PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 23 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.3 Section 23 05 49.01 - Seismic Restraint Systems (SRS) - Type P2 Buildings.

.4 Section 26 36 23 - Automatic Transfer Switches.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
- .2 CSA C22.3 No. 1-10, Overhead Systems.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
- .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 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.
- .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS in accordance with Section 01 01 00 - General Instructions. and Section 02 81 01 - Hazardous Materials.

.3 Submit for review single line electrical diagrams.

.4 Shop drawings:
- .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
- .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

1.5 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.4 Shop drawings:(Cont'd)
- .4 If changes are required, notify Departmental Representative of these changes before they are made.

.5 Quality Control: in accordance with Section 01 45 00 - Quality Control.
- .1 Provide CSA certified equipment and material.
- .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities 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 certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

.6 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
- .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
- .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Site Meetings:
- .1 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, in appropriate NMS Section 26 36 23 - Automatic Transfer Switches, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative 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 Section 01 01 00 - General Instructions.

1.8 SYSTEM STARTUP

.1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.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.

1.8 SYSTEM STARTUP (Cont'd)

.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.

1.9 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:
- .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- .3 Safety precautions.
- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.10 SEISMIC RESTRAINT

.1 Installation to comply with Section 23 05 49.01 - Seismic Restraint Systems (SRS) - Type P2 Buildings.

PART 2 - PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 01 00 - General Instructions.

2.2 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

.3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

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

.2 Control wiring and conduit: in accordance with Section 23 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

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

.2 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 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

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

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

.6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO." as directed by Departmental Representative.

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

.8 Terminal cabinets and pull boxes: indicate system and voltage.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

2.7 WIRING IDENTIFICATION (Cont'd)

.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.

2.8 CONDUIT AND CABLE IDENTIFICATION

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

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

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

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

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.

PART 3 - EXECUTION

3.1 INSTALLATION

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

.2 Do overhead and underground systems in accordance with CSA C22.3 No. 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 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

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 150 mm horizontal clearance between boxes.

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

.4 Locate light switches on latch side of doors.
- .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

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

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

.3 Install electrical equipment at following heights unless indicated otherwise.
- .1 Local switches: 1400 mm.
- .2 Wall receptacles:
  - .1 General: 300 mm.
  - .2 Above top of continuous baseboard heater: 200 mm.
  - .3 Above top of counters or counter splash backs: 175 mm.
  - .4 In mechanical rooms: 1400 mm.
- .3 Fire alarm stations: 1500 mm.
- .4 Fire alarm bells: 2100 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

.1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
- .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
- .2 Circuits originating from branch distribution panels.
- .3 Lighting and its control.
- .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .5 Systems: fire alarm system.
- .6 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.

.2 Carry out tests in presence of Departmental Representative.

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

3.7 FIELD QUALITY CONTROL (Cont'd)

.4 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 inspection of product installation in accordance with manufacturer's instructions.

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

3.8 CLEANING

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

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

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

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

1.2 PRODUCT DATA

.1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 - PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG. in accordance with Section 01 01 00 - General Instructions.

.2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Non Jacketted.

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Conductors:
- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.

.3 Insulation:
- .1 Cross-linked polyethylene XLPE.
- .2 Rating: , 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

.7 Fastenings:
- .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables at 1500 mm centers.
- .3 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:
- .1 Watertight, approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90 - lead sheath over cable assembly and under armour.

.3 Armour: interlocking type fabricated from aluminum strip.

2.3 ARMOURED CABLES (Cont'd)

.4 Connectors: anti short connectors.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

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

.2 Perform required tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.

.2 Conductor length for parallel feeders to be identical.

.3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.4 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.5 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:
.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.
.1 Install cable exposed, securely supported by straps & hangers.

3.5 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 01 00 - General Instructions a

PART 2 - PRODUCTS

2.1 EQUIPMENT

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

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as required.

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

.4 Insulated grounding conductors: green, copper conductors, size as indicated.

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

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

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

.3 Protect exposed grounding conductors from mechanical injury.

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

.5 Soldered joints not permitted.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: frames of motors, control panels, building steel work, generators, elevators.

