior to the building and are to be insulated. Hangers and supports to support assembly on the outside of the insulation, so as to protect insulation and pipe from water damage due to ambient conditions.

3.1.8. Terminate insulation on pipes passing through fire rated walls or floors, and fit tight to the fire stop material.

3.1.9. On piping systems specified to be insulated, include insulation on valves, flanges, couplings and unions.

3.1.10. Do not use staples to secure joints of insulation jackets.

3.1.11. Install insulation jackets with minimum 50 mm (2 in.) laps.

3.1.12. Provide insulation and jacket systems in accordance with Table 1 below:

TABLE 1: INSULATION AND JACKET SYSTEMS

Pipe Application	**Insulation**	**Thickness**	**Jacket**
Refrigerant liquid and suction piping	Type P3	25 mm (1 in.), unless a greater thickness is required by the manufacturer's written instructions.	Per insulation type

3.1.13. TABLE 2: MINIMUM PIPE INSULATION THICKNESS/PERFORMANCE (BASED ON ASHRAE 90.1 AND NATIONAL ENERGY CODE FOR BUILDINGS)

3.1.14. Minimum Pipe Insulation Thickness - mm (in.)

.1 Cooling Systems (Refrigerant)

Fluid Design Operating Temp. range deg. C. (deg. F.)	Insulation Conductivity		Nominal Pipe Diameter - mm (in.)					
	Conductivity [W/(m-K)] [(Btu-in.)/ h-sq.ft. – deg. F.]	Mean Rating Temp deg. C. (deg. F.)	Runouts[b] Up to 51 (2.0)	Less than 25 (1)	25-32 (1 to 1-1/4)	38-75 (1-1/2 to 3	100-150 (4-6)	200 (8) and up
5-16	0.039	24	25.4	25.4	25.4	25.4	25.4	25.4
(40-60)	(0.27)	(75)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)
Below 4.4	0.038	10	25.4	25.4	38.1	38.1	38.1	38.1
Below (40)	(0.26)	(50)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)	(1.5)

[b] Runouts to individual terminal units not exceeding 3.7 m (12 ft.) in length located within Partitions within Conditioned Spaces.

END OF SECTION

20 08 02.00 Cleaning and Protection

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. NOT USED

3. Execution

3.1. INSTALLATION

3.1.1. Clean thoroughly all fixtures and equipment from grease, dirt, plaster or any other foreign material. Chrome-plated fittings, piping and trim shall be polished upon completion.

3.1.2. Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned and polished in accordance with manufacturer’s written directions. Motors and equipment bearings shall be protected with plastic sheets, tied or taped in place. Aluminum fin heating or cooling elements shall be protected with cardboard covers.

3.1.3. Any dirt, rubbish, or grease on walls, floors or fixtures accumulated from the Work of the Mechanical Division shall be removed promptly from the premises by this Division.

3.1.4. Any unpainted steel surfaces, installed for longer than one year prior to the completion date, shall be prime coated under this Division.

3.1.5. During construction protect all services and equipment from dirt and debris, by using temporary caps over the open ends of pipes ductwork and equipment connections.

3.1.6. All equipment installed or stored on site shall be maintained in accordance with manufacturer’s recommended instructions (i.e. rotate shafts on fans, pumps, etc).

3.1.7. Refinish and restore to the original condition and appearance all mechanical equipment which has sustained damage to the manufacturer’s prime and finish coats of enamel or paint. Materials and work quality shall be equal to the manufacturer’s original.

END OF SECTION

23 09 23.00 Sequence of Operation for BAS

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS and SECTION 23 09 00.00 - BUILDING AUTOMATION SYSTEM (BAS).

1.1.2. The locations of all sensors shall be discussed with and approved by the Owner and/or Engineer's Representative, before installation. Locations shown are approximate only, and are given to assist the Contractor in pricing only, and shall not be construed as being the final approved location.

1.1.3. The control sequence descriptions are complementary. Provide detailed sequences of operation and all points required to implement the sequences.

1.1.4. All settings and set points listed in this Section shall be variable and Operator adjustable without the need to create or modify Custom Application Programs.

