Part 1 General

1.1 SUMMARY

.1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1.

.2 All Drawings and all sections of the Specifications shall apply to and form an integral part of this section.

.3 Carefully examine all plans and Specifications pertaining to this Contract and become familiar with all details. Visit the Site and determine all factors affecting this section of the Work and include all costs for same in Bid Opportunity.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 The electrical installation shall comply with the requirements of the Electrical Supply Authority, the latest edition of the Canadian Electrical Code, with all Provincial and Municipal Laws, Rules and Ordinances, and to the satisfaction of those persons having jurisdiction over same.

.3 Notify the Contract Administrator of any discrepancies or conflictions with any regulation seven (7) Working days before Bid Opportunity Bid Opportunity closes. Failing such notification, meet all such requirements without change to the Contract price.

.4 In no instance shall the standard established by these Specifications and Drawings be reduced by any of the codes, rules or ordinances.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

1.3 REQUEST FOR INTERPRETATION PROCESS

.1 General:

.1 Immediately on discovery of the need for interpretation of the Contract Documents, Contractor shall prepare and submit an RFI to the Contract Administrator in the form specified.

.2 Contract Administrator will return RFIs submitted to Contract Administrator by other entities controlled by Contractor with no response. The RFI will then be considered closed.

.3 Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor’s Work or Work of Subcontractors.

.4 For RFIs submitted electronically, include project name and RFI number in subject line of email.

.2 Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

.1 Project name (including building number).

.2 Project number.

.3 Date.

.4 Name of Contractor.

.5 Name of Contract Administrator.

.6 RFI number, numbered sequentially. (eg: RFI-001)

.7 RFI subject.

.8 Specification Section number, title and related paragraphs, as appropriate.

.9 Drawing number and detail references, as appropriate.

.10 Field dimensions and conditions, as appropriate.

.11 Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Price, Contractor shall state impact in the RFI.

.12 Contractor's signature.

.13 Attachments: Include sketches, descriptions, measurements, photos, product data, Shop Drawings, coordination Drawings, and other information necessary to fully describe items needing interpretation.

.1 Include dimensions, thicknesses, structural grid references, and details of affected Materials, assemblies, and attachments on attached sketches.

.3 RFI Forms: Contractor generated form including all content indicated in this Section.

.1 Form and attachments shall be electronic files in Adobe Acrobat PDF format.

.4 Contract Administrator's Action: Contract Administrator will review each RFI, determine action required, and respond. Allow 10 Working days for Contract Administrator's response for each RFI. RFIs received by Contract Administrator after 1:00 p.m. will be considered as received the following Working day.

.1 The following Contractor-generated RFIs will be returned without action:

.1 Requests for approval of submittals.

.2 Requests for approval of substitutions.

.3 Requests for approval of Contractor's means and methods.

.4 Requests for approval of corrective actions for deficient Work.

.5 Requests for coordination information already indicated in the Contract Documents.

.6 Requests for adjustments in the Contract Time or the Contract Sum.

.7 Requests for interpretation of Contract Administrator's actions on submittals.

.8 Incomplete RFIs or inaccurately prepared RFIs.

.2 Contract Administrator's action may include a request for additional information, in which case Contract Administrator's time for response will date from time of receipt of additional information.

.3 If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Contract Administrator in writing within 10 days of receipt of the RFI response. Failure to notify will result in the Work being included as part of the Contract.

.5 RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log with progress meeting minutes. Include the following:

.1 Project name.

.2 Name and address of Contractor.

.3 Name and address of Contract Administrator.

.4 RFI number including RFIs that were returned without action or withdrawn.

.5 RFI description.

.6 Date the RFI was submitted.

.7 Date Contract Administrator's response was received.

.6 On receipt of Contract Administrator action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Contract Administrator within 10 days if Contractor disagrees with response.

1.4 COORDINATION

.1 The Contractor is responsible for installing a complete, fully functional and fully operational system, and is responsible for reviewing all other trades' Drawings to ensure all electrical requirements are included in the Bid Opportunity price. Inform the Contract Administrator of any discrepancies during the Bid Opportunity process. Any discrepancies not identified, shall be incorporated by the Contractor at no cost during construction.

.2 The Contractor is responsible for coordination with all other trades and Contractors on Site.

.3 Through the Contractor, coordination shall include regular meetings, exchange of Shop Drawings and other technical information. Compile Working combined systems Drawings, where parts of the installation are complex or require input of several trades. Ensure the Contractor is in attendance and is aware of all coordination. Obtain and exchange schedules with all other trades and Contractors to ensure Work which impacts another trade or Contract is completed in sufficient time.

.4 All Work is to be properly phased to enhance coordination. Where it is evident that Work outside of phase has inhibited the Work of another Contractor, the Contract Administrator shall reserve the right to instruct the Contractor to remove said Work at the cost of the Contractor.

1.5 SUSTAINABLE DESIGN PROCEDURES

.1 The City has established, with the design team, the target for sustainable goals for the project. The Contractor, its Subcontractors and suppliers will be required to participate in the process to realize The City's sustainable goals.

.2 Refer to Front End Specifications.

1.6 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

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

.3 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.7 SUBMITTALS

.1 Submit Shop Drawings, produce detailed data and samples in accordance with previous sections, as specified herein, and to Contract Administrator's satisfaction.

.2 Shop Drawings submitted electronically (e.g. by email) shall comply with the following:

.1 Shop Drawings larger than 11 x 17 shall include a hard copy delivered separately by messenger the same day as the email copies.

.2 All necessary transmittals shall be included with the email submission.

.3 Emailed Shop Drawings shall comply in all respects with this section of the Specifications.

.3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or Material.

.4 Where applicable, include actual wiring, single line and schematic diagrams. Include all technical data and full details of each component.

.5 Include wiring Drawings or diagrams showing interconnection with Work of other sections.

.6 Shop Drawings must reflect actual equipment being provided. Generic Shop Drawings are not acceptable and will be returned for re-submittal without Contract Administrator’s review.

.7 Shop Drawings of all equipment must be submitted to the Contract Administrator for review in sufficient time to enable him to retain them for at least ten (10) Working days.

.8 Each applicable device to be highlighted or identified with an arrow.

.9 Each applicable device to be tagged (e.g. light fixture type, motor tag, etc.).

.10 Bind each system separately eg. Power distribution, Fire Alarm, etc. One common binder from one supplier will not be acceptable.

.11 Shop Drawing submission shall include a photocopy of all applicable Specification sections showing a complete compliance/ non-compliance listing. Refer to spec. detail sheet "Shop Drawing Compliance List Sample" for example.

.12 Division 26 shall check all Shop Drawings and make necessary changes, or cause the supplier to make necessary changes, prior to submission to the Contract Administrator. Shop Drawings will be reviewed by the Contract Administrator and if re-submission is required, Division 26 shall ensure that the supplier's Drawings have been changed to comply before returning them to the Contract Administrator for review again.

.13 Review of the Shop Drawings by the Contract Administrator shall not relieve the Contractor from responsibility for errors and omissions therein.

.14 Each Drawing submission to bear the following signed stamp, and shall include name of project, equipment supplier, and clause number equipment is specified under.

CONTRACTORS CERTIFICATION
This Drawing has been reviewed by
(firm name) .

All dimensions have been checked and found compatible with the Contract Drawings and all capacities, quantities, sizes, and other data contained in the Contract documents have been listed by the supplier on this Drawing and have been checked by the undersigned and found correct.

Date Per:

.15 Clearly show division of responsibility. No item, equipment or description of Work shall be indicated to be supplied or Work to be done "By Others" or "By Purchaser". Any item, equipment or description of Work shown on Shop Drawings shall form part of Contract, unless specifically noted to the contrary.

.16 Provide field dimensions required by electrical suppliers and Sub-Subcontractors. In cases where fabrication is required prior to field dimensions being available, check all related Drawings and obtain clarification from Contract Administrator if necessary.

.17 Main distribution and utility metering Shop Drawings must be approved by local utility prior to submission to Contract Administrator.

.18 Incomplete submissions will be returned for updating and re-submittal without Contract Administrator's review.

.19 Product Data: submit WHMIS MSDS in accordance with Division 1.

.20 Quality Control: in accordance with Division 1.

- .1 Provide CSA certified equipment and Material.
- .2 Where CSA certified equipment and Material is not available, submit such equipment and Material to authority having jurisdiction for special approval before delivery to Site.
- .3 Submit test results of installed electrical systems and instrumentation.
- .4 Permits and fees: in accordance with General Conditions of Contract.
- .5 Submit, upon completion of Work, load balance report.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work.
- .7 Other requirements as listed in Specification.

.21 Manufacturer's Field Reports: submit manufacturer's written reports, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in other sections.

1.8 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Front End Specifications.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction and as per the conditions of Provincial or Territorial Act respecting manpower vocational training and qualification.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Contract Administrator with schedule within 2 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste Materials for reuse and recycling in accordance with Front End Specifications.

1.10 SYSTEM STARTUP

.1 Upon completion of the project, demonstrate the operation, care and maintenance of all system equipment and components in the presence of The City, or his representative, and the Contract Administrator. Obtain signed certification from The City that such equipment was shown to be fully operational and that all necessary operating instructions have been provided.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

1.11 DRAWINGS

.1 Drawings are intended to communicate the general design intent. They are not to be interpreted as a description of means and methods of construction. The Contractor is responsible for reviewing the Drawings and Specifications of this and all other trades on the project to ensure that they deliver a fully coordinated, complete and fully operational system. Any component or service not described, but reasonably obvious as required for completion shall be included by the Contractor at no cost.

.2 Carefully examine all Drawings and Specifications relating to all Work, and all electrical Work indicated thereon shall be considered as a part of the Work by this section unless indicated otherwise. Prior to the date of the last addendum report at once to the Contract Administrator, any defect, discrepancy, omission or interference affecting the Work of this section, or the guarantee of same.

.3 Install all equipment as shown or as specified and in accordance with manufacturer's approved Shop Drawings.

.4 The Drawings accompanying these Specifications are intended to show the general arrangement and extent of the Work to be carried out, but the exact location and arrangement of all parts shall be determined as the Work progresses. The location of

equipment, outlets, etc., as given on the Drawings are approximately correct, but it shall be understood that they are subject to such modifications as may be found necessary or desirable at the time of installation to meet any structural or architectural requirements. Such changes shall be implemented as directed by the Contract Administrator, without additional charge.

.5 Electrical Drawings do not show all structural and other details. Architectural and structural conditions shall govern, and this Section shall make without charge, changes or additions to accommodate these conditions.

.6 Where Drawings indicate the general location and route to be followed by conduit, cable, etc., these locations must be governed by job conditions. Where the required conduit, cable, and boxes are not shown on Drawings or only shown diagrammatically, they shall be installed to conserve maximum head room and interfere as little as possible with free use of space through which they pass. Maximum clearance above floor shall be maintained under all suspended conduit and equipment, unless otherwise shown on the Drawings, or approved by the Contract Administrator.

.7 Submit a complete set of Drawings for the proposed installation to the Inspection Department having jurisdiction and receive written approval before installation or fabrication of any equipment. No extra compensation will be allowed for any changes or rearrangement of any electrical apparatus or Materials necessary due to failure to receive this approval.

.8 Provide the Electric Utility with three copies of a Drawing showing the main distribution and the proposed method of metering for approval prior to the manufacture of equipment.

1.12 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into operation and maintenance manuals specified.

.2 Provide one copy of Operation and Maintenance manuals to Contract Administrator for review. Operation and Maintenance manuals will be reviewed by the Contract Administrator and if re-submission is required, ensure that the manuals have been changed to comply before returning them to the Contract Administrator for review again.

