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Part 1 General

1.1 GENERAL

- .1 This Section covers items common to Sections of Division 16. 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.

1.2 SCOPE

- .1 The City shall free issue an existing UPS, batteries, battery cabinet and maintenance bypass panel to the Contractor. The Contractor shall take ownership of this equipment as though it has been procured by the Contractor. The Contractor shall be responsible for providing a complete and fully functioning UPS installation, which includes, but shall not necessarily be limited to the Work as described on the Drawings, within this Specification, and the following:
 - .1 Demolition of the existing UPS, battery cabinet, batteries, maintenance bypass transfer switch and cabling.
 - .2 **Legal disposal of the UPS and associated components.**
 - .3 Relocation of the new UPS from its storage location to the final installation as indicated on the Drawings.
 - .4 Procurement, positioning and assembly of new valve regulated sealed lead acid batteries, 12volt, 280 watt (30 minutes autonomy). Eaton Powerware Series PWHR12280 or approved equal.
 - .5 Connection of AC and DC wiring (including modification to existing wiring and supply of new wire in conduit).
 - .6 Interconnection of DC wiring between batteries.
 - .7 Through employment of Eaton Powerware, startup, testing, servicing and commissioning of the new UPS (including the supply of a rental load bank and temporary cables to test the UPS to 100% load).
 - .8 As part of servicing, and deficiencies identified shall be brought to the attention of the City who shall Contract directly with Powerware to resolve. The Contractor shall coordinate and provide attendance during the servicing.
 - .9 Production of record Drawings and O&M Manuals. This shall include obtaining O&M Manual information from Eaton Powerware.

1.3 CODES AND STANDARDS

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Abbreviations for electrical terms: to CSA Z85.
- .3 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.

- .4 Notify the Contract Administrator of any discrepancies or conflicts with any regulation seven (7) working days before Bid Opportunity's close. Failing such notification, meet all such requirements without change to the Contract price.
- .5 In no instance shall the standard established by these Specifications and Drawings be reduced by any of the codes, rules or ordinances.

1.4 CARE, OPERATION AND START-UP

- .1 Upon completion of the project, demonstrate the operation of all equipment 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 technician to supervise start-up of installation, check, adjust, balance, calibrate, test and commission components as specified in subsequent sections.
- .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 with all aspects of its care and operation.
- .4 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.

1.5 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235.
- .2 Control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 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.

1.7 MATERIALS AND EQUIPMENT

- .1 Provide Materials and equipment in accordance with Div. 16.

- .2 Equipment and Material to be CSA certified or certified by an equivalent recognized certifying agency to meet Canadian Standards. Electrical equipment consisting of individual certified components must also have a CSA or equivalent 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 General 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.

1.8 RESPONSIBILITY

- .1 Be responsible for any damage caused the City's, 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.

1.9 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" finish to EEMAC Y1-1-1955.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

1.10 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 (or certified by an equivalent recognized certifying agency to meet Canadian Standards) 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.

1.11 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 lighting fixtures, lamps, lens, 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.

1.12 MODIFICATIONS

- .1 Locations of all electrical equipment 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.

1.13 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.

1.14 IDENTIFICATION OF EQUIPMENT

- .1 Identify all electrical equipment with nameplates and labels as indicated on the Drawings.

1.15 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 Code: 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.

1.16 CONDUIT, OUTLET BOXES AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cable.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.
- .3 Colours: 25mm wide prime colour and 20mm wide auxiliary colour.

	<u>Prime</u>	<u>Auxiliary</u>
Up to 250V (normal power)	yellow	
Up to 250V (emergency power)	yellow & red	
Control	blue	
- .4 Other conduit systems as directed on Site; all conduit systems shall be identified.
- .5 Color outlet box covers to color designated and show circuit numbers in black felt marker on inside of covers.

1.17 WIRING TERMINATIONS

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

1.18 MANUFACTURERS AND CSA CERTIFICATION LABELS (OR EQUIVALENT)

- .1 Visible and legible after equipment is installed.

1.19 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250mm.