1.1.5. All set points and reset schedules shall be visual on the associated dynamic graphic.

1.1.6. Where the project includes an existing BAS, ensure that any upgrades to the existing BAS for this project scope does not negatively impact existing BAS infrastructure. Maintain the functionality of existing controls not revised by this scope of work.

2. Products

2.1. GENERAL APPLICATION PROGRAMS

2.1.1. Provide a specific set of programs to achieve automated, operator independent control of facility sub-systems.

2.1.2. Refer to SECTION 23 09 00.00 - BUILDING AUTOMATION SYSTEM (BAS) for software programs.

3. Execution

3.1. AIR-COOLED DIRECT EXPANSION SPLIT AIR CONDITIONER

3.1.1. System Start:

.1 System start shall be initiated by operator command locally or at the BAS. Upon signal to start, the system indoor unit fan shall start at locally set speed and condensing unit fan shall start.

3.1.2. Normal Operation:

.1 Indoor and outdoor unit fans shall remain ON until stopped by the Operator.

.2 AC Unit’s thermostat and built in controls shall modulate compressor output to maintain Room Temperature at Set-Point (adjustable).

.3 No “unoccupied” time set-back will be allowed; i.e. the unit will continuously operate on “occupied” mode.

3.1.3. System Stop:

.1 System stop is initiated by operator command at the local thermostat or at the BAS.

3.1.4. Alarms:

.1 Unit not operating.

.2 Supply Air Temperature out of range.

.3 Room Temperature out of range.

END OF SECTION

23 23 01.00 Refrigerant Piping

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.2.1. Submit Product data sheets for all Products required, except for pipe and fittings.

1.2.2. Submit a schematic piping diagram for each refrigerant piping system indicating pipe sizes, slopes, valves, traps, and piping specialties sealed by a Professional Engineer in the Province of the installation.

1.2.3. Submit confirmation of registration of the Project with the Authority Having Jurisdiction.

1.3. REGULATORY COMPLIANCE AND QUALITY ASSURANCE

1.3.1. The installing Contractor shall be certified and shall register all Projects in accordance with the requirements of the Authority Having Jurisdiction.

1.3.2. All components of a refrigeration piping system shall have a Canadian Registration Number or CSA certification acceptable to Authority Having Jurisdiction.

1.3.3. All systems shall display appropriate Ozone Depletion Prevention (ODP) tags prior to commissioning. Manufacturer shall not commission any system not displaying proper ODP tags.

1.4. SPECIAL CONSIDERATIONS FOR AC PIPING

1.4.1. AC refrigeration piping systems shall be installed as per the balance of this Specification with the following considerations and/or exceptions:

1.4.2. Refrigerant Contractors shall be certified by the AC Equipment Supplier. Proof of training certification shall be made available upon request.

1.4.3. There shall be minimal use of refrigeration specialties in the AC pipe system. Install all in accordance with AC manufacturer’s recommendations.

1.4.4. Approved flaring block, and approved torque wrenches, both available from AC manufacturer, shall be used for all flare connections.

1.4.5. Pipe clamps shall fasten around the piping insulation. Pipe clamps that compress the copper directly shall be installed a minimum of 900 mm (36 in) away from joints, and shall be loosely tightened to allow for copper expansion.

1.4.6. Provide AC manufacturer with actual pipe lengths installed for calculation of refrigerant charge. Supply and charge AC system with required quantity of refrigerant prior to AC manufacturer commissioning. Refrigerant charging shall be done in the liquid state.

2. Products

2.1. PIPE, FITTINGS AND JOINTS

2.1.1. Copper piping shall be air conditioning / refrigerant grade ASTM B280, annealed or hard drawn as required. Soft annealed copper tubing shall not be used in sizes larger than 22 mm (7/8 in).

.1 Braze all joints except as noted.

.2 Joints 22 mm (7/8 in) and smaller may be flared.

.3 Fittings shall be cast copper alloy for flared copper tube, or wrought copper and bronze solder-joint pressure fittings.

.4 Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings.

.5 Cast sweat-type joints and fittings shall not be permitted for brazed joints.

.6 Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of equipment.

