

1 GENERAL

1.01 RELATED SECTIONS

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 01 91 13 - Commissioning General Requirements
- .4 Section 07 84 00 - Fire Stopping
- .5 Section 08 31 00 - Mechanical Access Doors
- .6 Section 26 05 01 - Electrical Identification

1.02 GENERAL

- .1 This Section covers items common to all Sections of Division 26 and 27.
- .2 The General Conditions of the contract as well as provisions of Division 01 are part of and to be read in conjunction with this Section.
- .3 Refer to Section 01 91 13 - Commissioning General Requirements for commissioning requirements.

1.03 FUNCTIONAL PERFORMANCE TESTING (FPT)

- .1 Refer to Division 01 91 13 - Commissioning General Requirements.
- .2 Prior to Functional Performance Testing, submit the following documentation:
 - .1 Record drawings.
 - .2 Operations and maintenance manuals.
 - .3 Documentations listed in Section 01 78 00 - Closeout Submittals.
 - .4 Written confirmation of System Demonstration and Operating and Maintenance Instructions have been performed in accordance with Section 01 78 00 - Closeout Submittals.
- .3 Immediately rectify deficiencies or discrepancies discovered during the FPT process.

- .4 Return copies of deficiency lists to the Departmental Representative with all corrected items signed off.

1.04 CODES AND STANDARDS

- .1 Do complete installation in accordance with CSA C22.1 and local regulations, except where specified otherwise.
- .2 Comply with relevant CSA standards and all current Inspection Department bulletins.

1.05 REFERENCES

- .1 CSA C22.1-2015, Canadian Electrical Code.
- .2 CAN3 C235-83(R2015), Preferred Voltage Levels for AC Systems
- .3 CSA Z462-15, Workplace Electrical Safety.
- .4 CSA 080 Series-15, Wood Preservation.

1.06 CARE, OPERATION AND START-UP

- .1 Instruct the Departmental Representative and operating personnel in the operation, care, and maintenance of all equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .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.

1.07 VOLTAGE RATINGS

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

1.08 INTERFERENCE DRAWINGS

- .1 Refer to Division 01 for the requirement to provide interference drawings. Coordinate and cooperate with the production of these interference drawings and note that the installation of electrical systems must not commence until these interference drawings have been reviewed by the Departmental Representative.

1.09 PERMITS, FEES, AND INSPECTION

- .1 Submit to the Electrical Inspection Department, Municipal Authority, and supply authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Submit this information within twenty (20) working days of the award of Tender and provide the Departmental Representative with written notice at the time this has been submitted.
- .2 Provide the Departmental Representative with a copy of the electrical inspection department and supply authority plans review report immediately upon receipt. No shop drawings will be reviewed prior to receipt of the plans review report from the Contractor.
- .3 Obtain all necessary permits including an Electrical Wiring Permit for electrical work and Communications Cabling Permit for communications cabling work from the authority having jurisdiction, prior to commencement of work. Provide a copy of each permit to the Departmental Representative upon receipt. Properly display the permits on the work site.
- .4 Arrange for all required inspections to be conducted by the authority having jurisdiction. Provide a copy of all inspection reports to the Departmental Representative immediately upon receipt. Notify the Departmental Representative immediately of changes required by the authority having jurisdiction.
- .5 Furnish Certificates of Acceptance from authorities having jurisdiction upon completion of work. Include a copy in the Operation and Maintenance Manual.
- .6 Pay all associated fees.

1.10 MATERIALS AND EQUIPMENT

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

- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the authority having jurisdiction. Pay all fees associated with special approval and/or field certification.
- .3 Factory assemble control panels and component assemblies.
- .4 All equipment and materials which serve a similar function must be from a single manufacturer and a single product line.

1.11 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .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.

1.12 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment in accordance with Section 26 05 01.

1.13 WARNING SIGNS

- .1 Provide warning signs, as specified and/or to meet requirements of the Inspection Department.
- .2 Confirm electrical equipment is field marked to warn persons of the potential electric shock and arc flash hazards, as per CSA C22.1, Rule 2-306. Provide hazard labels in accordance with CSA Z462.

1.14 SINGLE LINE ELECTRICAL RISER DIAGRAMS

- .1 Provide a riser diagrams, framed under Plexiglas as follows:
 - .1 Fire Alarm system riser.
 - .2 Communication system riser.
 - .3 Power distribution riser.
 - .4 Intrusion system riser.

- .2 610 mm x 610 mm minimum size.
- .3 Locate power distribution riser in electrical room. Locate other systems' riser drawings in communications room.

1.15 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.
- .2 Verify mounting height of equipment before proceeding with rough in.
- .3 Coordinate with architectural elevations prior to mounting exterior electrical devices.
- .4 Install electrical equipment at the following heights unless indicated otherwise. Refer to device mounting height details on drawings.
 - .1 Local switches: 1200mm A.F.F. unless otherwise indicated
 - .2 Wall receptacles:
 - .1 General: 460 mm A.F.F. unless otherwise indicated
 - .2 Above top of counters or backsplash: 152 mm.
 - .3 In mechanical/boiler rooms: 1370 mm A.F.F.
 - .3 Panelboards: 1980 mm A.F.F. to top of panel.
 - .4 Communications system outlets:
 - .1 General: 460mm A.F.F. unless otherwise indicated
 - .2 Above top of counters or backsplash: 152 mm.
 - .3 In mechanical/boiler rooms: 1370 mm A.F.F.
 - .5 Exit signs: 2286 mm A.F.F. or 152 mm above door frame.
 - .6 Emergency lights and remote heads: 2286 mm A.F.F.
 - .7 Fire alarm manual stations: 1200mm A.F.F.
 - .8 Fire alarm signaling devices: 305 mm below finished ceiling.

1.16 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of an electrician.

1.17 CONDUIT AND CABLE INSTALLATION

- .1 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .2 Conceal all wiring and conduit unless noted otherwise. Where this is not possible due to existing construction, use metal surface mounted raceways. Refer to the contract documents for more detail.
- .3 Where conduits cross building expansion joints, provide conduit expansion joints with telescoping sleeve and insulated bushings.

1.18 FIRESTOPPING

- .1 Where conduits, cables, and cable troughs pass through fire-rated assemblies, provide firestopping in accordance with Section 07 84 00 - Fire Stopping.
- .2 Refer to architectural drawings for location of fire-rated assemblies.

1.19 FIELD QUALITY CONTROL

- .1 Have all electrical work carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program will be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted will be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 Conduct and pay for tests of the following:
 - .1 Fire alarm system.
 - .2 Communication system.
 - .3 Intrusion alarm system.
- .3 Furnish manufacturers' certificates or letters confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results for Departmental Representative's review.

- .6 Have installation, termination, and testing of the Access Control system carried out by a Certified Alarm and Security Technician licenced in the province of Prince Edward Island.

1.20 SHORT-CIRCUIT AND COORDINATION STUDY

- .1 At a minimum, provide the following:
 - .1 Manufacturer's trip curves for all breakers and fuses.
 - .2 Available trip settings for all breakers with adjustable settings.
 - .3 Conductor and conduit sizes for all feeders, including branch panel and relay panel feeders.
 - .4 Length of all feeders, including branch panel and relay panel feeders, to the nearest metre.
 - .5 Transformer impedances.
- .2 Provide Arc-Flash warning labels for all electrical equipment in accordance with CSA Z462. Obtain arc-flash ratings for each piece of equipment from the Departmental Representative prior to ordering labels.

1.21 DRAWINGS

- .1 Electrical drawings are not intended to show structural details or architectural features.
- .2 The electrical drawings are not to be scaled.
- .3 Electrical drawings, except where dimensioned, indicate general layouts only. Investigate structural and finish conditions and the work of all other trades affecting this work and arrange work accordingly.
- .4 Coordinate the elevation of all outlet boxes with architectural drawings and report any conflicts to the Departmental Representative prior to installation.
- .5 All electrical junction boxes must be accessible at the completion of the project. Coordinate the location of each junction box with the proposed location of mechanical services prior to installation.
- .6 Layouts on the electrical drawings are based on the specified equipment including electrical power connections, number of conductors and conduit sizes, and physical dimensions. Alternate equipment and systems proposed for use on this project which necessitate changes in service connections, numbers of conductors and conduit sizes to perform the specified functions may be considered by the Departmental Representative, however, any

required modifications or additions to the electrical contract or the work of other trade contractors must be done at no additional cost to the Contract. Furthermore, if it is found that the provisions made regarding space conditions and code required clearances are not met, the right is reserved by the Departmental Representative to require installation of the equipment specified.