.3 Include in operations and maintenance data:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of the electrical installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature alone is not acceptable.

.3 Wiring and schematic diagrams and performance curves.

.4 Names and addresses of local suppliers.

.5 Copy of reviewed Shop Drawings.

.4 Provide four (4) complete, hard-backed, D-ring loose leaf Maintenance Manuals. These shall consist of typewritten or printed instructions for operating and maintaining all

systems and equipment provided under this section of the Specification. Manuals shall also contain Shop Drawings, wiring diagrams, test results and manufacturer's brochures on all equipment, together with typed index tab sheets. Manuals shall also contain a DVD with PDF files of the contents of the manuals.

.5 As Work progresses, record on one (1) set of Contract Drawings, installed conduit layout as well as any approved changes and deviations from the original Contract and/or Working Drawings, including outlets, equipment and panel locations. Have these Drawings available for reference and observation at all times. At completion of Work, submit to the Contract Administrator, at the Contractor's Costs, AutoCAD Record Drawings and one hardcopy set of Record Drawings. The Contract shall not be considered complete and no final payment shall be made until these Drawings are accepted by the Contract Administrator. Provide separate Drawings for each system in order not to "crowd" Drawings.

1.13 TEMPORARY LIGHTING AND POWER

.1 **Electrical Sub-Contractor to provide temporary power for the site during the shutdown to the main distribution switchboard.** The historic site peak demand load has been found to be 1300 KVA in winter and 1200 kVA in summer. The shutdown will occur during off-peak hours, so the power requirement is expected to be less than the peak value. It is recommended that the Electrical Sub-Contractor perform metering in advance of the shutdown to assist with sizing of temporary power generation.

1.14 EXAMINATION OF DOCUMENTS AND SITE

.1 Carefully examine all plans and Specifications pertaining to this Contract and become familiar with all details. Visit the Site and determine all factors affecting this section of the Work; include all costs for same in Bid Opportunity.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Front End Specifications.

2.2 MATERIALS AND EQUIPMENT

.1 Provide Materials and equipment in accordance with Front End Specifications.

.2 Equipment and Material to be CSA certified. Electrical equipment consisting of individual certified components must also have a CSA certification for the entire assembly. Where there is no alternative to supplying equipment which is certified, obtain special approval from local Electrical Inspection Department or authority having jurisdiction.

.3 Factory assemble control panels and component assemblies.

.4 Submit for Contract Administrator's approval, a duplicate list of makes and types of all equipment and Materials for this project, prior to placing of orders for same. This shall be done within fourteen (14) days of the award of the project Contract to the Contractor in order to avoid delays in delivery and completion.

.5 Any Material or equipment ordered or installed without the Contract Administrator's prior approval shall, if so directed by the Contract Administrator, be removed and replaced with approved Material or equipment without a change in the Contract price.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Supplier and installer responsibility is indicated in Motor Schedule, or electrical Drawings, or in this Specification and related mechanical responsibility is indicated in Mechanical Equipment Schedule or mechanical Drawings and Specifications.

.3 Refer to other Sections of this Specification and to Drawings for responsibilities for control wiring and conduit.

.4 Coordinate with other trades. Identify any discrepancies during Bid Opportunity.

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction and Contract Administrator.

.2 Decal signs, minimum size 175 x 250 mm.

.3 Provide “Danger High Voltage” labelling on main electrical room door.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for type of conductors used.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows, and as indicated in other Specification sections:

.1 Nameplates: lamicoid 3mm thick plastic engraving sheet, black face with white core (black with white letters) lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Nameplates for equipment fed from emergency power or from emergency UPS power (increase nameplate size as required to suit wording) shall be red with white letters (red with white letters).

.3 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets, pullboxes and junction boxes to indicate system and/or voltage characteristics.

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

.7 Transformers: indicate capacity, primary and secondary voltages.

.8 Room names and numbers used shall be actual room names and numbers that will be used on the project. Co-ordinate and confirm with trades involved.

.9 Co-ordinate names of equipment and systems with Mechanical section to ensure that identical names are used.

.10 Nameplates for control devices: indicate equipment controlled.

.11 Adjacent to each breaker in CDP type panelboards, provide and mount lamacoid nameplates identifying the respective load and location.

.12 To match existing where applicable.

.13 All convenience receptacles shall have a lamacoid size 1 plate on which the panel and circuit number from which it is fed, is indicated. The identification shall be mechanically secured to the coverplate on the appropriate outlet. Pressure indented adhesive strip nameplates are not acceptable and shall not be used.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders (coloured plastic tapes) and branch circuit wiring (numbered wire markers). Conductor marker identification shall correspond with panel or terminal board directory information.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system. Colour coding used shall be documented by individual systems in Maintenance Manuals.

.5 Insulated grounding conductors shall have a green finish and shall be used only as a grounding conductor.

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cable.

.2 Colour coding to match existing where applicable.

.3 Confirm colour coding with City and Contract Administrator prior to start of Work.

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

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

	Prime	Auxiliary
Up to 250V (normal power)	yellow	
Up to 600V (normal power)	yellow	green
Fire alarm	red	
Other security systems	red	yellow
Control	blue	

.6 Other conduit systems as directed on Site; all conduit systems shall be identified.

.7 Colour outlet box covers to colour designated and show circuit numbers in black felt marker on inside of covers.

2.9 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green".

.2 Paint indoor switchgear and distribution enclosures light gray.

2.10 WORKMANSHIP AND MATERIALS

.1 The installation shall consist of Material and equipment specified unless as provided herein. Electrical equipment provided under this Contract shall be built in accordance with EEMAC standards and shall be C.S.A. certified and/or locally approved. All equipment supplied under this Contract shall be new and the best of its respective kind and of uniform pattern throughout.

.2 Any Material or equipment ordered or installed without the Contract Administrator's prior approval shall, if so directed by the Contract Administrator, be removed and replaced with approved Material or equipment without a change to the Contract.

.3 Replace inferior Work if so ordered by Contract Administrator without a change to the Contract.

.4 Retain same foreman or superintendent on the job until completed, unless otherwise directed by the Contract Administrator.

.5 All tradesmen shall carry all tools on their person at all times. Any tool not in use shall be under lock and key in an area authorized by the building supervisor.

2.11 REQUEST FOR EQUAL

.1 Refer to clause B7 for substitute requirements.

2.12 WIRING TERMINATIONS

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

2.13 SPARE PARTS

.1 The Contractor shall submit 15 days after Bid Opportunity a list of spare parts that the Contractor considers essential/important/useful to the operation of the systems described herein. This list shall be in addition to any spares/consumables called for in the Contract Documents and those which are required up to practical completion and hand over.

.2 Each spare part listed shall include the manufacturer's/ supplier's price including all mark-ups, delivery and packaging. The prices shall remain valid for 12 months following handover of the project.

.3 These spare parts may or may not be ordered during the Contract period. The Contractor shall only include these items in the Contract sum if specifically instructed to do so.

.4 Any spare parts listed shall be completely interchangeable with those specified in the Contract Documents and included in the Works.

.5 Any spares ordered shall be delivered to the specified client's representative complete with all documents/instructions.

2.14 HOUSEKEEPING PADS

.1 All floor mounted electrical equipment shall be mounted on concrete housekeeping pads.

.2 Pad mounted equipment with doors that open to the bottom of the enclosure shall have horizontal struts installed between the enclosure bottom and the concrete pad to prevent the door from dragging on the concrete.

.3 All housekeeping pads for electrical equipment to be installed by sub-trade hired and paid by Electrical Subcontractor, unless noted otherwise.

.4 Where housekeeping pads for electrical equipment are required to be installed by Contractor, notify Contractor and provide required pad sizes.

.5 Housekeeping pad shall be 4” (100mm) high, rebar 10M @ 12” (300mm) o/c, each way top, unless noted otherwise.

.6 Housekeeping pad shall extend 4” (100mm) on each side of equipment.

.7 Chamfer top edge and corners.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Arrange for holes through exterior wall and roof to be flashed and made weatherproof.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.

.4 Coordinate receptacle locations in mechanical rooms with Mechanical Subcontractor prior to install.

.5 Locate disconnect devices in mechanical rooms on latch side of centre line of equipment unless specified or indicated otherwise.

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

.7 Install electrical equipment at following heights unless indicated otherwise.

- .1 Local switches, timers, etc: 1200mm.
- .2 Wall receptacles:
  - .1 General: 400mm.
  - .2 Above top of continuous baseboard heater: 200mm.
  - .3 In mechanical rooms: 915mm.
- .3 Panelboards, annunciators etc.: 2000mm to top.
- .4 Thermostats: 1200mm.
- .5 Speed controls: 1200mm.
- .6 Manual starters: 1200mm.
- .7 Emergency power off buttons: 1200mm.

3.5 SHORT CIRCUIT AND TIME-CURRENT CO-ORDINATION OF PROTECTIVE DEVICES INCLUDING STUDY

.1 Submit a complete Short Circuit and Time-Current Coordination Study for the 600 volt breakers provided under this Contract (in CDP YY and MCC XX) as well as for the new and existing upstream breakers and fuses affecting the distributions in this Contract. If any existing breakers must be adjusted for proper coordination, other breakers affected must be included in the study and adjusted as required for proper coordination. Hydro protective devices to be included in the study.

.1 For the new distributions include all existing upstream overcurrent protection up to and including the main breaker in the main distribution.

.2 Some original construction drawings for the Transit Garage (circa 1968) are available, but the information may not be accurate as they have not been kept up to date. These drawings are available on site.

.3 The Contractor shall provide all information as required to his supplier of service to prepare this study. This shall include feeder sizes, feeder types, feeder lengths, transformer impedances, breaker catalogue numbers and tripping characteristics, equipment Shop Drawings, etc.

.4 Feeder types, sizes and lengths to be from the actual installation.

.5 Contractor to measure each feeder length after the feeder is installed.

.6 Estimated lengths from floor plans are not acceptable.

.7 Curves shall be plotted on a standard log-log scale as time versus current values on a common 600 Volt base. It shall be the responsibility of the Division 26 Contractor to provide time-current curves of all breakers, fuses, etc.

.8 The study shall:

.1 Select settings and characteristics for the protective devices in order to achieve maximum selectivity between devices during fault conditions (ie. the device nearest the fault will operate first, thus minimizing the interruption) and to provide proper protection for all distribution equipment, transformers, cable, etc.

.2 Determine the fault currents at critical points in the power system under the worst case conditions in order to ensure the adequacy of the electrical equipment and protective devices. Motor contribution is to be taken into account. All devices must be fully rated.

.3 Include all breakers in CDP type panelboards. Breaker settings shall be listed in the study for all breakers with adjustable trips.

.9 In addition to the curves for the protective devices, each Drawing shall show and include proper protection and coordination for:

.1 Transformer inrush points.

.2 Transformer full load currents.

.3 Transformer damage curves (single phase and three phase).

.4 Cable damage curves.

.5 The largest motor or motors likely to present coordination problems.

.10 All required breaker settings shall be listed in table form including breaker details such as breaker type, trip rating, etc. All breakers with adjustable trips shall be included in this list.

.11 Maximum available short circuit currents shall be listed for each bus. This listing shall also include the interrupting rating of the protective devices actually supplied in the Contract.

.12 In all cases use actual values for transformer impedance, cable types, cable sizes, cable lengths, available utility fault current, etc.

.13 Identification names and numbers for breakers and distribution in the study shall match the identification shown on the Contract documents.