1.20 SINGLE LINE ELECTRICAL DIAGRAMS

- .1 Provide updated colour coded single line electrical diagrams under plexiglass as follows:
 - .1 Electrical distribution system: Locate in main electrical room or as designated by City's representative.
 - .2 Drawings: 30" x 42" minimum size.
 - .3 Provide one (1) additional full size (30" x 42") color print for City's records.

1.21 CONDUIT AND CABLE INSTALLATION

- .1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .2 Install cables, conduit and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 Arrange for holes through exterior wall and roof to be flashed and made weatherproof.

1.22 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Control equipment including sequenced operation of systems where applicable.
 - .3 Any other electrical systems.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 All circuits shall be tested to ensure that the circuit numbers are correct and that the proper neutral conductors have been provided and installed.
- .4 Insulation resistance testing:
 - .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.
 - .3 Check resistance to ground before energizing.
- .5 Advise Contract Administrator of dates and times for all testing with sufficient advance notice to allow Contract Administrator to make arrangements to attend.
- .6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

- .7 Submit test results for Contract Administrator's review.
- .8 Insert test results and supplier's certifications in Maintenance Manuals.

1.23 DRAWINGS

- .1 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.
- .2 Install all equipment as shown or as specified and in accordance with manufacturer's approved Shop Drawings.
- .3 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.
- .4 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
- .5 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, an 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.
- .6 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.

1.24 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

1.25 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into operation and maintenance manuals specified.
- .2 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.
 - .6 Obtain UPS O&M Manual Information from Eaton Powerware and include in project O&M Manual.
- .3 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.
- .4 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 inspection at all times. At completion of Work, submit to the Contract Administrator, ACAD files of the 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.

1.26 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.

1.27 CUTTING, PATCHING AND CORE DRILLING

- .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 Div. 16 - Electrical in Bid Opportunity price. Division 16 - Electrical to employ and pay appropriate sub-trade whose Work is involved, for carrying out Work described above.
- .2 Perform all cutting, patching and re-painting required for installing electrical systems.
- .3 Division 16 shall retain services of General Subcontractor to carry out actual Work involved in cutting wall openings, floor openings and the like, and in patching up after installation has been completed.
- .4 Division 16 shall mark all openings required for conduits, cables, ducts, and the like.
- .5 Cutting to be 'neat' sizes. Patch all edges such as cover plates, etc. Hide cut edges.
- .6 Div. 16 - Electrical 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. 16 in the Bid Opportunity price.
- .7 If, in the opinion of Contract Administrator, cutting of holes has been improperly performed (i.e. too large for conduits or cables) Division 16 - Electrical to do all patching as per original Specifications and all costs will be borne by him.
- .8 Division 16 shall retain the services of a sub-trade to carry out all core drilling as required to complete the installation. Scan all slabs prior to core drilling to avoid in-slab services and reinforcement bars. Ensure dust control measures are taken to eliminate contamination of equipment.

1.28 FIREPROOFING

- .1 Where cables or conduits pass through floors, block or concrete walls and fire rated walls, seal openings as per specifications, to maintain fire rating.

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

1.29 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with an appropriate voltage in English.

1.30 SCHEDULING OF WORK

- .1 All Work shall be coordinated with the City. All shutdowns shall be scheduled after hours and on weekends, as directed by City.
- .2 Existing buildings 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. Where deemed necessary by Contract Administrator and City, temporary electrical shall be installed and/or Work shall be carried out at night and on weekends.
- .3 Contractor to maintain continuous and adequate all existing electrical systems and other services during entire time of this Contract. Provide temporary conduit, wire, equipment, etc. where necessary to meet this requirement.

1.31 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.

1.32 DEMOLITION OF EXISTING ELECTRICAL

- .1 Remove all unnecessary existing electrical equipment and wiring. 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. 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.
- .2 Refer to Specification Section 16195 - Work in Existing Building.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 16010 Electrical General Requirements

1.2 LOCATION OF CONDUIT

- .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 existing building elements and to determine the most efficient route to run conduit.

Part 2 Products

2.1 CONDUITS

- .1 Rigid galvanized steel threaded conduit.
- .2 Epoxy coated conduit: with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): with couplings. Minimum size shall be 19mm.
- .4 Flexible metal conduit and liquid-tight flexible metal conduit.