1.22 ACCESS DOORS

- .1 Where junction boxes, pull boxes, and miscellaneous electrical equipment are concealed, provide access doors for operating, inspecting, adjusting, and servicing. Provide access doors which meet or exceed the fire resistance rating of the partition or ceiling in which they are being installed.
- .2 Provide access doors in accordance with Section 08 31 00 - Mechanical Access Doors.

1.23 CONNECTION OF EQUIPMENT

- .1 Provide all connections required by the equipment supplied by this Division.
- .2 Provide all connections required by equipment supplied by the Owner or by other Divisions. Examine all drawings and specifications and identify all requirements.
- .3 Provide all necessary accessories to make connections, including flexible connectors, etc.

1.24 SPRINKLER-PROOF HOODS

- .1 Protect all distribution equipment within ventilated enclosures located in the building from the direct spray from sprinkler heads to the satisfaction of the Inspection Authority by the use of non-combustible hoods.
- .2 Install distribution conduits exiting or entering equipment enclosures equipped with sprinkler hoods with rain-tight EMT connectors equipped with rubber O-rings.

1.25 INSTALLATION REQUIREMENTS

- .1 Install all products and services to follow building planes. Installation must permit free use of space and maximum headroom to the satisfaction of the Departmental Representative.

- .2 Confirm the exact location of fixtures, outlets and connections.
- .3 Install all equipment and appurtenances to allow free access for adjustment, maintenance and/or replacement.
- .4 Provide all hangers, supports and fasteners such that no undue stresses are imposed on the structure and systems. Confirm the load onto structures does not exceed the maximum loading. Equipment supports not supplied by equipment manufacturer are to be fabricated using structural grade steel.
- .5 Exterior supports to be galvanized, unless noted otherwise.
- .6 Install all products and services in accordance with the respective manufacturer's recommendations.
- .7 Do not use high-velocity explosive-activated tools. Low-velocity system types are permitted.
- .8 Provide caps and seal all open ends of installed conduits to prevent the entrance of foreign substances.
- .9 Install all services capped for future possible use such that easy access is provided for future connections.

1.26 FIELD REVIEW

- .1 The Departmental Representative must have access to the site at all times for review of the work.
- .2 Correct any deficiencies as they are reported during the performance of the Work.

1.27 TORQUES FOR WIRE TERMINATION

- .1 For proper termination of conductors, field connections must be made properly tight.
- .2 Where possible, obtain and comply with Manufacturer's instructions for proper termination torque values for the equipment.
- .3 In the absence of Manufacturer's instructions, make terminations in conformance with the values given in Tables D6 and D7 of the Canadian Electrical Code.

1.28 CABLE TIES AND TYE WRAPS

- .1 Cable ties and tie wraps are only permitted to be used to provide limited support for bundling purposes only. These devices are not intended to provide the primary support for conduits or cables as required by the Canadian Electrical Code.

1.29 WORKING SPACE ABOUT ELECTRICAL EQUIPMENT

- .1 Arrange installation as required to maintain minimum working space around electrical equipment in conformance with the CEC.

1.30 LOW V.O.C. MATERIALS

- .1 All site applied coatings, adhesives & sealants must be low volatile organic compound (VOC) content.
- .2 Provide Material Safety Data Sheets for all products and materials of these types incorporated into the work.

1.31 PLYWOOD BACKBOARDS

- .1 Provide all plywood backboards for mounting of all wall-mounted electrical and communications equipment located inside electrical rooms, communications rooms, and other services rooms, including but not limited to panelboards, control panels, contactors, etc.
- .2 Plywood used for backboards must be marked indicating that it is Fire Retardant Treated Wood (FRTW) in accordance with the CAN/CSA-O80 standard, and meets Underwriters Laboratories FR-S rating, or equivalent. Materials must be free of formaldehyde and VOCs.

END OF SECTION

1 GENERAL

1.01 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 21 - Construction Waste Management Disposal
- .4 Section 09 91 00 - Painting

1.02 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include paint colour chips, other products specified in this section.

1.03 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

2 PRODUCTS

2.01 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as specified herein.
- .2 Identification:
 - .1 Provide all switchboards, panels, disconnect switches, receptacles, voice/data/CATV/Multimedia outlets, MCC's, transformers, control panels, fire alarm devices, magnetic starters, TOL's, etc. with lamicoid nameplates as further described herein. Take care to affix plates true, level, and plumb in all instances.
 - .2 Affix nameplates to all metal surfaces with steel type pop-rivets.
 - .3 Affix nameplates to other types of surfaces with contact-type cement.

- .4 Affix nameplates to building exterior surfaces with nylon inserts and self-tapping screws unless specifically indicated otherwise.
- .5 Apply contact type cement to complete rear side of plate, as opposed to several locations or areas on same.
- .6 Lamicoid nameplates installed on distribution panelboards, motor control centres, splitter troughs and transformers to indicate the following:
 - .1 Designated name of equipment.
 - .2 Amperage of overcurrent protection device.
 - .3 Voltages, number of phases and wires.
 - .4 Designation of power source.

Example

PANEL H - 150 AMPS
120/208V - 3PH - 4W
FED FROM MAIN SWITCHBOARD #QMS-1

- .7 Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, etc., to contain the following information:
 - .1 Designated name of equipment.
 - .2 Designated name of power source.
 - .3 Branch circuit breaker number(s) where possible.
 - .4 Voltage(s).

EXHAUST FAN NO. 5	SUPPLY FAN NO. 3
PANEL H - CCT. NO. 17	M.C.C. NO. 1
120V - 1 PH	600V - 3 PH

- .8 Lamicoid nameplates installed on fusible-type disconnect switches to also indicate maximum designated/designed fuse size.
- .9 Install lamicoid nameplates on all junction and/or pull boxes sized 150 mm x 150 mm and larger indicating name of system, designated panel name and electrical characteristics where applicable.
- .10 Install lamicoid nameplates adjacent to each overcurrent devices located in switchboards, MCCs, CDP panels, etc. They need only indicate designated name and/or number of equipment they feed. Identify unused O.C. devices as spare(s).
- .11 Lamicoid nameplates installed on main service entrance switches, or main entrance switchboards to indicate the following information on minimum size 150 mm x 50 mm plate complete with two (2) lines of 13 mm high lettering (Size #8 nameplate)

Example:

Example:

MAIN BREAKER 800 AMPS
346/600V, 3PH, 4W

MAIN SWITCH 200 AMPS
120/208V, 3PH, 4W

- .12 Install an additional lamicoid nameplate on all, or any piece of electrical equipment, or apparatus (i.e., Main Switchboard, CDP panels, panelboards, Motor Control Centres. etc.), that may contain overcurrent devices (i.e., circuit breakers and/or fuses), that have been designed for, and incorporate interrupting capacity sized larger than 10 KAIC.

Example:

Min, interrupting capacity of breakers installed in this panel to be not less than 22 KAIC

Example:

Min. interrupting capacity of fuses installed in this MCC to be not less than 100 KAIC

- .13 Install lamicoid nameplates above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source complete with associated circuit breaker number(s) as per the following:

- .1 1.5mm x 13mm high complete with 6 mm black letters on white core, directly above all receptacles. Plate to be identical width as finish device plate.

Example: PANEL H - 20

- .14 Identify receptacles intended for computer, electronic or other sensitive types of electronic equipment etc., as per following:

- .1 1.5mm thick x 19mm wide complete with 6 mm black letters on white core above all receptacles. Identical width as finish device plate.

Example: For computer use only
PANEL H - 24

- .15 Identify lamicoid nameplates above 120V receptacles protected by GFCI circuit breakers, or GFCI type receptacles as per the following:

- .1 1.5mm thick x 19mm wide complete with 6 mm black letters on white core above all receptacles. Identical width as finish device plate (EXAMPLE: GFCI Protected Panel H-26).