.14 The short circuit and coordination study shall be done by a Professional Engineer licensed in the Province of Manitoba and the study shall be signed and sealed by the Professional Engineer.

.15 Ground fault curves shall be plotted on the same Drawings as overcurrent curves to ensure proper coordination.

.16 As a minimum, the study shall be bound in a 3-ring loose leaf binder and shall include:

.1 A title sheet listing the study name, project name, project number, date, engineering company that prepared the study (including address and phone number), the engineers seal and signature, etc.

.2 Table of Contents.

.3 Purpose of the study.

.4 Input data.

.5 The criteria for determining proper selective coordination, protection, adequacy, etc. (eg. describe when coordination is achieved, minimum/maximum tripping times and current values, separation between curves, safety margins, damage curves, etc.).

.6 Summary stating that proper selective coordination, proper protection, adequacy of the equipment for the maximum available short circuit currents, etc. was achieved and listing any areas of compromise, potential problems, marginal adequacies, etc.

.7 Drawings of the breaker curves showing proper selective coordination, protection, adequacies, etc. On each Drawing, include a single line diagram of the distribution for the curves shown on the Drawing, breaker settings, etc.

.8 Maximum available short circuit currents at each bus.

.17 The study shall be started immediately on award of Contract and shall be submitted as a Shop Drawing for review in advance of distribution Shop Drawings. A minimum of 2 hard copies and one PDF file on a CD shall be submitted.

.18 In cases such as primary breaker protection for transformers provide breakers with fully adjustable solid state trips (fully adjustable LSI setting) for transformers 45 kVa and larger in order to allow proper coordination. Costs for this shall be included in the Bid Opportunity price.

.19 All breakers shall be set per the curves in the coordination study.

.20 The Short Circuit and Time-Current Coordination Study (revised to as-built conditions) shall be included in the Operating and Maintenance Manuals.

.2 Acceptable Supplier of Service:

.1 SMS Engineering

.2 Meg-A-Ron Engineering

.3 J.R. Stephenson Mfg. Ltd.

.4 Siemens

.5 Schneider

.6 Cutler Hammer

3.6 ARC FLASH HAZARD STUDY

.1 Scope

.1 The scope of the study shall include all new distribution equipment supplied by the equipment Manufacturer under this Contract, as well as the existing main distribution switchboard.

.2 References

.1 IEEE 141 - Recommended Practice for Electrical Power Distribution and Coordination of Industrial and Commercial Power Systems.

.2 IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

.3 IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis.

.4 IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings.

.5 IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

.6 IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations.

.7 CSA Z462 - Workplace Electrical Safety.

.8 ANSI Z535.4 - Product Safety Signs and Labels.

.3 Submittals For Construction

.1 Arc flash labels shall be provided in hard copy only and affixed to the relevant switchgear.

.4 Qualifications

.1 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Studies by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

.5 Study

.1 The Contractor shall furnish an Arc Flash Hazard Analysis Study report and schematics (including calculations) per Z462 - Workplace Electrical Safety, Annex D.

.2 As a minimum, the study shall be bound in a 3-ring loose leaf binder and shall include:

.1 A title sheet listing the study name, project name, project number, date, engineering company that prepared the study (including address and phone number), the engineers seal and signature, etc.

.2 Table of contents.

.3 Purpose of the study.

.4 Input data.

.5 The criteria for determining arc flash boundaries, arc flash levels and categories.

.6 Summary of calculations in a table format, including arc flash category for each item.

.7 Summary of analyses listing any areas of compromise, potential problems, marginal adequacies, etc.

.8 Recommendations for reduction of excessive arc flash levels.

.9 Drawings of the electrical distribution systems.

.10 Provide two (2) hard copies and one PDF file on a CD of the complete study.

.11 When the short circuit and time-current coordination study is included in the project the short circuit, time-current coordination and arc flash study shall be provided as one report.

.3 The study shall be started immediately on award of Contract and shall be submitted as a Shop Drawing for review in advance of distribution Shop Drawings.

.6 The Contractor shall provide all information as required for supplier of service to prepare this study. This shall include feeder sizes, feeder types, feeder lengths, transformer impedances, breaker catalogue numbers and tripping characteristics, equipment Shop Drawings, etc.

.7 Feeder types, sizes and lengths to be from the actual installation.

.8 Contractor to measure each feeder length after the feeder is installed.

.9 Estimated lengths from floor plans are not acceptable.

.10 All breakers shall be set by the Contractor per the curves in the coordination study.

.11 Arc Flash Hazard Analysis

.1 The arc flash hazard Study shall be performed according to the equations that are presented in Z462 - Workplace Electrical Safety, Annex D.

.2 The flash protection boundary and the incident energy shall be calculated for the following: switchboards, switchgear, motor-control centers, CDP's, panelboards, disconnect switches, variable frequency drives, capacitor banks, busway, UPS's, splitters.

.3 In addition, the Arc-Flash Hazard study shall include all significant locations where Work could be performed on energized parts.

.4 Safe Working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

.5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

.6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment locations. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculations will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

.7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculation on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

.1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.

.2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

.8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the Work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

.9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculations.

.10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to computer the incident energy for the corresponding location.

.11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arch flash event, a maximum clearing time based on the specific location shall be utilized.

.12 Incident energy and flash protection boundary calculations

.1 Arcing fault magnitude

.2 Protective device clearing time

.3 Duration of arc

.4 Arc flash boundary

.5 Working distance

.6 Incident energy

.7 Hazard Risk Category

.8 Recommendations for arc flash energy reduction

.12 Field Adjustment

.1 Arc Flash Warning Labels

.1 The Contractor of the Arc Flash Hazard Analysis shall provide a 4in. x 6in. thermal transfer type label of high adhesion polyester for each Work location analyzed.

.2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to Contract Administrator and after any system changes, upgrades or modifications have been incorporated in the system.

.3 The label shall be as specified in Figure Q.3 of CSA Z462, Workplace Electrical Safety. In addition to the requirements specified in Figure Q.3, provide information on the equipment location (i.e. Room Name and Number) following after "Equipment Name":

.4 Label Colours:

.1 Danger labels need to have the word "DANGER" in safety white letters on a safety red background;

.2 Warning labels need to have the word "WARNING" in safety black letters on a safety Orange background; and

.3 If a safety alert symbol is used, it needs to be the same colour as the signal word lettering and the exclamation mark needs to be the same colour as the signal word panel background.

.5 Labels shall be machine printed, with no field markings.

.6 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings. For additions to existing distribution system, all existing electrical distributions upstream of the new panels up to point of common coupling shall be labelled.

.1 For each 600 volt CDP type panelboard, one arc flash label shall be provided. For double tub 600V CDP's, one arc flash label shall be provided.

.2 For each motor control centre, one arc flash label shall be provided. Do not label each individual starter.

.3 For each 120/208V panelboard, one arc flash label shall be provided. For double and or multiple section panelboards, one arc flash label shall be provided.

.4 For each disconnect switch, splitter, capacitor bank, variable frequency drive, etc., one arc flash label shall be provided.

.5 For each switchgear, one arc flash label shall be provided. Do not label each individual section or breaker cell.

.7 Labels shall be field installed by Electrical Subcontractor. A label needs to be readily visible to the Worker and alert the Worker to the potential hazard in time to make appropriate action.

.8 NOTE: Persons who will be producing and/or installing arc flash and shock warning labels should consult ANSI Z535.4 to ensure that all applicable requirements of ANSI Z535.4 are met.

.13 Arc Flash Training

.1 The Contractor of the Arc Flash Hazard Analysis shall train the City's qualified electrical personnel of the potential arc flash hazards associated with Working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

.14 Acceptable Supplier of Service

.1 SMS Engineering

.2 Meg-A-Ron Engineering

.3 JR Stephenson Mfg. Ltd.

.4 Siemens

.5 Schneider

.6 Eaton

3.7 FIELD QUALITY CONTROL

.1 Verification of protective device coordination.

.1 A certified testing agency normally engaged in field service equipment testing shall be engaged and shall test all the circuit breaker settings for coordination verification as follows (to include new and existing breakers that require adjustment of settings):

.1 Test programmable/adjustable circuit breakers after programming/adjusting (where applicable).

.2 Verification of coordination testing shall consist of:

.1 Testing of all circuit breaker solid state relays with the breaker manufacturer's test kit to verify at least 3 points on each time-current characteristic. One point shall be tested at the breakpoint of the characteristic at the high end and another point shall be tested at the breakpoint of the characteristic at the low end. The other points shall be tested along the straight line of the characteristic.

.2 Ductor (contact resistance) testing and meggar (insulation) testing of all breakers including moulded case breakers in CDP type panels, other breakers with solid state trips, high voltage breakers, etc.

.3 The report shall be bound in a 3-ring loose leaf binder, similar to the Short Circuit and Time-Coordination Study, with title sheet, table of contents, purpose, test criteria, test equipment used, summary and test data. The test data shall list all devices in table form with both the actual tested values and the required values listed. All test values shall fall within +/- 10% of the required values. Necessary corrective action shall be taken to correct any problems and then re-tested until the equipment passes all required tests. Compare test results to the time current coordination study and confirm that the curves as actually tested provide the required coordination. After all tests and analysis has been completed successfully, the summary in the final report shall clearly state that all equipment has successfully passed all tests and is in good operating condition. The test report shall be certified by the testing agency and shall be signed and sealed by a Professional Engineer responsible for the testing. A minimum of 6 copies shall be submitted.

.4 The breaker co-ordination test report shall be included in the Operating and Maintenance Manuals.

.2 Load Balance:

.1 Measure phase current to panelboards with normal loads operating at time of acceptance.

.2 Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.4 Provide upon completion of Work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.3 Conduct following tests:

.1 Circuits originating from branch distribution panels.

.2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.3 All other electrical systems.

.4 Insulation resistance testing:

.1 Conductors rated 1000V and less:

.1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.

.2 Megger 350V - 600V circuits, feeders and equipment with a 1000V instrument.

.2 Conductor rated above 1000V:

.1 All cables rated above 1000V shall be tested with “Very Low Frequency” test method.

.4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.5 All circuits shall be tested to ensure that the circuit numbers are correct and that the proper neutral conductors have been provided and installed.

.6 Carry out tests in presence of Contract Administrator and City.

.7 Advise Contract Administrator of dates and times for all testing with sufficient advance notice to allow Contract Administrator to make arrangements to attend.

.8 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.9 Insert test results and supplier's certifications in Maintenance Manuals.

.10 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic Site visits for observation of product installation in accordance with manufacturer's instructions.

.3 Schedule Site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.11 Verification requirements in accordance with Front End Specifications for Sustainable Requirements.

.12 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

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

3.8 PERMITS, FEES AND INSPECTION

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.2 Pay all associated fees for inspection of the Work by authorities having jurisdiction.

.3 Notify Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of Work to Contract Administrator. Copies to be included in Maintenance Manuals.

3.9 RESPONSIBILITY

.1 Be responsible for any damage caused the City, or their Contractors due to improperly carrying out this Work.

.2 Install all components of this Work promptly and where applicable, in advance of concrete pouring, or similar construction. Provide and set in the proper sequence of construction, all sleeves, hangers, inserts, etc. and arrange for all necessary openings, where required to accommodate the electrical installation.

.3 Work shall be arranged in co-operation with other divisions of this Specification in such a manner that it doesn't interfere with the progress of the project. In areas where ducts or pipes must be installed along with conduit or cable, co-operate with other divisions so that the finished job will represent the most efficient use of the space.

.4 In no case proceed with any Work in uncertainty. Obtain, from the Contract Administrator, any clarification necessary and thoroughly understand all portions of the Work to be performed.