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 U channel type supports for two or more conduits at 1500 mm oc. (Surface mounted or suspended).
- .4 Six mm dia. galv. threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings for raceways: to CSA C22.2 No. 18.
- .2 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .3 Factory "ells" where 90 deg. bends are required for 25 mm and larger conduits.
- .4 Steel set screw connectors and couplings. Insulated throat liners on connectors.

- .5 Raintight connectors and fittings c/w O-rings for use on weatherproof or sprinklerproof enclosures. 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 100 or 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 c/w 3m spare length at each conduit end.

2.6 DUCT WATER SEALING

- .1 Floor and Wall Sleeve Seals: Where conduits penetrate through concrete floor or through wall below grade, provide LINK-SEAL sleeve seals.
- .2 Where conduits penetrate existing concrete floor or wall, anchor/water stop plate not required. Install LINK-SEAL sleeve seals only.
- .3 After installation of conduit and Link-Seal, Contractor shall apply waterproofing Material grout on outside of floor or wall around seal.
- .4 Complete installation to be per manufacturer's recommendations.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use rigid galvanized steel threaded conduit where specified.
- .4 Use epoxy coated conduit in corrosive areas.
- .5 Use electrical metallic tubing (EMT) except where specified otherwise.
- .6 Conduit stubs from floor slabs where exposed to damage to be rigid galv. steel.
- .7 The conduit sizes as shown or indicated are the minimum acceptable and shall not be reduced without the approval of the Contract Administrator.

- .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 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.
- .14 Conduit to be sized as per Canadian Electrical Code or as shown on Drawings. 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.
- .15 Running threads will not be permitted; proper couplings shall be used.
- .16 No circuits fed from emergency or essential power sources shall be run in the same conduit as other systems.
- .17 Provide separate conduit system for emergency distribution.
- .18 All conduit runs passing across expansion joints of the building shall be installed utilizing approved expansion fittings, and bonding devices.
- .19 Refer to 16010 for identification requirements.

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 on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 150 mm parallel to steam or hot water lines with minimum of 75 mm at crossovers.
- .7 No power driven pins (Ramset) shall be utilized to secure any portion of the conduit.

3.3 CONCEALED CONDUITS

- .1 Do not install horizontal runs in masonry walls.

- .2 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 16010 Electrical General Requirements
- .2 Section 16111 Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 16191 Fastenings and Support

Part 2 Products

2.1 MATERIALS

- .1 Conductors in Conduit/Cable Tray:
 - .1 Type: RW90
 - .2 Conductors:
 - .1 Solid Copper #10 AWG and smaller.
 - .2 Stranded Copper #8 AWG and larger.
 - .3 Sized as indicated (Minimum # 12 AWG).
 - .3 Insulation: cross link polyethylene (RW90), (RWU90), 90 deg. C.
 - .4 Configuration: Single conductor.
 - .5 Voltage Rating: Minimum 600V.
 - .6 Certification: CSA C22.22 No. 38 or latest revision.
 - .7 FT4 Rated when installed on Cable Tray, per CEC 12-2202.

Part 3 Execution

3.1 INSTALLATION IN RACEWAYS

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 16111.
 - .2 Ensure conduits are dry and free of debris before pulling cables.
 - .3 Colour coding and identification as per this section.
 - .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 Branch circuits exceeding 21 metres shall be #10 AWG, branch circuits exceeding 35 metres shall be #8 AWG.

3.2 INSTALLATION OF SINGLE CONDUCTOR CABLES

- .1 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.

- .2 Do not install PVC jacketed cables in circulating air plenums.
- .3 Single conductor cables installed underground shall be installed in the installation configuration outlined in Appendix B of the Canadian Electrical Code to provide the allowable ampacity required for the feeder.

3.3 INSTALLATION IN EQUIPMENT

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

3.4 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.

3.5 IDENTIFICATION

- .1 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, color 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 Color 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 Refer to 16010 for additional requirements.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 16010 Electrical General Requirements
- .2 Section 16111 Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 16191 Fastenings & Supports

1.2 LOCATION

- .1 Locate splitters, junction and pull boxes as indicated or as needed for each system.

Part 2 Products

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Sprinklerproof
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Minimum three spare terminals on each set of lugs in splitters.
- .4 Weatherproof where installed outdoors.
- .5 Enclosures in other areas to suit environment.