- .16 Apply lamicoid nameplate(s) for power/voice/data/multimedia outlets above face of finish plate, complete with information as specified in Section 27 05 28.
 - .1 1.5mm thick x 19mm wide complete with 6mm black letters on white cove above all receptacles. Identical width as finish device plate.
- .17 All addressable fire alarm devices are to be lamicoid identified.
 - .1 Lamicoid identification is to be chain hung on mechanical items (pressure switches, supervisory switches, etc.).
 - .2 Manual pull station lamicoid plate to be similar to typical receptacle lamicoid plate.
 - .3 Lamicoid wording to match physical location and annunciator display address.
- .18 Lamicoid 3mm thick plastic engraving sheet, white face, black core, for all electrical systems except fire alarm and emergency power which shall have red face with white core.
 - .1 1.5mm thick nameplates above receptacles as previously indicated, with top left and right corners to be rounded off.
 - .2 Lettering on lamicoid nameplates must not start, nor end nearer than 13mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates to be as indicated in the following chart:

NAMEPLATE SIZES

Size 1 10mm x 50mm	1 line 5mm high letters
Size 2 13mm x 70mm	1 line 6mm high letters
Size 3 16mm x 75mm	2 lines 5mm high letters
Size 4 19mm x 90mm	1 line 9mm high letters
Size 5 38mm x 90mm	2 lines 13mm high letters
Size 6 25mm x 100mm	1 line 13mm high letters
Size 7 25mm x 100mm	2 lines 6mm high letters
Size 8 50mm x 150mm	2 lines 13mm high letters
Size 9 75mm x 150mm	3 lines 13mm high letters

- .3 Have wording on nameplates and labels approved by the Departmental Representative prior to manufacture.
- .4 Allow for average of fifty (50) letters per nameplate and label.
- .5 Identification to be English.
- .6 Provide lamicoid nameplates and install on, or adjacent to, all various systems' control panels and/or cabinets complete with information as indicated. Nameplates to reflect individual system's assigned name, and where applicable, also indicate

both designated panel name and associated branch circuit breaker number(s).

- .1 Fire alarm panels
- .2 Security (intrusion) panels
- .3 Energy management panels
- .4 Television panels
- .5 Communication panels
- .6 Lockdown system panels
- .7 Low voltage lighting relay panels (EXAMPLE: LIGHTING RELAY PANEL #1 - LPA - 36).
- .7 Control Transformers:
 - .1 Concealed control transformers located within ceiling spaces are to have lamicoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, complete with associated branch circuit breaker number(s).
 - .2 A second plate with identical information is to be installed on underside of room grid system or access opening frame directly below control transformer, so as to identify its concealed location directly above same.
 - .3 All control transformers installed in either control cabinets or on walls adjacent to same, are to be identified with lamicoid nameplates containing information as previously indicated.
- .8 Junction and pull boxes: indicate system and voltage.
- .9 Co-ordinate names of equipment and systems with other trades to ensure that equipment identification is consistent.
- .10 In addition to required nameplates and colour coding, junction boxes and pull boxes to have the panel and circuit numbers of all wiring contained within listed on the cover plate. Write circuit list neatly using a black indelible marker.
- .11 Colour code electrical junction boxes, pull boxes, and conduit fittings as follows:
 - .1 Apply colour coding prior to installation of boxes/equipment.
 - .2 Where primary colour only is indicated:
 - .1 Colour inside and outside of box.
 - .2 Colour all cover plates.
 - .3 Where primary and secondary colours are indicated:
 - .1 Paint inside and outside of box with the primary colour.
 - .2 Diagonally apply to each half of the cover plate the primary and secondary colours.
- .12 Where a lamicoid identified item is installed above an accessible ceiling, provide two (2) lamicoid plates,

one (1) at the item location and one (1) directly below on the underside of the ceiling.

- .13 Paint boxes and conduits outside of the building in an area that will not cause vapours to enter the building ventilation system.

2.02 WIRING IDENTIFICATION

- .1 Identify wiring with self-laminating, permanently mechanically imprinted labels on both ends of each conductor and cable utilized. Identify conductors and cables in each junction or pull box through which they pass. Install labels in a flagged manner around individual conductors.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Identify all conductors with insulation colors as follows:
 - .1 Phase A - Red
 - .2 Phase B - Black
 - .3 Phase C - Blue
 - .4 Neutral - White
 - .5 Bond - Green
 - .6 Ground - Green
 - .7 Isolated Ground - Green c/w yellow strip
- .4 Color-coded conductor insulation as per the following:
 - .1 All sizes of phase conductors up to and including #2 AWG.
 - .2 All sizes of neutral, bond and/or ground conductors up to and including #3/0 AWG.
 - .3 Approved colored tapes in lieu of insulation coloring may be used to identify conductors that exceed sizes as previously indicated. Labelling is to take place at both ends of all runs at a minimum of 300mm from terminations, in addition to within all boxes between both ends of the run.
- .5 Use colour coded wires in communication cables, matched throughout system.
- .6 Indicate panel and circuit number of all phase conductors i.e.: "Panel 'A' - cct 3". Identify all neutral conductors bonding and ground conductors to indicate the phase conductor with which they are associated.

2.03 CONDUIT AND BOX IDENTIFICATION

- .1 Colour code conduits and metallic sheathed cables as per the schedule below.

- .2 Code with paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.
- .3 Colour code junction and/or pull boxes, conduit fittings (and respective covers), complete with their respective cover plates as per the following: Boxes are to be coloured both inside and outside, where one colour only is required. Boxes are to be coloured on inside only where two colours are required. Metal cover plates are to have both colours applied diagonally where two colours are required. Complete plate is to be painted where one colour only is required. All junction boxes are to be colour identified prior to installation and not within the building.
- .4 All various systems concealed junction and/or pull boxes located within ceiling spaces are to have their locations identified on room side of T-Bar grid spline or access cover frames with appropriate colour coded, circular shaped, self-adhering discs. Discs are to be both 19mm and 6mm in diameter as indicated in the following legend, with 6mm discs always being centered in middle of 19mm discs:

<u>SYSTEM</u>	<u>19mm DISCS</u>	<u>6mm DISCS</u>
0 to 50 Volts	Violet	
51 to 240 Volts	Yellow	
241 to 600 Volts	Orange	
Fire Alarm	Red	
Telephone (voice only)	Black	
Security	Brown	
Ground or Bond	Green	
Computer (data only)	Black	White
Voice & Data	Blue	White
Emergency Lighting (DC)	Yellow	Black
Other	Brown	White

- .5 Where boxes are not concealed, such as in an open ceiling concept, fasten discs directly to the outside of the boxes after architectural painting is complete. Cover plates for boxes containing branch circuits, are to have each branch circuit number neatly identified on the inside of the cover plate. Felt marker-pen may be used for this purpose.
- .6 Provide a legend of colour coding, mounted under plexiglass cover. Install in main electrical room. Minimum size: 610mm x 610mm.
- .7 Where boxes are not concealed, fasten disks directly to outside of boxes after architectural painting is complete. Cover plates for such boxes are to have each branch circuit number neatly identified inside of the cover plate.

2.04 TELECOMMUNICATIONS IDENTIFICATION

.1 Telecommunications Spaces:

- .1 Uniquely identify telecommunications spaces within a building as part of a complete administration system.
- .2 Use the room designation number within the administration system identifier as follows and provide a lamicoid type nameplate (minimum 50mm X 300mmL).

Example: TR-110

Where TR denotes Telecommunications Room

110 denotes architectural room number

- .3 For the Main Telecommunications room, use 'MTR' as the abbreviation for the room type.
- .4 Secure the lamicoid nameplate to the exterior of the door entering that space.
- .5 All telecommunications equipment racks within each telecommunications space require a unique component identifier as part of the administration system by a lamicoid type nameplate, minimum (50mm H) X (600mm L) shown and secured to the upper horizontal rail of the equipment rack.

Example: TR-110-Rack 1

Where Rack 1 denotes rack position in bay

110 denotes architectural room number

TR denotes Telecommunications room

- .6 All telecommunications termination hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers are to be self-adhesive thermal transfer type (minimum 300mm long x 50mm high) and placed appropriately to indicate all ports.

.2 Horizontal Distribution System:

- .1 Uniquely identify horizontal cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.
- .2 Horizontal cable identifiers must denote basic telecommunications system application and the originating telecommunications space termination equipment port:

Example: D-024

where 'D' denotes 'data',

'024' denotes Termination Equipment port number

- .3 For other telecommunications cabling system other than data, use the following abbreviations:

- .1 V=Voice
 - .2 DB=Data Backbone
 - .3 VB=Voice Backbone
 - .4 DMR=Demarcation Backbone
 - .5 TV=Internal Multimedia Broadcast System
 - .6 CA=Video Surveillance
- .3 Work Area:
 - .1 For the purposes of system administration, the work area includes the telecommunications outlet faceplate and all outlet termination hardware.
 - .2 All telecommunications outlet faceplates will be standard four port configuration with port assignments as shown.
 - .3 All Telecommunications Outlet (TO) locations require a unique component identifier as part of the administration system by a lamicoid type etched vinyl nameplate, minimum 120mm H X 70mm L and secured to the wall-space centered and above min. 12mm the telecommunications outlet faceplate.
 - .4 Telecommunications work area outlet identifiers must denote basic telecommunications system application, originating telecommunications space and termination equipment port:

Example: TR-118 D-012
Where: TR denotes telecommunications room
118 denotes architectural room number
D denotes data
012 denotes termination equipment port number
- .4 Backbone System:
 - .1 For the purposes of system administration, backbone system to include all backbone system cabling only.
 - .2 Uniquely identify all backbone system cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.
 - .3 Backbone cable identifiers to denote basic telecommunications system application and originating telecommunications space.
- .5 Telecommunications Demarcation Facilities:
 - .1 For the purposes of system administration, the telecommunications demarcation facilities includes three basic components:
 - .1 Building cross-connect hardware.
 - .2 Building demarcation backbone cable.
 - .3 Building demarcation termination hardware.
 - .2 All Building cross-connect hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers must be self-adhesive thermal transfer type and placed appropriately to indicate applicable pair assignments as shown;

- .3 All administration system requirements for associated termination hardware located within the telecommunications spaces are addressed in clause 2.4.1.
- .4 Uniquely identify all telecommunications demarcation backbone cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.
- .5 All telecommunications demarcation backbone cable identifiers must denote basic telecommunications system application and originating telecommunications space.