3.10 CLEANLINESS AND CLEANING

.1 This division shall maintain a clean tidy job Site. All boxes, crates, and construction debris due to this portion of the Work shall be neatly piled outside the construction area and shall be removed at least weekly during the construction period. All construction areas shall be kept clear of debris.

.2 Before the project will be accepted by the City, all panelboards, switches, receptacles, cover plates, and other electrical equipment shall be clean and free of dust, plaster, paint, etc. Any equipment which is scratched or damaged shall be refinished or replaced if so designated by the Contract Administrator.

3.11 MODIFICATIONS

.1 Locations of all convenience receptacles, outlets, switches, etc. are subject to modification by the Contract Administrator, who reserves the right to move these up to 3000 mm from the position shown, without change to the Contract price, provided notice is given before the related Work has commenced.

3.12 GUARANTEE

.1 Guarantee the satisfactory operation of all Work and equipment supplied and installed as a part of this section of the Specifications.

.2 Replace forthwith, at no additional Material or labour cost, any part which may fail, or prove defective within a period of twelve (12) calendar months after the final acceptance of the complete installation, provided that such failure is not due to improper usage, or ordinary wear and tear.

.3 No certificate given, payment made, partial or entire use of the equipment by the City or his representative shall be construed as acceptance of defective Workmanship or Materials.

.4 This general guarantee shall not act as a waiver of any specified guarantee or special equipment guarantees covering a greater length of time.

3.13 CUTTING AND PATCHING

.1 Cutting, patching and repairs to existing surfaces required as a result of the removal and/or relocation of existing equipment and piping, and/or installation of new equipment and piping in existing building(s) to be included by Electrical Subcontractor in Bid Opportunity price. Electrical subcontractor to employ and pay appropriate sub-trade whose Work is involved, for carrying out Work described above.

.2 Electrical Subcontractor shall mark all openings required for conduits, cables, ducts, and the like.

.3 Description:

- .1 Perform all cutting and patching required for installing electrical systems.
- .2 Electrical Subcontractor shall retain services of General Sub-trades to carry out actual Work involved in cutting wall openings, floor openings and the like, and in patching up after installation has been completed.
- .3 Cutting to be 'neat' sizes. Patch all edges such as cover plates, etc. Hide cut edges.
- .4 Electrical Subcontractor to perform all cutting only of existing surfaces as required as a result of the removal and/or relocation of existing equipment and conduit and/or installation of new equipment and conduit in the existing building to be included by the Div. 26 in the Bid Opportunity price.
- .5 If, in the opinion of Contract Administrator, cutting of holes has been improperly performed (i.e. too large for conduits or cables) Electrical Subcontractor to do all patching as per original Specifications and all costs will be borne by him.

3.14 FIRE ALARM ALTERATIONS

.1 Keep copy of latest edition of CAN/ULC-S524, Installation of Fire Alarm Systems, all time during the construction of the fire alarm system.

.2 The above standard may be referenced and reviewed during the engineering observations.

.3 It is highly recommended the Contractor to be familiar with the above standard.

.4 Newly altered fire alarm systems to be verified in accordance with CAN/ULC-S537, Verification of Fire Alarm Systems and local Codes.

.1 Provide verification report to Contract Administrator for review.

3.15 FIREPROOFING

.1 Where cables or conduits pass through floors, block or concrete walls and fire rated walls, seal openings with 3 M Brand Fire Barrier Products, to maintain fire rating.

.2 Seal all holes resulting from removal of cables, conduits and equipment.

.3 Fireproofing of electrical cables, conduits, trays, etc. passing through fire barriers shall conform to local codes and inspection authorities.

.4 Refer to following table for 3M brand products.

Pentrating Item	3M Brand Fire Barrier Product Options	Range of Applications			Concrete Walls and Assemblies		Gypsum Wall Assemblies	
		Penetrating Items	Annular Space	Maximum Opening Size	F Ratings (Hrs)	T Ratings (Hrs)	F Ratings (Hrs)	T Ratings (Hrs)
1. Plastic Pipe/ Conduit & Cast-in Coupling	FS-195+ Wrap Strip, CP 25WB+ Caulk or MP Moldable Putty+	PVC: 8 in. Nominal Diameter 4 Wraps/Application	0.2 in.	9 in. Diameter	2	2	2	1-1/2
		PVC: 4 in. Nominal Diameter 3 Wraps/Application	0.75 in.	6 in. Diameter	3	2	2	2
		ABS: 4 in. Nominal Diameter 3 Wraps/Application	0.75 in.	6 in. Diameter	2	2	1-1/2	1-1/2
	PSS 7904 Penetration Sealing System with CP 25 WB+ Caulk	PVC: 4 in. Nominal Diameter	3.0 in.	10 in. Diameter	3	1/2	- -	- -
		ABS: 4 in. Nominal Diameter	3.0 in.	10 in. Diameter	3 (in wall) 1 (in floor)	3 (in wall) 0 (in floor)	- -	- -
		PB: 2 in. Nominal Diameter	3.0 in.	8 in. Diameter	1/2	- -	- -	- -
2. Metal Pipe and Conduit	CP 25WB+ Caulk	1 in. Depth of Caulk: 20 in. Diameter	2.5 in.	22.5 in. Diameter	3	0	2	0
	FS-195+ Wrap Strip, CP 25WB+ Caulk or MP Moldable Putty+	4 in. Nominal Metal Pipe	1.75 in.	8 in. Diameter	2	0	2	2
	CS-195+ Composite Sheet with FS-195+ Wrap Strip and CP 25WB+ Caulk or MP Moldable Putty+	4 in. Nominal Metal Pipe (Multiple Pipes)	45.0 in.*	30 x 50 in.	4 (both sides) 3 (one side)	3/4 0	- -	- -
	PSS 7902 Penetration Sealing System CP 25 WB+ Caulk or MP Moldable Putty+	10 in. Nominal Diameter Pipe and 8x16 in Rectangular Cover Plate if fill is less than 10%	9.0 in.	10 x 20 in.	3	0	- -	- -
	CP 25WB+ Caulk	1/2 in. Diameter Depth of CP-25WB 12 in. Nominal Diameter Pipe	1.2 in.	14 in. Diameter	3	0	- -	- -

	FD 150 FireDam Caulk	2 in. Depth of FireDam 150 Chaulk 6 in. Nominal Diameter Pipe	2.0 in.	8-1/4 in. Diameter	3	0	- -	- -
	MP Moldable Putty+	1 in. Depth of Putty: 10 in. Nominal Diameter Pipe	0.75 in.*	12-1/4 in. Diameter	2 (1/2 in. Depth) 3 (1 in. Depth)	0	- -	- -
3. Insulated Electrical and Communications Cable	CP 25WB+ Caulk	1 in. Depth of Caulk; 43% of Area Filled, 350 MCM Cable and 100 Pair Telephone Cable	0.75 in.	6 in. Diameter	3	0	2	1-1/2
		1 in. Depth of Caulk; 37% of Area Filled, 3/0 350MCM Cable and 100 Pair Telephone Cable	0.75 in.					
		2-12 in. Depth of Caulk; 59% of Area Filled, 7C/12 AWG Cable, 100 Pair Telephone Cable	0.75 in.					
	FS-195+ Wrap Strip with CP 25WB+ Caulk or MP Moldable Putty+	4 in. Depth of Caulk with FS-195 Wrap; 59% Area Filled, 350 MCM Cable	0.75 in.	6 in. Diameter	2	0	- -	- -
	CS-195+ Composite Sheet with FS-195+ Wrap Strip and CP 25WB+ Caulk or MP Moldable Putty+	Multiconductor 12 AWG Cable, 100 Pair PVC Telephone Cable, Cable Bundle 3 in. Diameter	47.0 in.*	30 x 50 in.	4	1	- -	- -
	PSS 7904 Penetration Sealing System with CP 25 WB+ Caulk	350 MCM Cable; 30% of Area Filled. Cover Plate required if Fill is less than 10%	11.0 in.	8 x 16 in.	3	1/2	- -	- -
	MP Moldable Putty+	Telephone Cable; 100 Pair, 40% or Area Filled	0.75 in.	6-1/4 in. Diameter	2	0	- -	- -
4. Cable Tray	CS-195+ Composite Sheet with CP 25WB+ Caulk	Nominal Size Cable Tray 4 x 24 in.; 39% Area Filled in Tray; Cable Size: 300 MCM 4 in. Depth of Chaulk	14.64 in.	12 x 24 in.	3	0	- -	- -
	PSS 7904-R Penetration Sealing System with CP 25 WB+ Caulk	Nominal Size Cable Tray 4 x 18 in.; 52% Area Filled in Tray; 25 Pair No. 22 AWG Telephone Cable	9.0 in.	10 x 20 in.	3	3/4	- -	- -
5. Blank Openings and Construction Joints and Expansion Trenches	CP 25WB+ Caulk	1/2 to 1 in. Depth	- -	Joint Width	3	3	- -	- -
		2 in. Depth Cover Plate required when joint width exceeds 2 in.	- -	4 in. Diameter Opening 4 in. Joint Width	3	2	- -	- -
	MP Moldable Putty+	1 in. Depth	- -	1 in. Joint Width	2	2	- -	- -
	PSS 7904 Penetration Sealing System with CP 25 WB+ Caulk	4 in. Depth of Kit. Cover Plate Required.	- -	8 x 16 in.	3	1	- -	- -

* Distance Measured from the outer edge of the pentrant to the furthest edge of the opening

3.16 SCHEDULING OF WORK

.1 Existing building will remain in use during construction. Arrange Work so that interruption of services is kept to a minimum. Obtain permission from City prior to cutting into electrical services.

.2 Contractor to maintain continuous and adequate all existing electrical systems and other services during entire time of this Contract. Temporary power genset(s) must be available during any shut-downs to the main distribution switchboard. Provide temporary conduit, wire, equipment, etc. where necessary to meet this requirement. Refer to scope of Work description in the Front End Specification for details.

3.17 DEMOLITION OF EXISTING ELECTRICAL

.1 Remove all unnecessary existing electrical equipment, wiring, fixtures, in those portions of the existing building which are being remodelled or demolished. All devices/fixtures, etc. are not necessarily shown on the plans. The City shall select from the Materials and/or equipment remaining that which he wishes to retain, and the remainder shall be

removed from the Site. Any electrical equipment in remodelled sections or in structures removed or altered, adjacent to new Work, necessary for the operation of existing building, shall be relocated as necessary. All existing equipment re-used shall be made good and guaranteed. Power interruptions to be kept to a minimum and shall be at a time suitable to the building occupant. Refer to Front End Specifications for description of demolition/phasing.

.2 Drawings do not show all electrical requiring removal to accommodate renovations such as receptacles, switches, lights, starters, motors, components, heaters, etc. Division 26 shall visit Site, refer structural, mechanical and electrical Drawings and include all costs for demolition.

.3 Refer to Specification Section 26 05 05 - Work in Existing Building.

3.18 TESTING

.1 Test all circuits and wires for continuity, insulation resistance and high impedance grounds. Those circuits which test non-continuous, with an insulation resistance less than 2 Megohms or with high impedance grounds shall be replaced.

.2 All empty conduits shall be left with an insulated #14 AWG fish wire.

.3 Test all panels under full load and make necessary reconnection of single phase loads from one leg or phase to another to balance the load on legs or phases as nearly as possible. Test results, test values measured, date of each measurement, company name and signature of person making each measurement shall be neatly recorded. Record all changes on Record Drawings.