2.2 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 gasketed covers where exposed to weather.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .3 Install junction and pull boxes clear of all mechanical ductwork and piping.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.
- .2 Identify splitters with size 7 nameplates.
- .3 Identify junction and pull boxes with size 3 nameplates.
- .4 Identify cabinets with size 5 nameplates.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 16010 Electrical General Requirements
- .2 Section 16111 Conduits, Conduit Fastenings and Conduit Fittings

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 In moist or dusty areas, gasketed watertight or dust tight boxes and covers shall be provided.

2.2 CONDUIT BOXES

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

2.3 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 Boxes to be mounted plumb and square with building lines.
- .5 Install pull boxes, or fittings, in conduit runs where more than four bends are necessary.
- .6 Install pull boxes where run exceeds 23.0 (75 feet) in length.

- .7 All junction, outlets and pull boxes shall be so installed that they are always readily accessible.
- .8 No power driven pins (Ramset) shall be utilized to secure boxes without specific approval from Contract Administrator.
- .9 All concealed junction boxes, conduit fittings, etc. to be c/w galv. steel covers, secured with two bolts.
- .10 Co-ordinate locations with millwork.
- .11 No more than two extension rings shall be used in sequence.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2No.65-1956(R1965) Wire Connectors.
- .2 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors: 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, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install pressure type wire connectors and tighten.
 - .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 C22.2 No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 16010 Electrical General Requirements
- .2 Section 16111 Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 16122 Wires and Cables

Part 2 Product

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings or as required.
 - .1 Manufacturers: B-Line, Burndy, Electrovert, Unistrut, Pilgrim, Pursley.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole malleable iron 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.
- .5 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.
- .6 For surface mounting of two or more conduits use channels at 1500 mm oc spacing.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 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.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .12 Threaded rod to be minimum 6 mm diam. galv. or nickel plated. Black steel rod is not acceptable.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 16010 Electrical General Requirements
- .2 Section 16111 Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 16131 Splitters, Junction and Pull Boxes
- .4 Section 16132 Outlet Boxes, Conduit Boxes and Fittings
- .5 Section 16191 Fastenings and Supports

1.2 COORDINATION

- .1 The building shall remain open and in normal operation during the construction period.
- .2 Where existing services such as electrical power, 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. Submit for approval a written, concise schedule of each disruption at least 120 hours (or as directed by the City) in advance of performing Work and 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.

1.3 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 wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturers 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 Patch, repair and paint walls and ceilings in existing areas that have been damaged or cut open due to the new electrical installation.
- .3 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 WORK SPECIFIED ELSEWHERE

- .1 Section 16010 Electrical General Requirements
- .2 Section 16122 Wires and Cables

1.2 REFERENCES

- .1 Ground equipment to: CSA C22.2 No. 41.
- .2 Copper grounding conductors to: CSA G7.1.

Part 2 Products

2.1 EQUIPMENT

- .1 Grounding conductors system, circuit and equipment, grounding to be bare (or green insulated if indicated/required) stranded copper sized in accordance with the Canadian Electrical Code.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, tinned, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, type RW-90, FT-4 when installed in cable tray.
- .4 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.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, conductors, connectors, accessories, as indicated, to conform to requirements of local authority having jurisdiction over installation.
- .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. Soldered joints not permitted.
- .5 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .6 Make grounding connections in radial configuration only, with connections terminating at single grounding point street side of water pipe. Avoid loop connections.
- .7 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .8 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. All locknuts and couplings shall be securely tightened. All flexible conduit shall include an insulated ground wire and shall be properly grounded through an approved fitting. A separate ground conductor shall be installed in all fibre, PVC or plastic duct runs and shall be connected to maintain the grounding of the system.
- .9 A minimum #3/0 AWG bare ground wire shall be installed in all cable trays.

3.2 SYSTEM AND CIRCUIT GROUNDING

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

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, control panels, and distributions.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 16010.
- .2 Perform ground grid resistance tests using method appropriate to Site conditions and to approval of the local inspection authority. A report shall be submitted to the Contract Administrator from the testing agency.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator, if provided, during tests.

END OF SECTION