3 EXECUTION

3.01 PAINTING OF BOXES

- .1 Do not paint junction boxes, pull boxes, cabinets, etc. inside the building at any time during construction.

3.02 TIMING

- .1 Provide identification only after all painting specified in Section 09 91 00 - Painting has been completed.

3.03 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Protection:
 - .1 Do not paint, insulate or cover in any way.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 CSA C22.2 No. 65-13, Wire Connectors.

2 PRODUCTS

2.01 MATERIALS

- .1 Spring-type pressure wire connectors: with current carrying parts of copper and copper alloy sized to fit copper conductors 10 AWG or less. Provide connectors complete with appropriate size insulating cap.
- .2 Clamps or connectors for armoured cable, liquid tight flexible metal conduit.
- .3 Bushing stud connectors are not acceptable.

3 EXECUTION

3.01 INSTALLATION

- .1 Make connections and terminations electrically and mechanically secure. Sizes of connectors to be as per manufacturer's recommendations for various sizes and combinations of wire sizes.
- .2 Make joints required in branch wiring #10 and smaller utilizing spring-type pressure wire connectors. Plier tighten wire connectors. Cap to completely fit or cover all enclosed conductors as required.
- .3 Make joints for all other wiring utilizing colour keyed compression type connectors complete with compression tools. Apply an initial layer of compound type tape followed by an additional layer of vinyl tape.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 CSA C22.2 No. 0.3-09(R2014), Test Methods for Electrical Wires and Cables.
- .2 CSA C22.2 No. 208-14, Fire Alarm and Signal Cable.

1.02 RELATED WORK

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

1.03 PRODUCT DATA

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

1.04 OPERATION AND MAINTENANCE DATA

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 PRODUCTS

2.01 BUILDING WIRES

- .1 Conductors: soft drawn copper of 98% conductivity; stranded for #12 AWG and larger. Minimum size: #12 AWG.
- .2 Copper conductors sized as indicated or as required by C.E.C., with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90-XLPE.
- .3 Grounding and bonding conductors sized up to and including #10 AWG are to have green coloured RW90 cross linked insulation. Type TW75 green coloured insulation is acceptable for sizes #8 AWG and larger.
- .4 Provide phase colour-coding of conductors as per CEC rule 4-036, unless noted otherwise.
- .5 Color code phase conductor sizes up to and including #2 AWG as follows:
 - Phase A Red

Phase B	Black
Phase C	Blue
Neutral	White or Grey
Bond	Green
Ground	Green
Isolated Ground	Green c/w Yellow Strip

- .6 Insulation Color Coding as per following:
 - .1 Phase conductors up to and including #2 AWG.
 - .2 Neutrals, bonds and ground conductors up to and including #3/0 AWG.
 - .3 Approved colored tapes in lieu of insulation coloring may be used to identify conductors that "exceed" sizes as noted on both ends of runs.

2.02 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated, minimum #12 AWG.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Termination of AC90 cable to utilize steel connections with accompanying lock nuts similar to or equal to T&B 3301 series.
- .5 Provide supports as per Section 26 05 29 - Hangers and Supports for Electrical Systems.

2.03 CONTROL CABLES

- .1 Type LVT: two (2) soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
- .2 Control circuit wiring 50V and less: Cat 6A with yellow jacket.
- .3 Cables to be FT6 rated.

2.04 FIRE ALARM CABLES

- .1 Type FAS 105 to CSA C22.2 No. 208, PVC insulation, size and quantity of conductors as indicated, Red PVC outer jacket.

2.05 SECURITY AND ACCESS CONTROL SYSTEM CABLING

- .1 Minimum FT4 rated.

- .2 Insulated copper conductors, size as indicated or required by manufacturer.
- .3 White coloured PVC outer jacket.

2.06 OVERHEAD SECONDARY CONDUCTORS

- .1 Neutral Supported (NS90) quadraplex conductors sized as indicated or as required by C.E.C., with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90-XLPE.
- .2 100% rated insulated neutral support conductor, complete with white finish.
- .3 Low-temperature rating of -40°C.

3 EXECUTION

3.01 INSTALLATION OF BUILDING WIRES

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

3.02 INSTALLATION OF FIRE ALARM CABLES

- .1 Install fire alarm cables in E.M.T.
- .2 Fire alarm cabling will be permitted to be installed in flexible metal conduit for final connection to various fire alarm devices installed upon flush mounted outlet boxes in finished ceiling tiles and to sprinkler devices. Flexible metal conduit is not exceed 5m in total length. Minimum size: 16mm.

3.03 INSTALLATION OF ARMOURED CABLES

- .1 AC-90 will only be permitted for branch circuit wiring drops from ceiling junction boxes to light fixtures within the same room. The installation of AC-90 cable for branch circuit wiring home runs or runs between rooms is not acceptable.
- .2 A home run is defined as that portion of the branch circuit wiring that runs between the applicable panelboard and the area or room in which it either:
 - .1 Terminates at the applicable branch circuit device, or
 - .2 Makes a splice for final connection to the applicable branch circuit device.

- .3 The grouping together of AC-90 cables to form a bundle for securing purposes is acceptable provided:
 - .1 In addition to securing AC-90 cables at 1.5m intervals to structure, multiple or bundled groups of armoured cables shall be tye-wrapped together at mid-point between each structure support and are to be secured to structure at 1.5m intervals, and also secured together between each structure support at 1.5m intervals.
 - .2 Limit the grouping of AC-90 cables to a maximum of eight (8) current carrying conductors, including associated oversized neutrals, where phase sharing occurs.
- .4 Install concealed, parallel and perpendicular to building lines and shall be adequately secured to the building structure at not less than 1.5m intervals in such a manner as to ensure they are protected from potential types of mechanical damage occurring. Install independent supports for cabling in ceiling spaces, and do not use those of other trades. Do not secure cables to mechanical piping systems, ducts, or suspended ceiling support wires. The laying of un-supported cables directly upon the ceiling grid system is strictly prohibited.
- .5 Always install and secure surface cables directly to the underside of ceiling slabs or metal decking where located in concealed ceiling spaces.
- .6 The following examples incorporate uses of both common and dedicate branch circuit neutral conductors.
 - .1 Maximum of two (2) runs of #12/4 conductor cables including common (oversized) branch circuit neutrals in each.
 - .2 Maximum of two (2) runs of #12/3 conductor cables, including oversized branch circuit neutrals (if net 3 phase 3 wire) plus one (1) run of #12/2 cable.
 - .3 Maximum of four (4) runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.
- .7 Where dedicated or separate branch circuit neutral conductors are non-phase sharing they need not be sized larger than phase conductors they are accompanying unless specifically indicated otherwise.
- .8 AC-90 fixture feeds to originate from the sides of outlet boxes and not from the box cover. Where three (3) and/or four (4) fixture drops extend from any one outlet box, do not use a box smaller than 119 mm square.
- .9 Fixture drop is defined as that portion of AC-90 cable or flexible conduit being used to make final connection between

accessible type junction or outlet box located in ceiling space and its respective light fixture.