3.3 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, fire alarm, security systems, intercommunication systems as follows:
.1 Fire alarm, security systems, intercommunication systems as indicated.

3.4 FIELD QUALITY CONTROL

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

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

.3 Perform tests before energizing electrical system.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with 01 01 00 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with 01 01 00 - General Instructions.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with 01 01 00 - General Instructions.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
.1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES
.1 Canadian Standards Association (CSA International)
.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS
.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
.3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 DELIVERY, STORAGE AND HANDLING
.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 01 00 - General Instructions.

PART 2 - PRODUCTS

2.1 SPLITTERS
.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES
.1 Construction:welded steel enclosure.
.2 Covers Flush Mounted: 25 mm minimum extension all around.
.3 Covers Surface Mounted: screw-on turned edge covers.

PART 3 - EXECUTION

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

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

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

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

.4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.

.2 Identification Labels: size 2 indicating voltage and phase or as indicated.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.3 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit samples for floor box in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with 01 01 00 - General Instructions.

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.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

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

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

2.2 GALVANIZED STEEL OUTLET BOXES (Cont'd)

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished drywall walls.

2.6 CONDUIT BOXES

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.8 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 35 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 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
.1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES
.1 Canadian Standards Association (CSA International)
- .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
- .2 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .3 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing.

1.3 ACTION AND INFORMATIONAL SUBMITTALS
.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
- .1 Submit cable manufacturing data.

.3 Quality assurance submittals:
- .1 Test reports: submit certified test reports.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL
.1 Separate waste materials for reuse and recycling in accordance with Section 01 01 00 - General Instructions.

.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.

PART 2 - PRODUCTS

2.1 CABLES AND REELS
.1 Provide cables on reels or coils.
- .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

.3 Identify cables for exclusively dc applications.

.4 Reel and mark shielded cables rated 2,001 volts and above.

2.2 CONDUITS .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

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

2.3 CONDUIT FASTENINGS .1 One hole steel straps to secure surface conduits 50 mm and smaller.

.1 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 at 1500 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.

Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.
.1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

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

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

2.6 FISH CORD .1 Polypropylene.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms.

3.2 INSTALLATION (Cont'd)

.3 Surface mount conduits except in finished areas.

.4 Use electrical metallic tubing (EMT) except as indicated.

.5 Use flexible metal conduit for connection to motors in dry areas.

.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 lighting and power circuits: [NPS 3/4] [19 mm].

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

.9 Mechanically bend steel conduit over 19 mm diameter.

.10 Install fish cord in empty conduits.

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

.12 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Run conduits in flanged portion of structural steel.

.3 Group conduits wherever possible on surface channels.

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

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

3.5 CLEANING

.1 Proceed in accordance with Section 01 01 00 - General Instructions.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
.1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES
.1 CSA International
.1 CSA C802.2-12, Minimum Efficiency Values for Dry Type Transformers.

1.3 ACTION AND INFORMATIONAL SUBMITTALS
.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS
.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING
.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 DESIGN DESCRIPTION
.1 Design 1.
.1 Type: ANN.
.2 3 phase, kVA as indicated, 600 V input, 120/208 V output, 60 Hz.
.3 Voltage taps: standard.
.4 Insulation: Class H, 150 degrees C temperature rise.
.5 Basic Impulse Level (BIL): standard.
.6 Hipot: standard.
.7 Average sound level: 45 db A.
.8 Impedance at 17 degrees C: less than 6%
.9 Enclosure: CSA, sprinkler proof, removable metal front panel.
.10 Mounting: floor.
.11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
.12 Copper windings, separate windings per phase.
.13 Voltage Regulation to be 4% or better.

2.2 EQUIPMENT IDENTIFICATION

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

.2 Label size: 7.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Mount dry type transformers up to 75 kVA, on concrete housekeeping pad.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize transformers after installation is complete.

.8 Make conduit entry into bottom 1/3 of transformer enclosure.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 01 00 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 01 00 - General Instructions.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by dry type transformers installation.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No. 29-11, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store and protect panelboards from nicks, scratches, and blemishes.

.2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.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.