.4 Keep a record of all final tests, bind, and turn over typewritten results to the Contract Administrator as a part of the maintenance manual. All final test values measured, date of each measurement, company name and signature of person making each measurement shall be neatly recorded. After all tests have been successfully completed, each test report shall contain a summary which clearly states that all results were satisfactory.

.5 Upon completion of the Work and adjustments of all equipment, all systems shall be tested in the presence of the Contract Administrator to demonstrate that all equipment furnished and installed or connected as a part of this section of the Contract shall function electrically in the required manner as determined by the Contract Administrator.

.6 All circuits shall be tested to ensure that the circuit numbers are correct and that the proper neutral conductors have been provided and installed.

.7 Voltage tests shall be conducted and transformer taps adjusted or other corrective measures carried out as directed by the Contract Administrator.

.8 Refer to other Sections for details.

.9 Submit a report that includes test results, observations, summary, etc. Test report to clearly state that all results are acceptable.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 05 21 - Wires and Cables.

.3 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).

.2 Canadian Standards Association (CSA)

.1 CSA C22.2No.0.4-M1982(R1993), Bonding and Grounding of Electrical Equipment (Protective Grounding).

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste Materials in accordance with Section Front End Specifications, and with the Waste Reduction Workplan if applicable.

.2 Place Materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.4 COORDINATION

.1 The building shall remain open and in normal operation during the construction period.

.2 Where existing services such as electrical power, fire alarm system, gas detection system, etc. are required to be disrupted and/or shut down, coordinate the shut-downs with The City and carry out the Work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Refer to Division 1 for required duration of shut-down notice to the City. Obtain City's written consent prior to implementing.

.3 Should any temporary connections be required to maintain services during Work in the existing building, supply and install all necessary Material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of The City and Contract Administrator.

.4 If existing equipment shown on Drawings is defective it shall be brought to the Contract Administrator and City's attention prior to Work completion.

.5 Refer to General Conditions for phasing and staging of Work and adhere to that schedule. Comply with instructions regarding Working hours necessary to maintain the building in operation.

1.5 EXISTING DEVICES IN NEW CONSTRUCTION

.1 Existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.

.2 Where services are concealed within walls, floors or ceilings and cannot be visually identified, Contractor shall provide electronic scanning devices or other approved means to locate and identify concealed services prior to drilling.

1.6 SCHEDULE OF WORK

.1 Carefully note and refer to the Contract Administrator's general schedule of Work and include for all requirements to conform to it.

Part 2 Products

2.1 MATERIALS

.1 Provide all Materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.

.2 New fire alarm devices, starters, panelboards, etc. required to be tied in to existing systems shall match the existing devices.

.3 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturer’s requirements and instructions.

Part 3 Execution

3.1 INSTALLATION

.1 Install boxes, conduit and wiring through existing areas as required for the new installation.

.2 Add modules, switches, etc. in existing control panels, as required, to extend existing systems to new or renovated areas.

.3 Patch and repair walls and ceilings in existing areas that have been damaged or cut open due to the new electrical installation.

.4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install pressure type wire connectors and tighten according to manufacturers recommendations.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install bushing stud connectors in accordance with EEMAC 1Y-2 and NEMA.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical

.2 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Size as indicated. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with minimum 600 V insulation of chemically cross-linked thermosetting polyethylene Material rated RW90 and RWU90.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper. (FT4 insulation where exposed).

.2 Circuit conductors: copper, size as indicated. Minimum size 12 AWG and larger.

.3 Insulation:

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

.2 Colour code: Black, red, blue and white in 4C cable.

.4 Inner jacket: polyvinyl chloride Material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride Material meeting requirements of vertical tray test to CSA C22.2 No. 0.3 with maximum flame travel of 1.2M.

.7 Fastenings:

.1 One hole 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 Threaded rods: Minimum 6 mm dia. to support suspended channels.

.8 Connectors:

.1 To be approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated. Minimum size 12 AWG.

.2 Type: AC90 to have a separate bare copper ground.

.3 Armour: interlocking type fabricated from [galvanized steel] [aluminum] strip.

.4 Connectors: as per manufacturers requirements.

2.4 CONTROL CABLES

.1 Type LVT: soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket, and armour of closely wound aluminum wire.

2.5 VARIABLE FREQUENCY DRIVE POWER CABLES

.1 For output wiring to the motor from the VFD.

.2 Use cable specifically designed for Variable Frequency Drives.

.1 Teck Drive RX cable as manufactured by Nexans. Minimum size 12 AWG.

.2 PVC jacket rated at FT4.

.3 Continuous corrugated impervious aluminum shield.

.4 CSA approved to standard C22.2 No. 123.

.5 Teck Drive RX cables are to be installed in connectors specifically made for use with the Drive RX cables.

.6 Install Drive RX cable from VFD output to output line reactor/dv/dt filter and from output line reactor/dv/dt filter to motor.

.7 Terminate the Drive RX cable grounds per the cable manufacturer's instructions, using ground bushings as directed. The ground connections are to be made at the ground points indicated by the VFD manufacturer. Coordinate with Division 25.

.8 Install per manufacturer's instructions.

.3 The input wiring to the VFD must be separated from the output wiring from the VFD by a minimum of 300mm.

Part 3 Execution

3.1 GENERAL

.1 To Minimize Voltage Drop

.1 All branch circuit wiring and conduit shall be installed to minimize voltage drop. Install additional conduit runs as required to take the most direct and shortest route to outlets, light fixtures, etc.

3.2 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems.

.2 In cabletroughs, where available.

3.3 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Group cables wherever possible on channels.

.2 Single conductor cables shall be installed one cable diam. apart on suspended cable tray or channel supports and shall be clamped with aluminum cable clamps. Cables shall be terminated using non-magnetic connectors. Cable armor shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG bare (unless otherwise noted) copper ground wire shall be installed with each feeder. Cable bending radius shall be at least twelve times the overall cable diam. and bends shall not damage or distort the outer sheath.

3.4 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit.

.2 Ground control cable shield.

3.5 INSTALLATION OF FIRE ALARM CABLES

.1 Do not install cables that are part of the fire alarm system in PVC conduit. This includes but not limited to the following: wiring to fire alarm devices, annunciators, communications wiring, power supply wiring, etc.

3.6 INSTALLATION IN EQUIPMENT

.1 Group and lace-in neatly wire and cable installed in switchboards, panelboards, cabinets, wireways and other such enclosures.

3.7 TERMINATIONS

.1 Terminate wires and cables with appropriate connectors in an approved manner.

.2 Compression adapters intended to terminate larger feeders on small lugs are not acceptable. All lugs, including breaker lugs, are to be sized to accommodate the cable being terminated.

3.8 IDENTIFICATION

.1 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, colour coded as listed below.

.2 Wire in conduit 1/0 AWG and larger and single conductor cables for normal power feeders shall be identified at each outlet box and termination with a 150 mm band of coloured vinyl tape of the appropriate colour. Emergency power feeders shall be provided with an additional 75 mm band of red vinyl tape installed adjacent to the 150 mm band of the coloured phase identification tape, as listed below. Neutral and ground conductors shall be identified. Paint or other means of colouring the insulation shall not be used.

.3 Colour code wire in conduit and single conductor cables as follows:

Phase A - red
Phase B - black
Phase C - blue
Neutral - white
Ground - green

.4 Maintain phase sequence and colour coding throughout project.

.5 Use colour coded wires in communication cables, matched throughout system.

.6 Identify control conductors in motor control equipment, contactors, fire alarm panels, etc. with mylar/cloth wire markers.

.7 Refer to 26 05 00 for additional requirements.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results – For Electrical.

.2 Section 26 05 05 – Common Work Results (Work In Existing Building) – For Electrical.

1.2 REFERENCES

.1 Ground equipment to: CSA C22.2 No. 41.

.2 Copper grounding conductors to: CSA G7.1.

.3 CSA C22.2No.0.4, Bonding and Grounding of Electrical Equipment (Protective Grounding).

1.3 SHOP DRAWINGS

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures, and 26 05 00 - Electrical General Requirements.

.2 Include:

.1 Ground grid connection components

Part 2 Products

2.1 EQUIPMENT

.1 Grounding conductors: system, circuit and equipment, grounding conductors to be bare (or minimum #12 AWG insulated if installed in a raceway or as indicated/required) stranded copper sized in accordance with the Canadian Electrical Code or as indicated.

.2 Insulated grounding conductors: green, type RW-90, FT-6 rated where installed in free air.

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

.1 Grounding and bonding bushings.

.2 Grounding or bonding clamps. All grounding and bonding clamps shall be brass where attached to copper pipes. Clamps for other applications shall be of a type and Material that will minimize deterioration from galvanic action due to dissimilar metals.

.3 Bolted type conductor connectors.

.4 Bonding jumpers, straps.

.5 Pressure wire connectors.

.6 All compression connectors, lugs, etc. used in grounding circuits in any location, shall have bolts, nuts, etc. of silicone bronze alloy equal to “Everdur” metal.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 The grounding of the electrical system shall conform to the requirements of the electrical code, the inspection authority having jurisdiction and shall be as indicated on the Drawings. Additional grounding requirements shall be as described in this Specification and as shown on the Drawings.

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

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

.4 Protect exposed grounding conductors from mechanical injury.

.5 For a single ground conductor installed in EMT or rigid steel conduit provide permanent and effective connection to the conduit at each end. Use solderless lugs, clamps or ground bushing at each end.

.6 All ground/bonding cables, bus, etc., in locations where subject to mechanical damage, shall be protected by rigid metal conduit, steel guards, or other suitable shields. In all cases where rigid metal conduit or other metallic encasement of ground/bonding conductors is required, the conductor shall be permanently and effectively bonded to the conduit/enclosure at both ends of its length. Use solderless lug, clamp or ground bushing at each end. This requirement applies to all such enclosures regardless of length.

.7 Use two hole, long barrel, copper compression lugs for grounding connections to equipment.

.8 All compression connectors, lugs, etc., used in grounding circuits in outdoor locations, shall have bolts, nuts, etc., of silicon bronze alloy.

.9 Install bonding wire for flexible conduit, connected at both ends to conduit by using grounding bushing, solderless lug or clamp.

.10 All bonding jumpers shall be sized at least equal to their corresponding grounding conductors unless noted otherwise. Where attached to equipment, conduits, cabinets, etc., suitable approved two hole, long barrel, copper compression lugs shall be used.

.11 No soldered connections shall be used on grounding circuits at any point.

.12 Where a ground cable is to be bonded to building steel, the location of such ground connections shall be at points where they will not be subject to mechanical damage, but if possible will be accessible for inspection.

.13 Connections to steel shall consist of Cadwelding.

.14 Any bonds between dissimilar metals such as between copper and steel, must be thoroughly sealed or painted against moisture to minimize corrosion.

.15 All surfaces to which grounding bus or cable is to be bolted shall be cleaned of all paint, rust, etc., and Worked to a bright flat surface. Immediately before bolting to steel member, the contact surface of both shall be lightly coated with an oxide-preventing agent.

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

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

.18 All CDPs, MCCs and panelboards shall have a ground bus for connection of feeder and branch circuit ground conductors.

.19 All transformer enclosures shall be connected to the ground bus.

.20 Where ground conductors pass through fire rated floor, or wall, etc., provide rigid metal conduit of the required size. Connect each conduit end to the grounding/bonding conductor with solderless lug, clamp or grounding bushing. Firestop penetration through fire rated walls and floors.

.21 All conduit runs containing feeders and branch circuits shall be complete with an insulated green ground wire bonded to all outlet boxes, junction boxes, pull boxes, equipment enclosures, etc. The conduit system shall be continuous but shall not be relied on to serve as the equipment grounding means. Ground conductors shall be sized according to the Canadian Electrical Code, but shall be minimum #12 AWG.