- .1 Fixture drops are not to exceed 3 m in total length unless specifically indicated otherwise.
- .2 There must not be more than four (4) drops permitted to be fed from any one box regardless of its size. Secure AC-90 cables used for fixture drops within 300 mm of the junction box. Provide each light fixture complete with its own separate fixture drop originating from junction box located in the same room as the fixture. An exception will be made for recessed down lights which may be wired from one fixture to another if they have integral junction boxes and the luminaire access opening is 150 mm or greater in diameter.
- .3 Wire each light fixture with a separate whip emanating from an overhead junction box.
- .4 Minimum" size 119mm square box will be used when extending three (3) or four (4) drops.
- .5 Both #12 AWG and #14 AWG type AC-90 armoured cables may be used where the total fixture drop loads do not exceed the following:
 - .1 5000W at 347V, #12AWG
 - .2 3500W at 347V, #14AWG
 - .3 1800W at 120V, #12AWG
 - .4 1300W at 120V, #14AWG
- .10 Provide separate pig-tail type leads in each light fixture junction/outlet box for final connection to fixture drops. Only connect these pig-tails to light fixture returns and associated neutral conductors.
- .11 Support and securing of type AC90 cables, low voltage wiring etc., will not be derived from either suspended ceiling support wires and/or by directly laying atop of the ceiling grid system.
- .12 Where application of AC90 cables, other types of pliable cables, open low voltage or communication wiring, etc. are to be used; install neatly and parallel or perpendicular to the building lines unless otherwise noted.

3.04 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in E.M.T. complete with bonding conductor, minimum 21mm conduit and #14 AWG bonding conductor.
- .2 Bond control cable shield where required.

- .3 Building management system controls wiring methods to be installed in accordance with Section 27 05 28 - Pathways for Communications Systems (per voice and data structured cabling).

3.05 INSTALLATION OF CABLES: GENERAL

- .1 Support cables independently of supports used for equipment of other trades; do not support from or secure cables to ductwork, piping and ceiling hanger wires.
- .2 Do not lay cables on top of suspended ceiling grids and tiles.
- .3 Install cables in a neat and professional manner, so as to conserve headroom. Correct any unacceptable work at no additional cost to the Contract.
- .4 Install cables parallel and perpendicular to building lines.
- .5 Secure cables to underside of metal decking.
- .6 The tye-wrapping of the neutral conductor with its respective phase conductors is to be made at the closest point of entry within all panelboards, pull boxes, junction boxes and outlet boxes, etc.
- .7 All branch circuits which do not have neutral conductors are to have their respective phase conductors tye-wrapped together in accordance with Clause 3.5.6 above.
- .8 All stranded conductors are to be twisted together prior to any types of terminations taking place, but not necessarily limited to: receptacles, light switches, neutral terminal strips, bonding terminal strips, circuit breakers, disconnect switches, starters, contactors, relays, all types of termination lugs, panelboards, etc.
- .9 All CDP's panelboards, MCC's (pull boxes, junction boxes, etc.) will have their respective feeder phase and neutral conductors tye-wrapped together and with enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is such that ease of clamping the ground detector can be accomplished without excessive exposure to live bus.
- .10 After all electrical wiring has been completed by the Electrical Subcontractor, test the grounded electrical distribution system to confirm there are no grounds or shorts in the system.

3.06 VOLTAGE DROP

- .1 Run all branch circuits so that the voltage drop in no instance exceeds 3% of the line voltage. The following table is to include both vertical and horizontal lengths of conductor runs. Minimum size of branch circuit neutral where phase sharing occurs must be #10 AWG. Minimum size of branch circuit neutral where dedicated to its own branch circuit phase conductor must be #12 AWG. Note that minimum size #10 AWG bond conductors to accompany #8 branch circuit conductors.
- .2 At a minimum, provide size conductors in accordance with the following table:

<u>Branch Circuit Length of Run</u>	<u>Phase Wire Size</u>	<u>Dedicated Neutral</u>	<u>Shared Neutral</u>	<u>Bond Size</u>
Up to 24.3 m	#12	#12	#10	#12
Up to 38.1 m	#10	#10	#8	#12
Up to 56.3 m	#8	#8	#6	#10

- .3 Oversized #10 AWG branch circuit wiring conductors to be extended to outlet box of device they feed (including switch legs). Oversized #8 AWG branch circuit wiring conductors to be extended from panelboard to junction box located on wall or ceiling directly above wall light switches and/or receptacles. Reduce #8 AWG wire to #10 AWG for vertical portion of drop only.

3.07 INSTALLATION OF SECURITY AND ACCESS CONTROL SYSTEM CABLING

- .1 Install access control and security system wiring in conduit in its entirety unless noted otherwise.
- .2 The portion of wiring installed in door frames to feed electric strikes or electric latch retraction devices need not be installed in conduit provided that the door frames are suitable for such use. Install wiring in conduit once it exits the door frame.

3.08 INSTALLATION OF OVERHEAD SECONDARY CONDUCTORS

- .1 Install as indicated on drawings and in accordance with section 33 71 20 - Electrical Pole Lines and Hardware.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- .1 Materials and installation for overhead connectors and terminations.

1.02 RELATED SECTIONS

- .2 General Commissioning (Cx) Requirements: Section 01 91 13
- .3 Electrical Pole Lines and Hardware: Section 33 71 20

1.03 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.41-2013, Grounding and Bonding Equipment.
 - .2 CSA C22.2 No.65-2013, Wire Connectors.
- .2 IEEE 48-2009, IEEE Procedures and Requirements for Alternating Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5kV Through 765kV or Extended Insulation Rated 2.5kV Through 500kV.

1.04 PRODUCT DATA

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

1.05 CERTIFICATES

- .1 Obtain inspection certificate of compliance covering high voltage stress coning from manufacturer's approved agent and include it with as-built drawings.

PART 2 PRODUCTS

2.01 CONNECTORS AND TERMINATIONS

- .1 Aluminum power lug type compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Tin-plated copper terminal plug compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .3 Aluminum dead-end clamp type compression connectors to CSA C22.2 No.65 as required sized for conductors.

- .4 Tin plated copper long barrel 2-hole compression grounding connectors to CSA C22.2 No.41 as required sized for conductors.
- .5 Heat-applied medium voltage termination kit for single conductor cable. Rated for outdoor installation. Suitable for shielded and non-shielded cable applications, complete with weather sheds. To IEEE 48, Class 1 termination requirements as required sized for conductors.
- .6 Contact aid for aluminum cables where applicable.

PART 3 EXECUTION

3.01 INSTALLATION

- .1 Install termination kits and connectors in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.
- .3 Install all cables in a continuous run, splices shall not be acceptable.
- .4 Clean and score aluminum conductors prior to terminating.

END OF SECTION

PART 1 GENERAL

1.01 RELATED SECTIONS

- .1 Wires and Cables 0-1000V: Section 26 05 21
- .2 Electrical Pole Lines and Hardware: Section 33 71 20

1.02 REFERENCES

- .1 IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 41-2013, Grounding and Bonding Equipment

PART 2 PRODUCTS

2.01 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required and suitable for application.
- .2 Rod electrodes: copper clad steel 19mm diameter by 3m long.
- .3 Direct buried grounding conductors: bare stranded copper of 98% conductivity, soft annealed, size as indicated.
- .4 Insulated grounding and bonding conductors: soft drawn stranded copper of 98% conductivity, type RW90 (green coloured insulation as indicated in 26 05 00, item 10 - Wiring Identification).
- .5 Ground bus: copper, minimum size 6mm x 75mm x 600mm size and as indicated, complete with insulated supports, fastenings, connectors.
- .6 Ground connections to take place on the ground bus are to be as follows:
 - .1 For wire sizes 6 AWG and smaller: copper, one-hole, short barrel (single crimp) lugs.
 - .2 Wire larger than 6 AWG to be two-hole, long barrel (dual crimp) lugs.
- .7 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.
- .8 Copper compression type, long barrel, two hole type lugs unless specified otherwise.
- .9 Copper compression type connectors (cable to cable, cable to ground rod, etc.).

PART 3 EXECUTION

3.01 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Conform to the requirements of the Departmental Representative, applicable codes and the local electrical inspection authority having jurisdiction.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding and bonding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes using copper welding by thermit process or inspectable copper crimp type compression connectors.
- .5 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs except grounding terminations in 600V switchboards, 600V CDP panels, 600V MCC's to be copper, compression type, long barrel, two hole connectors.
- .6 Soldered joints not permitted.
- .7 Install insulated bonding conductor in all conduits.
- .8 Install separate insulated bonding conductor to outdoor lighting standards.
- .9 Connect building structural steel to ground as indicated on the drawings.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point on street side of water pipe. Avoid loop connections.

- .11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .12 Ground secondary service pedestals.
- .13 Secure the 'feed' bonding conductor (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or provide a "pig-tail" lead for device terminations.
- .14 Twist ground/bond wires together with a screw-on type wire connector, and place in the rear of the outlet box.
- .15 Bond EMT "wall stubs" or sleeves to ground as per CEC requirements.
- .16 All conduits containing insulated ground conductor(s) shall be bonded at both ends.
- .17 Bend radius of all grounding/bonding conductors must be a minimum of 200mm in diameter.