.2 Panelboards up to 250 V: bus and breakers rated for 10,000 A (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: voltage, phases, mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Minimum of 2 flush locks for each panel board.

.6 Two keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of same ampere rating of mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: air dried enamel.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.

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

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

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, mounted in plastic envelope at inside of panel door.

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 unistrut frame secured to floor & underside slab above.

.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 neutral conductors to common neutral bus.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 01 00 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 01 00 - General Instructions.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by panelboards installation.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.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 CSA International

- .1 CSA C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CAN/CSA C22.2 No. 42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA C22.2 No. 55-M1986(R2008), Special Use Switches.
- .4 CSA C22.2 No. 111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

PART 2 - PRODUCTS

2.1 SWITCHES .1 20 A, 347 V, single pole, three-way, switches to: CSA C22.2 No. 55 and CSA C22.2 No. 111.

.2 Manually-operated general purpose AC switches with following features:
- .1 Terminal holes approved for No. 10 AWG wire.
- .2 Silver alloy contacts.
- .3 Urea or melamine moulding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 Brown toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No. 42 with following features:
- .1 Brown urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
- .1 Brown urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.

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

.3 Stainless steel, 1 mm thick cover plate, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.

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

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

2.4 SOURCE QUALITY CONTROL .1 Cover plates from one manufacturer throughout project.

PART 3 - EXECUTION

3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 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 in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Receptacles:
- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .4 Install GFI type receptacles as indicated.

.3 Cover plates:
- .1 Install suitable common cover plates where wiring devices are grouped.
- .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 01 00 - General Instructions.
- .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 01 00 - General Instructions.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 01 35 21 - LEED Requirements.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.3 Repair damage to adjacent materials caused by wiring device installation.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
.1 Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.

1.3 ACTION AND INFORMATIONAL SUBMITTALS
.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Provide fuse performance data characteristics for each fuse type and size. Performance data to include: average melting time-current characteristics.

.3 Shop Drawings:
- .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING
.1 Ship fuses in original containers.

1.5 EXTRA MATERIALS
.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Three spare fuses of each type and size installed above 20 A.

PART 2 - PRODUCTS

2.1 FUSES - GENERAL
.1 Fuse type references L1, J1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer.

2.2 FUSE TYPES
.1 Class L fuses.
- .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Class J fuses.
- .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.
- .1 Install rejection clips for Class R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

.5 Install spare fuses in fuse storage cabinet.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 26 24 16.01 - Panelboards Breaker Type.

1.2 REFERENCES

.2 CSA International

.1 CSA C22.2 No. 5-13, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2013).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.1 Production certificate of origin must be submitted to Departmental Representative for approval.

.2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

.4 Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

.3 Contractor's name and address and person responsible for project.

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

.5 Name and address of building where circuit breakers will be installed:

.1 Project title.

.2 End user's reference number.

.3 List of circuit breakers.

1.4 DELIVERY, STORAGE AND HANDLING

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers: 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.

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

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

.7 Circuit breakers to have minimum 10,000 A symmetrical rms interrupting capacity rating.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

.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.

PART 3 - EXECUTION

3.2 INSTALLATION

.1 Install circuit breakers as indicated.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 26 28 13.01 - Fuses - Low Voltage.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
- .1 CAN/CSA C22.2 No. 4-04 (R2009), Enclosed Switches.
- .2 CSA C22.2 No. 39-M89 (R2007), Fuseholder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 01 00 - General Instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No. 4 size as indicated.

.2 Provision for padlocking in on-off switch position by three locks.

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

.4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.

.5 Fuseholders: to CSA C22.2 No. 39 relocatable and suitable without adaptors, for type and size of fuse indicated.

2.1 DISCONNECT SWITCHES (Cont'd)

.6 Quick-make, quick-break action.

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

2.2 EQUIPMENT IDENTIFICATION

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

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

.1 CSA International
- .1 CSA C22.2 No. 178.1-12, Automatic Transfer Switches.
- .2 CAN/CSA C60044-1-07(R2011), Instrument Transformers.