.22 Ground conductors shall be run with all single conductor cable feeders (RA-90, Teck, etc). Multi-conductor cables shall use the internal bonding conductor or sheath unless otherwise noted.

.23 For feeders to 600 Volt distributions, the insulated ground wire shall be minimum #3/0 AWG (to allow the future grounding of transformer neutral points for transformers fed from the 600 Volt distribution).

.24 All locknuts and couplings shall be securely tightened.

.25 Conduit expansion joints and telescoping sections of metal raceways and cable trays not thoroughly bonded otherwise, shall be provided with approved bonding jumpers.

.26 Where ground conductors pass through floor slabs, building walls, etc., and are not encased in rigid metal conduit, sleeves of approved non-metallic Material of the required size, shape, and length shall be provided, unless otherwise specified or shown on Drawings.

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

.28 In general, circuits for system grounding and equipment bonding shall be separate and independent of each other. No bond or common connection shall exist between these two installations, except the basic ground to which each is connected.

.29 For power systems, all metal ducts, motor frames, steel supports for starters, panels, switches, etc., which are not rigidly secured to, and in contact with the grounded structural metal frame of the building, and conduit system, or which are subject to excessive vibration and possible loosened ground contacts, shall be securely bonded to building steel or to the conduit system by means of stranded copper jumpers. Jumpers shall have circular-mil cross section of not less than 30 percent of that of the largest conductor entering the enclosure being grounded, with a minimum size of No. 6 AWG copper being used in any jumper.

3.2 TRANSFORMER NEUTRAL GROUNDING

.1 For Delta/Wye transformers:

.1 The primary bonding/grounding conductor, where present, shall be run in the same conduit as the primary feeder to the transformer.

.2 The primary bonding/grounding conductor, where present, shall be connected to transformer ground bus.

.3 The secondary neutral and the secondary bonding conductors, where present, shall be run in the same conduit as the secondary feeder from transformer.

.4 The secondary neutral and the secondary bonding conductor, where present, shall be connected to XO point of the transformer.

.5 Connect ground grid with continuous conductor through connector on ground bus to XO point.

.6 Ground enclosure with continuous conductor from enclosure ground lug through connector on ground bus to XO point.

3.3 CABLE SHEATH GROUNDING

.1 Bond metallic sheath and concentric neutral conductor/tape of single conductor cables together at supply end only. Insulate metallic sheath and concentric neutral conductor/tape at load end.

.2 Use No. 6 AWG flexible copper wire, clamped, to cable sheath and/or concentric neutral/tape.

.3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.4 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral points of 600V and 208 V system.

3.5 EQUIPMENT BONDING

.1 Install bonding connections to typical equipment included in, but not necessarily limited to following list: service equipment, switchgear, panelboards, transformers, frames of motors, motor control centres, starters, control panels, building steel Work, panels, etc.

3.6 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform tests before energizing electrical system.

.3 Disconnect ground fault indicator, if provided, during tests.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size and thickness as required, surface mounted, suspended.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel Work.

.6 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits use channels.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings

1.2 SUBMITTALS

.1 Submit Shop Drawings and product data for cabinets in accordance with Section 26 05 00 - Common Work Results - For Electrical.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

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

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

.3 Cast type with gasketted covers where exposed to moisture or weather or where specified.

.4 NEMA 4X enclosure for all junction or pull boxes installed on the rooftop.

Part 3 Execution

3.1 JUNCTION, PULL BOXES, CABINETS AND ENCLOSURE INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

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

.4 Install junction and pull boxes clear of all mechanical ductwork and piping.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 26 05 00 - Common Work Results - For Electrical

.2 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

1.2 REFERENCES

.1 CSA C22.1, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

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

.6 Sectional boxes shall not be used without specific approval of the Contract Administrator.

.7 In moist or dusty areas, gasketted watertight or dust tight boxes and covers shall be provided.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 102 mm square outlet boxes with extension and plaster rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

2.3 CONDUIT BOXES

.1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle where exposed to moisture.

2.4 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

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

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

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

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved Material to prevent entry of debris during construction. Remove upon completion of Work.

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

.4 Wires in outlet, junction and switch boxes, not having a connection within box shall not be spliced, but shall continue unbroken through the box.

.5 Maintain continuity of vapor barrier where boxes are installed in exterior walls and ceilings. Use air/vapor barrier boxes for outlets installed in walls or ceilings with a vapor barrier.

.6 Boxes to be mounted plumb and square with building lines.

.7 Install pull boxes, or fittings, in conduit runs where more than four bends are necessary.

.8 Install pull boxes where run exceeds 23.0 (75 feet) in length.

.9 All junction, outlets and pull boxes shall be so installed that they are always readily accessible.

.10 No power driven pins (Ramset) shall be utilized to secure boxes without specific approval from Contract Administrator.

.11 All concealed junction boxes, conduit fittings, etc. to be c/w galv. steel covers, secured with two bolts.

.12 Apply acoustic sealant to seal wires penetrating moulded vapour barrier boxes.

.13 No more than two extension rings shall be used in sequence.

.14 For installations in moist areas, dusty areas, etc., meet all requirements of authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical

.2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .2 CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5 CAN/CSA C22.2 No. 227.3, Flexible Nonmetallic Tubing.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.

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

.3 Flexible metal conduit: to CSA C22.2 No. 56, and liquid tight flexible metal conduit.

.4 Minimum size of conduit shall be 19mm.

2.2 CONDUIT FASTENINGS

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

.2 Beam clamps to secure conduits to exposed steel Work.

.3 Channel type supports for two or more conduits.

.4 Threaded rods to support suspended channels, sized for the load.

2.3 CONDUIT FITTINGS

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

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 Steel set screw connectors and couplings. Insulated throat liners on connectors.

.4 Raintight connectors and fittings c/w O-rings for use on weatherproof or sprinklerproof enclosures.

.5 Raintight couplings to be used for surface conduit installations exposed to moisture or sprinkler heads.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.

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

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene with 3M spare length at each conduit end.

Part 3 Execution

3.1 INSTALLATION

.1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

.2 Produce layout sketches of conduit runs through mechanical and electrical service areas in order to pre-avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

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

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

.5 Use flexible metal conduit for connection to motors in dry areas, transformers and equipment subject to vibration or movement. Provide a separate insulated grounding conductor within flexible conduit.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.7 Minimum conduit size for power circuits: 19 mm.

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

.9 Mechanically bend steel conduit over 19 mm dia.

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

.11 Install fish cord in empty conduits.

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

.13 Dry conduits out before installing wire.

.14 The conduit sizes as shown or indicated are the minimum acceptable and shall not be reduced without the approval of the Contract Administrator.

.15 Conduit to be sized as per Canadian Electrical Code or as shown on Drawings and Specifications. Note that the sizes of branch circuit conductors scheduled and/or specified on the Drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit.

.16 Running threads will not be permitted; proper couplings shall be used.

.17 Liquid tight flexible conduit runs shall not exceed 1.5m.

.18 All conduit runs passing across expansion joints of the building shall be installed utilizing approved expansion fittings, and bonding devices.

.19 Refer to 26 05 00 for identification requirements.

.20 No power driven pins (Ramset) shall be utilized to secure any portion of the conduit.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

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

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible.

.5 Do not pass conduits through structural members except as indicated.

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

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 26 05 00 – Common Work Results - For Electrical.

.2 Section 26 28 21 – Moulded Case Circuit Breakers.

1.2 REFERENCES

.1 ASTM - American Society of Testing Materials

.2 CAN/CSA – C22.2, No. 31 – Switchgear Assemblies

.3 CSA C22.2No.0.4, Bonding and Grounding of Electrical Equipment (Protective Grounding).

.4 CSA Standard C22.2 No. 29 - Panelboards and Enclosed Panelboards

.5 CSA Standard C22.2 No. 5 - Molded Case Circuit Breakers

.6 NEMA AB 1 - Molded Case Circuit Breakers

.7 NEMA PB 1 - Panelboards

.8 NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.3 SUBMITTALS

.1 Submit Shop Drawings and product data.

.2 Indicate on Shop Drawings:
- .1 Power ratings.
- .2 Enclosure type.
- .3 Single line diagrams.
- .4 Breaker sizes, and kA ratings.
- .5 Trip unit models and sizes.
- .6 Trip unit range of each adjustable setting.
- .7 Bus kA rating (bracing).
- .8 System kA rating.
- .9 Customer meter model (where applicable).
- .10 Floor or wall anchoring method and foundation template.
- .11 Dimensioned cable entry and exit locations.
- .12 Dimensioned position and size of bus.
- .13 Overall length, height and depth of complete distribution.
- .14 Dimensioned layout of internal and front panel mounted components.
- .15 Weight of each section.

.3 Include time-current characteristic curves for breakers as required for the coordination study.

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1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into maintenance manuals.

1.5 STORAGE

.1 Store distribution on Site in protected dry location. Cover with plastic to keep off dust.

1.6 APPROVED MANUFACTURERS

.1 Eaton, Schneider and Siemens.

.2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these Specifications in their entirety. Products in compliance with the Specification and manufactured by others not named will be considered only if pre-approved by the Contract Administrator ten (10) days prior to bid date.

Part 2 Products

2.1 RATING

.1 Distribution shall be totally enclosed, dead front fabricated from formed and welded #12 gauge steel and front accessible only. Verify with plans for maximum overall dimensions. The distribution shall be CDP type, minimum 38" wide.

.2 Distribution shall have door in door design. The distribution trim shall be hinged to the tub to allow full access to all buswork, wireways, breakers, etc. in the interior of the distribution. Bolted trim is not acceptable. A separate door in the trim shall allow access to the front of the breakers. Door over breakers to have lock. All locks to be keyed alike.

.3 Main circuit breaker or switch, where indicated on the Drawings, shall be molded case type of size and type as shown on the Drawings. Circuit breaker or switch shall have the continuous ampere rating engraved into operating handle such that rating is clearly visible after installation of panel cover.

.4 Feeder circuit breakers shall be moulded case of sizes and types as shown on the Drawings. Each circuit breaker shall have the continuous ampere rating engraved into breaker handle such that rating is clearly visible after installation of panel cover.

.5 All breakers to be CDP type breakers using CDP type connector mounting hardware. Smaller frame breakers that require additional mounting means, additional panelboard interiors, etc. will not be allowed.

.6 Breakers with 400A frames and smaller shall utilize twin breaker hardware mounting kits. Breakers shall be mounted double wide to save space.

.7 Bus bars shall be tin plated copper braced to withstand a short circuit current as shown on Drawings. Bus bars shall extend the full length of each section. Neutral bus shall be full capacity. Copper ground bus shall be continuous and extend through main breakers or switch section and each feeder breaker section.

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.8 Distribution enclosure shall be treated to inhibit rusting and painted with a primer and two (2) coats of ASA61 grey enamel.

.9 Enclosure shall be NEMA 1, protected from spray from sprinkler heads as outlined in Canadian Electrical Code.

.10 Where exposed to weather minimum NEMA 4 shall be provided.

.11 All breakers shall have individual lamacoid nameplates securely fastened with rivets on panel cover adjacent to respective breaker.

.12 Interrupting capacity of main breaker or switch and feeder circuit breakers shall be RMS symmetrical at applied voltage and as follows:

.1 Up to 250V bus and breakers interrupting capacity (RMS Symmetrical) as shown on Drawings, 10 ka minimum when not shown.