3.02 ELECTRODES

- .1 Install rod electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.
- .3 Use size #4/0 AWG copper conductors for connections to electrodes unless otherwise indicated.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.03 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary systems.
- .2 The main incoming ground conductor is to run unbroken to the main electrical service entrance overcurrent device ground bus and then to the wall mounted ground bus.

3.04 EQUIPMENT GROUNDING

- .1 Install grounding/bonding connections to typical equipment including, but not necessarily limited to following list: Service equipment, transformers, switchgear, duct systems, frames of motors,

motor control centers, starters, control panels, building steel work, generators, cellular floor headers and cells and fittings, distribution panels, outdoor lighting, metallic waste water piping systems, metallic rain water leader systems, metallic gas fuel piping systems.

3.05 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on each wall of electrical and telecommunications rooms.
- .2 Ground items of electrical equipment to ground bus as indicated herein and on the Drawings.

3.06 COMMUNICATION SYSTEMS

- .1 Telecommunications: provide grounding and bonding in accordance with BICSI Telecommunications Distribution Methods Manual (TDMM), 12th Edition.

3.07 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 Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Where applicable, disconnect ground fault indicator during tests.

END OF SECTION

1 GENERAL

- .1 Not Applicable.

2 PRODUCTS

2.01 SUPPORT CHANNELS

- .1 U shape, size 40 mm x 40 mm, galvanized steel, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.
- .2 All threaded hanger rods will be minimum 10mm diameter, larger if required, made from galvanized steel.

2.02 CABLE TIES

- .1 Use cable ties solely for the purpose of holding cables in place when installed in cable tray.
- .2 Nylon flame retardant, low smoke cable tie. Size as required.
- .3 Nylon flame retardant, low smoke cable tie mounting bracket. Mechanical fastening type only; adhesive mounts not acceptable.

3 EXECUTION

3.01 INSTALLATION

- .1 Secure equipment to hollow and solid masonry, tile and plaster surfaces with expanding anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Where outlet boxes are set in drywall construction, a piece of steel stud will be secured to either side of the outlet box or use caddy quick-mount box supports, or caddy J-1-A for side box supports.
- .4 Secure all equipment in a manner so as not to distort or cause undue stress on any components.
- .5 Secure equipment to masonry, tile or plaster surfaces with lead anchors or nylon shields.

- .6 The use of toggle bolts for securing equipment to hollow masonry walls, suspended ceilings, or drywall is strictly prohibited.
- .7 Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.
- .8 Secure surface mounted equipment with twist clip fasteners to inverted T-bar ceilings.
- .9 Fasten exposed conduit or cables within 1m of each outlet box, junction box, pull box, cabinet or conduit fittings with spacing between supports as per CEC to building construction or support system using straps.
 - .1 One-hole zinc plated steel straps to secure surface conduits and cables smaller than 41mm.
 - .2 Two-hole zinc plated steel straps for conduits and cables 41mm and larger.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .10 Suspended support systems:
 - .1 Support single or multiple cables or conduits on a common steel support channel system supported by 10 mm-diameter threaded rod hangers, washers and nuts where direct fastening to building construction is impractical. Channel to be sandwiched between nuts and washers located on both upper and underside portions of channels.
 - .2 Do not support a single conduit using a threaded rod and a conduit clip.
- .11 For surface mounting of two or more conduits use steel channels. Securely attach channels to hangers with the maximum spacing not greater than:
 - .1 Conduits of one size only:
 - .1 16 mm to 21 mm conduit: 1524 mm spacing
 - .2 27 mm to 35 mm conduit: 1980 mm spacing
 - .3 41 mm and larger conduit: 3050 mm spacing
 - .2 Conduits of mixed size:
 - .1 Arrange supports so that maximum spacing of supports conforms to above, based on smallest conduit diameter.
- .12 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .13 Provide adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .14 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .15 Do not use supports or equipment installed for other trades for conduit or cable support.
- .16 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .17 Fasten individual and multiple runs of armoured cables to structure and in bundles as permitted in Section 26 05 21 - Wire and Cables (0 - 1000V).
- .18 Various suspended types of junction, pull and/or outlet boxes as well as conduits, are to be supported with minimum size 9 mm threaded rod, nuts and flat washers. Secure threaded rods to boxes with one flat washer and nut installed on both sides of box.
 - .1 One (1) rod is required for all type boxes sized 150 mm x 150 mm and smaller (23.3 cm² and smaller).
 - .2 Two (2) rods are required for boxes sized 23.3 cm² and larger, up to and including those sized 300 mm x 300 mm (929 cm²).
 - .3 Minimum of four (4) rods are required for all boxes sized larger than 929 cm².
- .19 Cut-off excess rod within 13 mm of channel bottom.
- .20 In addition to the CEC minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300 mm from midpoint of all 90° bends. Maximum spacing between conduit support channels shall be dictated by smallest size conduit(s) being supported and/or secured to same.
- .21 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .22 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

1 GENERAL

1.01 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

2 PRODUCTS

2.01 PRODUCTS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Interior units to be CSA Type 1 enclosure.
- .2 Exterior units to be CSA Type 4X, 304 or 316 stainless steel.
- .3 Main and branch lugs or connection bars to match required size and number of incoming and outgoing conductors as indicated.
- .4 Provide at least three (3) spare terminals on each set of lugs in splitters.

2.02 JUNCTION AND PULL BOXES

- .1 Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface mounting.
- .2 Type D: welded steel construction with screw-on flat covers for surface mounting. Surface or flush mounting as indicated. Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Junction and pull boxes larger than 125mm x 125mm to be Type "E", complete with continuously hinged door. Junction and pull boxes 125mm x 125mm and smaller shall be complete with screw cover.
- .4 Single-gang sectional type devices boxes being used in steel stud walls for the installation of both metallic and non-metallic type cables, must not be sized smaller than 250 cm², complete with wrap around type bracket.
- .5 Two or more flush installed sectional boxes, ganged together or boxes sized 100 mm-square and larger (intended for devices), are to have an additional support bracket installed on opposite side of box, not presently secured to metal stud.

- .6 Where larger sized devices or other types of flush outlet or junction boxes may be required, suitably sized 100 mm x 100 mm deep or 119 mm square boxes complete with appropriate sized extension tile rings are to be utilized. The use of plaster rings in lieu of tile type extension rings is not acceptable.
- .7 Provide junction boxes 150mm x 150mm used in branch circuit wiring complete with bonding terminal strips.

2.03 CABINETS

- .1 Type E: sheet steel, hinged screw-to-lock, door and return flange overlapping sides, handle, and catch, for surface mounting. Finish ASA-61 grey enamel. Complete with bonding terminal strip.
- .2 Type T: 1.6 mm steel cabinet, 1.9 mm cover, latch lock, TWO (2) keys. Finish - ASA - 61 grey enamel. Complete with bonding terminal strip.

3 EXECUTION

3.01 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.

3.02 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations. Install with hinges at side or bottom of enclosure; do not install with hinge on top.
- .2 Mount cabinets with top not higher than 2m above finished floor.
- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes. Each run of raceway must not have more than the equivalent of four (4) 90-degree bends installed, including the bends located at an outlet or fitting.
- .4 Where located above accessible ceiling systems, locate enclosures within 750mm of ceiling. Where radiant heating panels are installed, junction boxes are to be in-board of same for easy access.

- .5 Suspend enclosures on 9mm plated steel threaded rod or rods secured to enclosure with one flat washer and one nut on both sides of box.
- .6 Support all suspended types of junction and pull boxes using a minimum of 10 mm threaded rod complete with nuts and flat washers. Secure threaded rods to boxes using one flat washer and nut installed on both sides of box. Provide as follows:
 - .1 Boxes up to 120 mm-square: 1 rod.
 - .2 Boxes from 120 mm- to 250 mm-square: 2 rods.
 - .3 Boxes with dimensions above 300 mm: 4 rods.
- .7 Concealed junction or outlet boxes feeding a maximum of two (2) fixture drops must not be sized smaller than 100mm².
- .8 Bond pull boxes and cabinets to ground utilizing a bonding conductor.
- .9 Use type T cabinets when equipment is required to be housed in a lockable enclosure.
- .10 Place pull boxes in straight sections of conduit run and shall not be used in lieu of a bend.
- .11 In no case will a pull or junction box be installed in a ceiling space that is not considered accessible.
- .12 All junction and or pull boxes 150mm x 150mm in size or larger where surface installed will be either type "C" or "E", complete with hinged cover plate.
- .13 All type "D" junction and / or pull boxes where flush mounted, will have the finish cover plate sized a minimum of 25mm larger than the box.
- .14 All concealed type junction and / or pull boxes larger than 120mm square boxes will be type "C" or "E", complete with hinged cover plates.
- .15 Do not use sectional boxes with PVC. Rigid/thin wall conduit installation section boxes are intended for flexible conduit, AC-90, and/or other types of "pliable" cables.