.2 National Electrical Manufacturers Association (NEMA)
- .1 NEMA ICS 2-2002(R2005), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .1 Indicate on drawings:
    - .1 Make, model and type.
    - .2 Load classification:
      - .1 Tungsten lamp load: _____kW.
      - .2 Motor load: _____kW.
      - .3 Restricted use: resistance and general loads, 0.8 pf or higher _____ kW.
    - .3 Single line diagram showing controls and relays.
    - .4 Description of equipment operation including:
      - .1 Automatic starting and transfer to standby unit and back to normal power.
      - .2 Test control.
      - .3 Manual control.
      - .4 Automatic shutdown.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.

.3 Detailed instructions to permit effective operation, maintenance and repair.

.4 Technical data:
- .1 Schematic diagram of components, controls and relays.
- .2 Illustrated parts lists with parts catalogue numbers.
- .3 Certified copy of factory test results.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect transfer switches from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:
- .1 Monitor voltage on phases of normal power supply.
- .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
- .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
- .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
- .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

2.2 MATERIALS

.1 Instrument transformers: to CAN/CSA C60044-1.

.2 Contactors: to NEMA ICS2.

2.3 CONTACTOR TYPE TRANSFER EQUIPMENT

.1 Contact Type Transfer Equipment: to CSA C22.2 No. 178.1.

.2 Two- 3 pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, solenoid operated, with CSA enclosure.

.3 Rated: 600 V, 60Hz, 4 wire, solid neutral, amperage as noted.

.4 Main contacts: silver surfaced, protected by arc disruption means.

.5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

.6 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.

.7 Fault withstand rating: 35 kA symmetrical for 3 cycles with maximum peak value of 70 kA.

.8 Lever to operate switch manually when switch is isolated.

2.3 CONTACTOR TYPE TRANSFER EQUIPMENT (Cont'd)

.9 Neutral bar, solid rated: 100%.

2.4 CONTROLS

.1 Selector switch - 4 position "Test", "Auto", "Manual", "Engine start".
- .1 Test position - normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
- .2 Auto position - normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
- .3 Manual position - transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.
- .4 Engine start position - engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Control transformers: dry type with 120 V secondary to isolate control circuits from:
- .1 Normal power supply.
- .2 Emergency power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
- .1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.
- .2 Time delay: normal power to standby, adjustable solid state, 0 to 60 s minutes.
- .3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 s delay.
- .4 Time delay on retransfer from standby to normal power, adjustable 5 to 180 s.
- .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 20 s intervals to 10 minutes.
- .6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 s intervals to 180 s.
- .7 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.
- .8 Neutral disconnected position delay: allow time for motors to delay between live sources, adjustable, 0 to 5 s.

.4 Solid state electronic in-phase monitor.

2.5 ACCESSORIES

.1 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.

.2 Auxiliary relay to provide 4 N.O. and 4 N.C. contacts for remote alarms.

.3 Instruments:
- .1 Digital true RMS, indicating type 2% accuracy, flush panel mounting:
  - .1 Voltmeter: ac, scale 0 to 1000 V.
  - .2 Ammeter: ac, scale 0 to 400 A.
  - .3 Frequency meter: scale 55 to 65 Hz.

.4 Voltmeter selector switch: rotary, maintained contacts, panel mounting type, round notched handle, four position, labelled "OFF-Phase A-Phase B-Phase C".

2.5 ACCESSORIES (Cont'd)

.5 Ammeter selector switch: rotary, maintained contacts, panel mounting type, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF - Phase A - Phase B - Phase C".

.6 Manual bypass and isolator: to both supplies.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Control panel:
- .1 For selector switch and manual switch: size 4 nameplates.
- .2 For meters, indicating lights, minor controls: use size 2 nameplates.

2.7 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Departmental Representative.

.2 Notify Departmental Representative 5 days minimum in advance of date of factory test.

.3 Tests:
- .1 Operate equipment both mechanically and electrically to ensure proper performance.
- .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
- .3 Check voltage sensing and time delay relay settings.
- .4 Check:
  - .1 Automatic starting and transfer of load on failure of normal power.
  - .2 Retransfer of load when normal power supply resumed.
  - .3 Automatic shutdown.
  - .4 In-phase monitor operation.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transfer switches installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Locate, install and connect transfer equipment as indicated.