.2 347/600V panelboards: bus and breakers interrupting capacity (RMS Symetrical) as shown on Drawings, 14 ka minimum when not shown.

.13 All devices must be fully rated. Series rated devices are not acceptable.

.14 All current carrying components such as buswork, interconnecting components, etc. shall be copper. No aluminum components will be allowed.

.15 All feeder terminations to be two hole long barrel copper compression lugs sized to the conductor. This includes phase, neutral and ground connection points. Multi ranging lugs and dieless crimpers are not to be used.

.16 Double tub distributions are to be sub-feed type.

.17 Distribution to have full height vertical bus.

.18 Distribution shall have a metal frame welded to the inside of panel door, as large as possible but minimum (220 x 280mm) (9" x 11"), and shall be c/w typewritten index card and protective transparent cover. On shop Drawings, indicate proposed size of metal frame.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification per Section 26 05 00.

Part 3 Execution

3.1 INSTALLATION

.1 Locate distribution as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Distribution shall be floor mounted on concrete housekeeping pads or mounted on wall. Provide strut channel between pad and enclosure bottom or between wall and back of enclosure.

.3 Connect breakers in distribution to feeders.

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.4 Connect control and communication wiring (where applicable).

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

.6 Program all trip units per coordination study.

.7 Test all breakers after trip units are programmed.

.8 Provide test report to Contract Administrator for review.

.9 Incorporate test report in maintenance manuals.

END OF SECTION

□

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 28 21 - Moulded Case Circuit Breakers.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29, Panelboards and enclosed Panelboards.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.3 Up to 250V branch circuit panelboards: bus and breakers interrupting capacity (RMS Symmetrical) as shown on drawings, 10 ka minimum when not shown.

.4 347/600V panelboards: bus and breakers interrupting capacity (RMS Symmetrical) as shown on drawings, 14 ka minimum when not shown.

.5 All devices must be fully rated. Series rated devices are not acceptable.

.6 Sequence phase bussing such that circuit breakers will be numbered in consecutive order, with each breaker identified by permanent number identification as to circuit number and phase.

.7 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.8 Provide panel covers for all panelboards and supply two keys for each panelboard and key panelboards alike.

.9 Aluminum bus with neutral of same ampere rating as mains.

.10 Mains: suitable for bolt-on 25mm wide breakers.

.11 Trim and door finish: baked grey enamel.

.12 Enclosure shall be metal, NEMA 1 and c/w drip hood in sprinklered areas.

.13 Where exposed to weather minimum NEMA 4 shall be provided.

2.2 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to The City.

.5 Lock-on devices for receptacles, fire alarm, emergency, gas detection, and similar circuits.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 MANUFACTURERS

.1 Acceptable Manufacturers: Eaton, Schneider.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards painted with fire retardant paint. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - For Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect branch circuit neutral conductors to common neutral bus. Common neutrals shall be shared by vertically adjacent breakers except for GFI protected branch circuits and dimmer circuits which shall not share neutrals with other circuits. Neutral conductors

shall be identified with mylar/cloth wire markers showing the circuit numbers of the circuits sharing the neutral.

.6 Wiring in panelboards shall be neat and set in as if laced. All neutral conductors shall be identified in the panel with their associated circuit numbers by means of Brady Markers.

.7 All panelboards throughout the building shall be phased together such that the left-hand, centre and right-hand panelboard busses represent phases A, B and C respectively. All indicating meters shall be identified to this sequence.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 24 31 - Mechanical Equipment Connections.

.3 Section 26 29 10 - Motor Starters to 600V.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-Q9000, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Manufacturers Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures, etc.

.3 Indicate:

.1 Outline dimensions
.2 Configuration of identified compartments.
.3 Floor anchoring method and dimensioned foundation template.
.4 Cable or Bus duct entry and exit locations.
.5 Dimensioned position and size of busbars and details of provision for future extension.
.6 Schematic and wiring diagrams.
.7 Complete nameplate schedule.

.4 Include data for each type and style of starter.

Part 2 Products

2.1 SUPPLY CHARACTERISTICS

.1 600 V, 60Hz, 3 phase, 3 wire, grounded.

.2 Minimum 35 KA RMS Symmetrical fault current available, or as noted on drawings.

2.2 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Enclosure shall be NEMA 1 rated and protected from spray from sprinkler heads as outlined in Canadian Electrical Code.

.4 Where exposed to weather minimum NEMA 4 shall be provided.

2.3 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables or bus duct to enter at top or bottom as indicated.

.8 Provision for outgoing cables to exit via top or bottom.

.9 Removable lifting means.

.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to Site, as indicated complete with hardware and instructions for re-assembly.

2.4 SILLS

.1 Continuous 50 mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.5 BUSBARS

.1 Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment insulated self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: 600 A minimum or as indicated on drawings.

.2 Branch vertical busbars: 300 A as indicated on drawings.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 35 kA rms symmetrical or as indicated on drawings.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact Material and long creepage surface designed to discourage collection of dust.

2.6 GROUND BUS

.1 Copper ground bus extending entire width of motor control centre.

.2 Starter units for motors above 25 HP @ 208 volts or 50 HP @ 600 volts shall be reduced voltage, closed transition auto-transformer type.

.3 Starter units to be rated 35 KAIC RMS symmetrical at 600 Volts or as indicated on drawings.

2.7 MOTOR STARTERS AND DEVICES

.1 Starters to be as specified in Section 26 29 10.

2.8 STARTER UNIT COMPARTMENTS

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons and indicating lights mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.9 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.

2.10 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.1 Motor control centre main nameplate: size No. 7, engraved name, number and system.

.2 Individual compartment nameplates: size No. 5, engraved motor number, name and horsepower.

2.11 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Paint motor control centre exterior light gray and interiors white.

2.12 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Submit written test results to Contract Administrator.

.3 Manufacturer to provide proof of quality control program in accordance with CAN/CSA-Q9000.

2.13 MANUFACTURERS

.1 Acceptable manufacturers: Schneider Electric, Eaton, Siemens.

.2 All manufacturers shall provide their industrial quality product line; commercial quality motor control centres are not acceptable.

Part 3 Execution

3.1 INSTALLATION

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Ensure correct overload heater elements are installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters in sequence to prove satisfactory performance of motor control centre, motors, control devices, sequences, etc.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 05 21 - Wires and Cables.

.3 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.5 Section 26 24 19 - Motor Control Centre.

.6 Section 26 28 23 - Disconnect Switches - Fused and Non-Fused up to 1000V.

.7 Section 26 29 10 - Motor Starters to 600V.

1.2 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association (CSA)

.1 CSA C22.2No.0.4, Bonding and Grounding of Electrical Equipment (Protective Grounding).

1.3 SYSTEM DESCRIPTION

.1 Provide complete electrical power and control connections for mechanical equipment, except as noted herein.

1.4 COORDINATION

.1 Review all mechanical Shop Drawings prior to submittal to the Contract Administrator. Resolve internal conflicts prior to submission.

.2 Verify electrical supply characteristics of all equipment prior to rough-in. Report any discrepancies immediately. Revise wire sizing, device type, connection type, breaker size, etc., as required, to accommodate the electrical supply characteristics of the equipment supplied by other trades.

Part 2 Products

2.1 MATERIALS

.1 Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.

.2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices and fittings required to provide control wiring for mechanical equipment except for temperature/humidity control systems.

.3 Unless otherwise noted, motors and control devices shall be supplied by Div. 25. Motor horsepower ratings shall be as shown in the Mechanical Specifications. Motor voltage and phase ratings shall be as shown on the Div. 26 Drawings or schedule.

2.2 EXTERIOR EQUIPMENT

.1 All equipment mounted on the exterior of the building shall be weatherproof.

Part 3 Execution

3.1 POWER WIRING

.1 Install power feeders, starters, disconnects and associated equipment and make connections to all mechanical equipment.

.2 Install branch circuit wiring for mechanical systems control panels and control transformers.

.3 Install main power feeders to starter/control panels furnished by Mechanical. Install branch circuit wiring for motors, electric coils, etc.

3.2 CONTROLS

.1 Install all electrical controls except controls supplied under Mechanical, unless otherwise noted herein. Controls which have both electrical and mechanical connections shall be installed by the trade supplying the control.

.2 Wire and connect remote thermostats, control panels, P/E switches, etc. for electric heaters and rooftop HVAC units.

.3 Wire and connect float switches, pressure switches, alternators, alarms, etc. for booster pumps, jockey pumps and compressors.

.4 Install, wire and connect controls which are an integral part of any packaged unit and are supplied by the trade supplying the packaged unit. Include wiring for controls for such items as roof-top air handling units, boilers, chillers, including all interlock wiring.

.5 Division 25 shall supply and install all conduit, wire, devices and fittings required to wire and connect control systems specified. Control wiring shall be installed in conduit.

.6 Wire and connect electrical interlocks for starters supplied by Div. 26.

.7 Wire and connect thermistor control devices, built-in to large motors, to motor starters as per wiring diagrams provided by Div. 25.

3.3 COORDINATION

.1 Refer to mechanical Drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.

.2 Obtain full information from Mechanical, regarding wiring, controls, overload heaters, equipment ratings and overcurrent protection. Notify the Div. 21, 22, 23, 25 Subcontractor, at once, if any information provided is incorrect or unsatisfactory.

.3 Coordinate control wiring requirements and provide all control wiring and connections as required to make the control systems operate as specified.

.4 Refer to Divisions 21, 22, 23 & 25 Specifications for any further electrical requirements.

3.4 SHOP DRAWING REVIEW

.1 Review Mechanical equipment Shop Drawings and adjust breaker/feeder sizes as required.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.3 SUBMITTALS

.1 Submit Shop Drawings and product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

Part 2 Products

2.1 SWITCHES

.1 Toggle operated general purpose AC Switches 15A and 20A 120Vac single pole, double pole, as indicated, with the following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea molding.

.4 Suitable for back and side wiring.

.5 Brown toggle for normal power.

.6 Up to 80% of rated capacity of motor loads.

.2 Switches of one manufacturer throughout project.

.3 Switches to be premium Specification grade.

.4 Acceptable manufacturers:

Manufacturer	120 Volt	347 Volt
Hubbell	1200 Series	18200 Series
Bryant	4800 Series	6800 Series
Leviton	1200 Series	18200 Series
Pass & Seymour	AG-1 Series	3700 Series
Smith & Stone	4-4800 Series	1-3700 Series
Slater	710 Series	3400 Series

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 Vac, 15 A, U ground, with following features:

.1 Nylon face, brown or ivory for normal power, red for emergency power.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Double wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 VAC, 15 A, U ground with following features:

.1 Nylon face, brown or ivory for normal power, red for emergency power.
.2 Suitable for No. 10 AWG for back and side wiring.

.3 Receptacles of one manufacturer throughout project.

.4 Acceptable manufacturers: Hubbell, Arrow Hart, Bryant, Pass & Seymour, Slater. Catalogue No. 5262 for all manufacturers.

.5 Acceptable manufacturers for ground fault receptacles shall be:

.1 Arrow Hart - GF 5242
.2 Bryant - GFR 52FT
.3 Hubbell - GF 5252
.4 Pass & Seymour - 1591-R

2.3 COVER PLATES

.1 Cover plates from one manufacturer throughout project.

.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.3 Cast gasketted cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.4 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.5 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles as indicated.

.6 Receptacles of configurations 5-15R, 5-20R, 5-20RA, 6-15K, 6-20R and 6-20RA where exposed to weather, shall be provided with cover plates suitable for wet locations whether or not a plug is inserted into receptacle.