3.03 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical Identification
- .2 Provide a legend of colour coding used under plexiglass and located in the Main Electrical Room.

- .3 All various system "concealed" junction and / or pull boxes located in ceiling spaces will have locations identified on room side of T-bar grid spline or access cover frames with appropriate colour coded, circular shaped, self-adhering discs.
- .4 Discs will be both 18mm and 6mm in diameter as described in following legend, with 6mm discs being centered in middle of 18mm discs. Concealed junction, pull and outlet boxes, conduit fittings, etc.in ceiling spaces complete with their respective metal cover plates, and all location discs, will be colour coded as follows:

Various Systems	18mm Disc.	6mm Disc.
51 to 240 Volts	Yellow	
241 to 600 Volts	Orange	
Fire Alarm	Red	
Telephone	Black	
P.A. Intercom, Panic Alarm		Blue
Security	Brown	
Ground or Bond	Green	
Cable Television	Yellow	
Computer / Data	Black	White
Energy Management	Red	White
Others (As Noted)		

- .5 Labeling of all branch circuit phase and neutral conductors will be done on both ends of all circuit conductors plus in any junction and/or pull boxes located in between. Panduit write-on self-laminating labels nos. PLD-1 or PLD-2 will be used. Wrap around conductor in a "U" fashion and have same adhere to itself.
- .6 Cover plates for junction and or pull boxes located above finish ceilings housing branch circuits will have each branch circuit number neatly identified on plate. Use felt marker for this purpose.
- .7 All various systems junction and/or pull boxes etc., where located above grid system, will have location identified on underside or room side of T-Bar spline, with 19mm self-adhering, colour coded circular shaped discs affixed directly to spline in close proximity to where concealed box is located. Install the same type of disc on ceiling or wall access cover plates.
- .8 Concealed boxes installed above drywall ceilings or behind walls are to have their locations identified on the room side of access opening frames with properly colour coded identification disks.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 CSA C22.1-2015, Canadian Electrical Code, Part 1.

1.02 RELATED SECTIONS

- .1 Section 26 05 01 - Electrical Identification.
- .2 Section 26 05 29 - Hangars and Supports for Electrical Systems.
- .3 Section 26 05 34 - Conduits, Conduit Fittings, and Fastenings.

2 PRODUCTS

2.01 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 100 mm square or larger outlet boxes as required for special devices.
- .3 Provide multi-gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Boxes for 347 V devices shall be rated as such.

2.02 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76mm x 50mm x 38mm or as indicated. 100mm square outlet boxes when more than one conduit enters one side with extension and tile rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 100mm x 54mm x 47mm.
- .3 100mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 100mm square outlet boxes with extension and tile rings for flush mounting devices in finished walls.

- .5 Tile rings to have square corners. Select appropriate depth of tile ring to suit application.
- .6 Provide the following for each multi-media outlet:
 - .1 A 119 mm x 119 mm x 53mm deep box with 38 mm extension ring and a single gang, square, welded tile ring, located where indicated.

2.03 MASONRY BOXES

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

2.04 CONCRETE BOXES

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

2.05 CONDUIT BOXES

- .1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for all surface wiring of devices (switches, receptacle, thermostats and similar devices) installed lower than 2440 mm AFF. Matching steel type FS metal device plates specifically made for FS boxes are to utilize 4-point fastening.
- .2 Surface type boxes larger in size than 119 mm-square where installed on or within ceiling spaces to be type "E" complete with hinged-type cover plates. Hinged covers are not required for pull boxes.

2.06 FITTINGS- GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Double locknuts and insulated bushings on sheet metal boxes.

2.07 COLOUR CODING

- .1 Colour coding of system to be as per Section 26 05 01 - Electrical Identification.

3 EXECUTION

3.01 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 6mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Install flush mounted boxes in all finished areas unless otherwise indicated.
- .6 Install surface mounted boxes in service rooms and above ceilings unless otherwise indicated.
- .7 Install flush mounted boxes in outside of exterior walls unless otherwise indicated.
- .8 Install type FS boxes for all surface-mounted devices (regardless of system type involved).
- .9 Install concealed boxes in accessible locations.
- .10 For flush installed 100mm or 120mm square box being used as a pull box or junction box, install a single or double gauge tile ring and blank cover installed on the box.
- .11 Do not use sectional type boxes with rigid galvanized steel conduit, rigid PVC conduit, or EMT.
- .12 Connect boxes to AC-90 cables specifically made for only AC-90 cables.
- .13 When installing flush boxes in metal drywall partitions where the grouping of multiple device boxes is required, support the box between the studs with a box mounting bracket. Where a single flush box is installed, this box may be supported by the wall stud without any additional support required.
- .14 Identify all boxes in accordance with Section 26 05 01 - Electrical Identification.

END OF SECTION

1 GENERAL

1.01 LOCATION OF CONDUIT

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

1.02 REFERENCES

- .1 CAN/CSA C22.2 NO. 45.1-07 (R2012), Electrical Rigid Metal Conduit - Steel.
- .2 CSA C22.2 No. 56-2013, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .3 CSA C22.2 No. 83-1985(R2013), Electrical Metal Tubing.
- .4 CSA C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit.

1.03 TRADE SIZE

- .1 The following are Metric trade sizes and Imperial trade size equivalent based on CEC Metric Units.

<u>Metric (mm)</u>	<u>Imperial (inch)</u>
12	3/8
16	1/2
21	3/4
27	1
35	1-1/4
41	1-1/2
53	2
63	2-1/2
78	3
91	3-1/2
103	4
129	5
155	6

1.04 RELATED WORK

- .1 Section 26 05 29 - Hangers and Supports for Electrical Systems.

2 PRODUCTS

2.01 CONDUITS

- .1 Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1.
- .2 Electrical metallic tubing (EMT) with steel set screw couplings: to CSA C22.2 No. 83.
- .3 Rigid PVC conduit, fittings; couplings and connectors: to CSA C22.2 No. 211.2.
- .4 Flexible aluminum conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.
- .5 ENT conduit is not permitted.

2.02 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits smaller than 41mm. Two hole steel straps for conduits 41mm and larger.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5m oc.
- .4 10mm dia. threaded rods to support suspended channels.

2.03 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Use conduit fittings (LB, LL, LR) for 90° bends. "Ells", or corner pulling elbows are prohibited.
- .3 Connectors and couplings for EMT: galvanized steel set-screws type c/w case hardened steel locknuts. Provide insulated throats on connectors up to and including 27 mm. Install metal thread-on bushings on all EMT connectors sized 35 mm or larger.
- .4 Use waterproof type connectors on all vertical conduit runs connecting equipment. Equip connectors with a rubber "O" Ring gasket. In addition, any conduit couplings in the vertical portion of the conduit run over equipment enclosures equipped with sprinkler hoods must be rain tight.

- .5 Flexible metal conduit connectors to be nylon insulated, steel or malleable iron type similar to T & B Tite-Bite #3115 thru 3124. Provide insulating bushings (anti-shorts) for flexible metal conduit connectors. Install plastic thread-on bushings on all flexible metal conduit connectors sized 35 mm or larger.
- .6 Liquid-tight flexible metal conduit fittings:
 - .1 Specifically listed for liquid tight flexible metal conduit.
 - .2 Steel type, to match conduit size.
 - .3 Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
 - .4 Safe edge ground type.
 - .5 Connectors to have insulated throats.
- .7 Plastic screw-on bushings for conduit ends up to 35mm diameter; metal bushings for larger sizes.

2.04 GENERAL FITTINGS

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Double locknuts and insulated bushings on sheet metal boxes.

2.05 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 205 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 21 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.06 FISH CORD

- .1 Polypropylene: minimum 3mm diameter.