.2 Check solid state monitors and adjust as required to ensure correct operation.

3.3 FIELD QUALITY CONTROL

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

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 01 00 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 01 00 - General Instructions.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 00 - General Instructions.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.2 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative
- .3 Photometric data to include: spacing criterion.

.3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.

- .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and. maintenance.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 01 00 - General Instructions.

.4 Divert unused metal materials from landfill to metal recycling facility.

.5 Disposal and recycling of fluorescent lamps as per local regulations.

.6 Disposal of old PCB filled ballasts.

PART 2 - PRODUCTS

2.1 LAMPS .1 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid-start, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as indicated.

2.2 BALLASTS .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic.
- .1 Rating: 120/347 V, 60 Hz, for use with 2-32W, rapid start lamps.
- .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
- .3 Power factor: minimum 95% with 95% of rated lamp lumens.
- .4 Current crest factor: 1.7 maximum.
- .5 Harmonics: 10% maximum THD.
- .6 Operating frequency of electronic ballast: 20 kHz minimum.
- .7 Total circuit power: 72 Watts.
- .8 Ballast factor: greater than 0.90.
- .9 Sound rated: Class A.
- .10 Mounting: integral with luminaire.

2.3 FINISHES .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 OPTICAL CONTROL DEVICES .1 As indicated in luminaire schedule.

2.5 LUMINAIRES .1 As indicated in luminaire schedule.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Locate and install luminaires as indicated.

.2 Provide adequate support to suit ceiling system.

3.2 WIRING .1 Connect luminaires to lighting circuits:
- .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE ALIGNMENT .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.4 CLEANING .1 Clean in accordance with Section 01 01 00 - General Instructions.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 00 - General Instructions.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 26 05 21 - Wires and Cables (0-1000 V).

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

.4 Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.

.5 Section 26 36 23 - Automatic Transfer Switches.

.6 Section 26 50 00 - Lighting.

.7 Section 27 05 28 - Pathways for Communications Systems.

.8 Section 28 31 00.01 - Multiplex Fire Alarm System.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Disconnect switches to Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.

.2 Wire to Section 26 05 21 - Wires and Cables (0-1000 V).

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

.4 Lighting to Section 26 50 00 - Lighting.

2.2 ELEVATORS

.1 Provide a fused disconnect switch for power to each elevator isolation transformer; sized as indicated. Provide wire, conduit and connection to line side terminals of each respective elevator isolation transformer. Provide ground conductor in conduit.

.2 Provide a fused F15A disconnect switch for control and lighting to each elevator controller; sized as indicated. Provide wire, conduit and connection to line side terminals of each respective elevator controller. Provide ground conductor.

.3 Provide lighting and GFI receptacles in elevator machine room, shaft and pit as indicated.

.4 Provide fire alarm detection in elevator machine room, shaft and pit as indicated.

.5 Provide conduit from elevator machine shaft to main control centre on ground floor and at security desk.

.6 Provide heating and ventilation equipment connections, disconnects as indicated.

.7 Emergency lighting in elevator cars to be provided by elevator supplier.

.9 Provide connection from lead elevation controller in each room to emergency power automatic transfer switches for pre-transfer signal.

2.2 ELEVATORS (Cont'd)

.10 Provide connection from lead elevation controller in each room to fire alarm control panel for automatic recall and alternate floor feature.

.11 Refer to electric elevators specification Sections 14 20 03 & 14 20 06 for specific requirements and coordinate all work associated with elevators, with the elevator contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install equipment as indicated for elevator services.

.2 Coordinate exact location of equipment with Division 14.

.3 Leave sufficient lengths of wire to make connection to controllers.

.4 Do not install any wiring or equipment in elevator hoistway, except as indicated.

.6 Provide ground connections to elevator main supply disconnect & isolation transformers.

.7 Provide light switch & GFI receptacle in elevator pits.

.8 Provide min. 2-15A duplex GFI receptacles in machine room.

.9 Provide telephone connection conduit and wiring to lead elevator controllers.

.10 Provide smoke detectors and addressable F.A. relay in machine rooms c/w connections to controllers for auto recall function.

END