.1 Approved Manufacturers:
.1 Cooper WIU-1 (1 gang), WIU-2 (2 gang).
.2 Appleton WCDIU1 (1 gang), WCIU2 (2 gang).
.3 Hubbell RW57300 (1 gang), RW57750 (2 gang).

.7 Where receptacles are installed facing downward, at an angle of 45° or less from horizontal, standard cover plates may be used.

.8 Weatherproof cover for switch with gaskets as indicated.

Part 3 Execution

3.1 INSTALLATION

.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 00 or as indicated.

.4 Where pilot lights are required, or shown on the Drawings, install flush neon pilots in outlet box grouped with associated switch.

.5 Study the drawings and co-operate with other trades so that the location and elevation of switch outlets shall not necessitate any unnecessary cutting of dadoes, fitments, etc. If this is not done, this Electrical Subcontractor will be required to move these outlets at no additional cost to the Contract. Properly locate all switches with reference to door swing, regardless of indicated position or door swing shown on electrical Drawings.

.6 Switches shall be mounted 1.4m (4'-6") above finished floor on the strike side of the door.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles horizontally at height specified in Section 26 05 00 or as indicated.

.3 Horizontally mounted receptacles shall have the hot line terminal on the bottom.

.4 Where switch and convenience outlets are shown close to one another, mount receptacles below and in line with the switch.

.5 Suitably ground all receptacles with #12 green insulated wire to outlet box. Provide additional separate ground conductor to isolated ground receptacles.

.3 Coverplates:

.1 Install suitable common cover plates where wiring devices are ganged.

.2 Do not use cover plates intended for flush outlet boxes on surface-mounted boxes.

.3 Provide a coverplate on each outlet.

3.2 IDENTIFICATION

.1 Identify receptacles with size 1 nameplate indicating panel and circuit number. Nameplates to be mechanically fastened. Refer to Section 26 05 00.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 24 17 - Panelboards Breaker Type

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.144, Ground Fault Circuit Interrupters.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 SUBMITTALS

.1 Submit product data and Shop Drawings in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Submit test report for field testing of ground fault equipment to Contract Administrator and a certificate that system as installed meets criteria specified herein.

Part 2 Products

2.1 MATERIALS

.1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144 NEMA PG 2.2.

.2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Single pole ground fault circuit interrupter for 15 A, and 20 A, 120 V, 1 phase circuit c/w test and reset facilities.

2.3 GROUND FAULT PROTECTOR UNIT

.1 Self-contained with 15 A, 120 V circuit interrupter and duplex single receptacle complete with:

.1 Solid state ground sensing device.

.2 Facility for testing and reset.

.3 CSA Enclosure 1, surface flush mounted with stainless steel painted face plate.

Part 3 Execution

3.1 INSTALLATION

.1 Do not ground neutral on load side of ground fault relay.

.2 Pass phase conductors including neutral through zero sequence transformers.

.3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For Electrical and co-ordinate with Section 01 45 00 - Quality Control if required.

.2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.

.3 Demonstrate simulated ground fault tests.

.4 Submit report of tests to Contract Administrator and a certificate that system as installed meets criteria specified herein. Include copies of report in maintenance manuals.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 24 16 CDP Type Distribution (Up to 1200A).

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 SUBMITTALS

.1 Submit product data & Shop Drawings in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Include time-current characteristic curves for breakers with ampacity of 100 A and over.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5

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

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 5-10 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 All devices must be fully rated. Series rated devices are not acceptable.

.7 Interrupting ratings (RMS symmetrical) to match bus interrupting ratings shown on Drawings.

.8 When interrupting ratings are not shown on Drawings shall be as follows:
.1 Up to 250 Volts - 10,000 Amps
.2 347/600 Volts - 14,000 Amps

.9 Maximum breaker sizes, except for motors:

.1 20A for #12 copper conductor.

.2 30A for #10 copper conductor.

2.2 THERMAL MAGNETIC BREAKERS DESIGN

.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 DESIGN

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 SOLID STATE TRIP BREAKERS (LSI)

.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 and ground fault tripping.

.1 Each breaker shall have the following independent and fully adjustable curve shaping characteristics:

.1 Adjustable long time pickup

.2 Adjustable long time delay

.3 Adjustable short time pickup

.4 Adjustable short time delay with selective curve shaping

.5 Adjustable instantaneous pickup with instantaneous OFF function

.6 Adjustable ground fault pickup (where shown on Drawings)

.7 Adjustable ground fault delay with selective curve shaping (where shown on Drawings)

.2 Breakers feeding transformers 45 kVA and larger shall have solid state trips, fully and independently adjustable LSI settings.

.1 The range of the instantaneous settings shall be suitable for coordination with the inrush current of the protected transformer. The band of the instantaneous portion of the breaker time-current curve must clear the transformer inrush current at value which is 12 times the transformer full load current.

2.5 MANUFACTURERS

.1 Acceptable manufacturers: Eaton, Schneider, Square D, Siemens.

2.6 REQUIRED FEATURES

.1 Include:

.1 Shunt trip.

.2 Auxiliary switch.

.3 Motor-operated mechanism c/w time delay unit.

.4 Under-voltage release.

.5 On-off locking device.

.6 Handle mechanism.

.2 Enclosure shall be NEMA 1, protected from spray from sprinkler heads as outlined in Canadian Electrical Code.

.3 Where exposed to weather minimum NEMA 4 shall be provided.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

.2 Program/adjust programmable/adjustable breakers

.3 Test breakers as follows:

.1 Breakers in CDP's.
.2 Breakers in MCC's.
.3 Programmable/adjustable breakers.
.4 Refer to Specification Section 26 05 00 for details on testing.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 26 05 00 - Common Work Results - For Electrical

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4, Enclosed Switches.

.2 CSA C22.2 No.39, Fuseholder Assemblies.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible disconnect switch in CSA Enclosure and size as indicated.

.2 Enclosure shall be NEMA 1 protected from spray from sprinkler heads as outlined in Canadian Electrical Code.

.3 Where exposed to weather minimum NEMA 4 shall be provided.

.4 Metal enclosure with provision for padlocking in on-off switch position by three locks.

.5 Mechanically interlocked door to prevent opening when handle in ON position.

.6 Quick-make, quick-break action, heavy duty industrial grade.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Disconnect switches located at motors connected to variable frequency drives are to be provided with one Form 'C' electrical contact to interlock from the disconnect to the VFD. The interlock is to operate prior to the main power contacts opening to the motor.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Result - For Electrical.

.2 Indicate name of load controlled and voltage on size 6 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses as indicated.

.2 Install additional brackets, supports, etc. required for mounting the disconnect switches.

.3 Provide conduit and wire to interlock between VFD and motor disconnect to power down VFD when motor disconnect is operated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14-95(R2001), Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2001, Industrial Control and Systems: General Requirements.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include schematic, wiring, interconnection diagrams.

1.5 QUALITY ASSURANCE

.1 Submit to Contract Administrator one copy of test results.

Part 2 Products

2.1 OPERATOR CONTROL STATIONS

.1 Enclosure: CSA Type 1, surface or flush mounting: as required.

2.2 PUSHBUTTONS

.1 Illuminated, Heavy duty, Oil tight. Operator recessed flush extend mushroom type, as indicated. Black Green, with 1-NO and 1-NC contacts rated at A, AC DC, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position labelled "emergency stop".

2.3 SELECTOR SWITCHES

.1 Maintained, 2 or 3 position labelled as indicated heavy duty oil tight, operators wing lever cylinder lock, contact arrangement as indicated, rated 120 V, 5 A, AC.

2.4 INDICATING LIGHTS

.1 Heavy duty Oil tight, full voltage, LED type, push-to-test, lens colour: red, green, supply voltage: 120 V, lamp voltage: 12 V, labels as indicated.

2.5 CONTROL AND RELAY PANELS

.1 CSA Type 4X enclosure in garage area. Enclosure to be c/w hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.6 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: 600 V, 60 Hz ac.

.3 Secondary: 120 V, AC.

.4 Rating: 150 (minimum) VA or as required.

.5 Secondary fuse: 3 A.

.6 Close voltage regulation as required by magnet coils and solenoid valves.

Part 3 Execution

3.1 INSTALLATION

.1 Install pushbutton stations, control and relay panels, control devices and interconnect.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - For Electrical.

.2 Section 26 24 31 - Mechanical Equipment Connections.

.3 Section 26 24 19 - Motor Control Centres.

1.2 SUBMITTAL

.1 Submit Shop Drawings in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Indicate:

- .1 Mounting method and dimensions.
- .2 Starter size and type.
- .3 Layout of identified internal and front panel components.
- .4 Enclosure types.
- .5 Wiring diagram for each type of starter.
- .6 Interconnection diagrams.

1.3 EXTRA MATERIALS

.1 Provide maintenance Materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide listed spare parts for each different size and type of starter:

- .1 3 contacts, stationary.
- .2 3 contacts, movable.
- .3 1 contacts, auxiliary.
- .4 1 control transformers.
- .5 1 operating coil.
- .6 2 fuses.
- .7 10% indicating lamp bulbs used.
- .8 1 HOA kit.

Part 2 Products

2.1 MATERIALS

.1 Starters: EEMAC E14-1.

- .1 Half size starters not acceptable.
- .2 Provide NEMA rated starters only; IEC rated starters are not acceptable.

2.2 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fused disconnect switch or circuit breakers with operating lever on outside of enclosure or MCC wrapper to control disconnect or circuit breaker, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons, Selector switches: heavy duty labelled as indicated.

.2 Indicating lights: heavy duty oil tight type and colour as indicated.

.3 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

.4 HOA selector switch.

.5 Two speed single winding starters shall have individual Red run pilot lights for LOW and HIGH speed run indication.

.6 Provide and install time delay relay (to sequence starting after power failure) adjustable 0 - 120 seconds for motors 15 horsepower and larger.

2.3 FULL VOLTAGE REVERSING MAGNETIC STARTERS

.1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two - 3 pole magnetic contactors mounted on common base.

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.

.3 Three overload relays with heater elements, manual automatic reset.

.2 Accessories:

.1 Pushbuttons and Selector switches: heavy duty labelled as indicated.

.2 Indicating lights: heavy duty type and colour as indicated.

.3 Auxiliary control devices as indicated.

.3 Enclosure shall be NEMA 1 and protected from spray from sprinkler heads as outlined in Canadian Electrical Code.

2.4 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 GAS BOILER EMERGENCY SHUTDOWN

.1 For all gas boilers, the Electrical Subcontractor shall provide and install a remote emergency boiler shutdown switch as follows:

.1 For gas boilers requiring a 208 volt electrical supply, provide and install a toggle switch tied into the boiler shutdown control circuit.

.2 These emergency boiler shutdown switches shall meet the following requirements:

.1 Locate outside the boiler room door if there is no public access to this area. Otherwise, locate inside the boiler room at the door. Confirm exact location on Site.

.2 Locate at a height of 1.5 m above floor.

.3 Provide lamacoid identification at the switch to read “Emergency Boiler Shut-Off”. Lettering to be minimum 12 mm high.

.4 For more than one boiler in the boiler room, provide and install a muti-pole relay controlled by one shutdown switch. Provide a 120 volt circuit for the relay.

2.6 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results - For Electrical.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.

2.8 MANUFACTURERS

.1 Acceptable manufacturers: Eaton, Schneider Electric, Siemens.

.2 All manufacturers shall provide their industrial quality product line; commercial quality starters are not acceptable.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters in location indicated (if not in MCC).

.2 Connect power and control wiring as indicated.

.3 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For Electrical and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

.5 Ensure motor rotation corresponds with the direction required by the driven equipment.

END OF SECTION