2.2. BRAZING FILLER METAL

2.2.1. Filler metal shall be type BAg-5 with AWS Type 3 flux except as noted,

2.2.2. Copper to copper joint filler metal shall be BCuP-5 or BCuP-6.

2.2.3. Brazing rods for all joints shall be 15% Lucas Milhaupt “sil-Fos”.

2.3. PIPING ACCESSORIES

2.3.1. As specified and required by AC manufacturer.

2.3.2. Insulation

.1 Liquid, suction and hot gas lines shall be individually insulated in accordance with Section 20 07 00.00 – INSULATION.

3. Execution

3.1. GENERAL

3.1.1. Install all piping in the best workpersonlike manner and in accordance with the best practices of the trade. Piping shall be pitched 13 mm (1/2 in) for every 3000 mm (10 ft) of length in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and as shown.

3.1.2. Pipe supports shall be a maximum of 1800 mm (6 ft) apart. Pipe clamps shall fasten around the piping.

3.1.3. Piping supports and guides using steel or reinforced polytetrafluoroethylene (PTFE) slides shall be provided where required to allow longitudinal pipe movement.

3.1.4. Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping.

3.1.5. Install in accordance with CSA B52 and ASME B31.5 Mechanical Refrigeration Code.

3.1.6. Nitrogen purging / sweeping shall be used when brazing and welding to minimize oxidization.

3.1.7. Isolation valves shall be installed where shown on the schematics or as required.

3.1.8. Prevent the release of refrigerants into the atmosphere during installation and testing.

3.1.9. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Pipe or tubing shall be cut square reamed to remove burrs, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

END OF SECTION

23 09 23.00 Unitary Air-Conditioning Units

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

1.2. MATERIALS

1.2.1. Unitary Air Conditioning Units (UACU) shall be Mitsubishi or Carrier, equal to Mitsubishi “Mr. Slim”.

1.2.2. UACU shall be air-cooled direct expansion split system type with minimum two speed indoor evaporator section and fully modulating remote mounted outdoor condensing unit.

1.2.3. The unit model shall be as specified in the “Air-Conditioning Unit Schedule”.

1.2.4. The split mounted air-conditioner shall be provided with the capacities indicated in the “Air-Conditioning Unit Schedule”.

1.2.5. Condensing unit and the compressor shall be capable of operating at ultra-low temperature ambient at temperatures as low as -34.4 deg. C. (-30 deg. F.).

1.2.6. Provide the AC unit with its wall-mounted thermostat for local controls and temperature setting.

1.2.7. The air-conditioning unit shall be provided with filter. Provide two sets of spare filters.

3. Execution

1.3. INSTALLATION

1.3.1. Supply and install refrigeration piping, electrical and signal wiring between the indoor (evaporator) unit and the condensing unit (outdoor unit) in accordance with the manufacturer’s instructions.

1.3.2. Wall penetrations for the refrigerant piping between the indoor & outdoor units, shall be completely waterproofed by use of pliable silicon based caulking.

1.3.3. The elevator machine room is located at the south-west corner of the building with two exposed walls. Locate the new split air-conditioner’s condensing unit away from car traffic to prevent any risk of impact.

1.3.4. Make sure there are no obstructions directly above the outdoor unit (such as a soffit) or in front of the unit (such as a shrub) that can restrict the air flow of the unit. Maintain all necessary servicing clearances as per the AC unit manufacturer’s instructions. Maintain minimum 3 ft clearance from any existing utility meter and vent opening.

1.3.5. Route the condensate drain piping on to the adjacent planter on the south side of the elevator machine room. Make sure that, condensate drainage will not spill on walkways or a paved area.

1.3.6. Supply and install wall-mounted thermostat required by the A/C manufacturer to control the AC unit locally. Thermostat shall be located away from a direct heat source and shall be installed at approximately 60 inches height.

1.3.7. Provide necessary electrical interlocks to prevent simultaneous operation of the existing heater and the new ac. Ensure that the existing heater inside the elevator machine room shall remain “OFF” while the new AC unit is “ON”.

1.3.8. Outdoor mounted condensing unit shall be provided with manufacturer’s mounting frame or pedestal. The condensing unit shall be installed on 750 mm x 750 mm (30 in. x 30 in.) precast concrete paving stones for am even and stable ground. Contractor shall provide the specified elastomeric vibration isolating pads between the unit and the mounting frame.

END OF SECTION