3 EXECUTION

3.01 INSTALLATION

- .1 Install conduits as high as possible 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 and in unfinished areas. Install conduits as high as possible and secured to building structure with approved supports.
- .3 Use electrical metallic tubing (EMT) except in cast concrete.
- .4 Install EMT as a complete system and securely fasten in place within 300 mm of each outlet box, junction box, cabinet, couplings, fittings and changes in direction and the spacing between supports as follows:
 - .1 Not greater than 1500 mm for 16 mm and 21 mm trade size EMT
 - .2 Not greater than 1800 mm for 27 mm and 35 mm trade size EMT
 - .3 Not greater than 3000 mm for 41 mm trade size EMT or larger.
- .5 Use rigid galvanized steel threaded conduit through poured concrete floor slabs and where otherwise specified.
- .6 Use rigid PVC conduit underground: minimum size 21mm dia.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
- .8 Minimum conduit size for lighting and power circuits: 21mm.
- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 21mm dia.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.
- .15 Install insulated copper bonding conductor in all conduit runs. Minimum size: #12 AWG or Table 16 of C.E.C. whichever is larger.
- .16 Non-connected PVC or steel raceways protruding up through open bottoms of free-standing equipment require PVC bell ends and

steel type ground bushings installed on ends of respective types of conduits. Extend conduits a minimum of 50mm above housekeeping pad or concrete trough.

- .17 Install plastic bushings in all EMT sized 35mm and larger before pulling in conductors.
- .18 Installation of conduit for control circuit wiring and structured cabling.
 - .1 Install surface wiring in EMT.
 - .2 Conduit to extend 750mm of all various control devices associated with the operation of any given piece of mechanical equipment or device they may feed.
 - .3 Unless indicated otherwise, use liquid tight flexible metal conduit complete with matching connectors for final connection between EMT and applicable control device. Junction or pull boxes may also be used to make this transition.
 - .4 Locate EMT type conduit wall stub complete with flush installed device box in all partitions to accommodate wiring between device and accessible ceiling.
 - .5 Install EMT connectors complete with nylon insulated throat or threaded type bushing on end of EMT stub where it protrudes through the wall above the accessible ceiling. EMT plastic end cap bushings that are CSA approved may also be used.
 - .6 Bond EMT conduit stubs to ground as required by the CEC.
 - .7 Turn out EMT conduit stubs installed in walls into the accessible ceiling space in the room where the associated wall box is located. Provide separate stubs for each room.
- .19 Where construction consists of metal Q-deck and steel joists (roof deck), install conduits as follows:
 - .1 In such a manner that the nearest outside surface of the conduit is not less than 38mm from the nearest surface of the metal roof deck. Typically, this would involve the installation of conduits on the underside of the top flange, secured with beam clamps or canstrut.
 - .2 Installation of conduits or raceways between the top flange of a steel support structure and a steel roof deck is not permitted due to the possible penetration of roof deck mechanical screws or fasteners.
- .20 Where construction consists of metal Q-deck and steel joists (non-roof deck), install conduits as follows:
 - .1 Between the top flange of a steel support structure and the Q-deck.
 - .2 Where conduit sizes preclude the above mentioned method, install as high as possible in the space to conserve headroom.

- .21 Provide expansion joints for rigid conduit systems to the requirements of the CEC.
- .22 Code approved conduits will be used for underground or below slab installations.
- .23 Liquid tight flexible metal conduit will be used for equipment such as cameras or motors. Limit length to 1.2m. Confirm feeds to camera are secure and inaccessible
- .24 Provide two (2) 20mm spare conduits to accommodate future power or data etc., into any areas that may become inaccessible after construction; or, installation at a later time would cause a major disruption to the operation
- .25 Install spare conduits in a concealed secure manner but allowing for future access.
- .26 Clearly show in slab or underground conduits on the record drawings.
- .27 Do not install conduits (indoors and outdoors) in a manner in which they may be used as a climbing aide to gain access to rooftops or non-secured areas.
- .28 All distribution panel boards, motor control centers, splitter troughs, various other systems control panels, etc., which are fed underground to utilize code approved, rigid type, thick wall and PVC conduit.
- .29 PVC conduits sized 25mm diameter and larger will be installed in trenches not less than 300mm in depth from underside of concrete floor slab to bottom of trench. Place conduits on a 50mm bed of sand and place a second 50mm of sand on top (completely around) of conduits prior to backfilling.
- .30 PVC conduits of "all" sizes prior to turning-up through floor slabs, are to have transition to threaded steel take place.
- .31 Fire barrier material equivalent to 3M will be provided for all penetrations of conduits between walls, floors or ceilings.

3.02 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5m 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 76mm parallel to steam or hot water lines with minimum of 25mm at crossovers.

3.03 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage. Slope conduits entering/exiting the building away from the building.
- .2 Waterproof joints (PVC accepted) with heavy coat of bituminous paint.
- .3 Conduits are only permitted to be installed below floors and are not to be installed in concrete floors unless specifically indicated otherwise.
- .4 Install PVC conduits sized 35mm and larger are in trenches not less than 305mm in depth from underside of concrete floor slab to bottom of trench. Place conduits on a 50mm bed of sand and place a second 50mm bed of sand on top. Completely surround conduits with sand prior to backfilling.
- .5 Wiring for all various systems devices and/or outlets installed below ground floor concrete floor slabs may be performed utilizing minimum 21mm PVC rigid conduit. Transition from PVC rigid thick wall conduit to rigid steel threaded conduit is to take place below the floor slab. Transition from rigid steel to EMT above concrete floor slab.
- .6 PVC conduits of all sizes prior to turning-up through floor slabs, unless specifically indicated otherwise, are to have transition to rigid steel threaded conduit take place as previously indicated.
- .7 All underground conduit must be upsized one (1) trade size above the minimum code requirement.
- .8 Rigid PVC (thick wall) conduit shall be permitted to be direct buried.
- .9 Conduit installation is not to influence the thickness of the floor slab.
- .10 Do not run conduits along concrete walls installed to reinforce wall installations.

- .11 The installation of PVC type conduits above ground is prohibited.
- .12 All underground conduits are to be up-sized at least one trade size above the minimum code requirement for ease of pulling.
- .13 Only use rigid Types EB1 and DB2/ES2 PVC (thin wall) Conduit (CSA C22.2 211.1) where embedded in concrete.
- .14 Direct bury rigid PVC (thick wall) Conduit (CSA C22.2 No. 211.2).

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials, components, cabinets, instruments and installation for metering and switchboard Instruments.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 01 91 15 – Electrical Systems Commissioning
- .4 Section 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCES

- .1 ANSI C12.20-2010, Electricity Meters 0.2 and 0.5 Accuracy Class.
- .2 IEC 62053-22-Ed.1, B:2003, Electricity Metering Equipment – Particular Requirements – Part 22: Static Meters for Active Energy (Classes 0.2 and 0.6S).

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Indicate meter, instrument, outline dimensions, panel/enclosure drilling dimensions and include cut-out template.
- .3 Provide wiring diagrams for meters, metering cabinets and overall metering system.

1.5 WASTE

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all 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 Divert unused wiring materials from landfill to metal recycling facility as approved by the Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 METER

- .1 Main Switchboard:
 - .1 Digital power and energy meter with the following features:
 - .1 Large, backlit LCD display which can present real-time and timestamped historical parameters, graphical trends and histograms, measurement accuracy standards.
 - .2 Meets IEC 62053-22 Class 0.2S and ANSI C12.20 0.2 Class 10 and 20.
 - .3 Power and energy.
 - .1 V L-L, L-N per phase, min/max, unbalance.
 - .2 Frequency: present, min/max.
 - .3 Current per phase and L4 and L5.
 - .4 Power: kW, kvar, kVA per phase and total.
 - .5 Demand: kW, kvar, kVA.
 - .6 Energy: kWh, kvarh, kVAh, rec/del.
 - .7 Power factor.
 - .4 Power quality measurements to include:
 - .1 Sag/swell, harmonics monitoring.
 - .2 Harmonics: individual, even, odd up to 63rd.
 - .3 Symmetrical components: zero, positive, negative.
 - .4 512 samples per cycle sampling rate.
 - .5 Disturbance direction detection.
 - .5 Logging and recording to include.
 - .1 5Mb memory
 - .2 Min/Max, historical and waveform logging
 - .3 Timestamp resolution in 0.001 seconds.

- .4 Historical trend information via front panel display.
 - .5 GPS time synchronization.
 - .6 Communications and I/O
 - .1 RS-232/RS485, RS-485, Ethernet, Optical.
 - .2 One (1) internal modem.
 - .3 Four (4) Analog inputs
 - .4 Four (4) Analog outputs.
 - .5 Sixteen (16) digital status inputs.
 - .6 Four (4) digital status outputs.
 - .7 Three (3) relay outputs.
 - .8 Onboard web server
 - .7 Setpoints, alarming and control
 - .1 65 setpoints / % cycle.
 - .2 Math, logic, trig, log, linearization formulas.
 - .3 Call-out on single and multi-condition alarms.
- .2 Digital metering package to include all necessary CT's, PT's, test blocks, wiring, communications devices, terminal strips, etc. Metering equipment to be installed in the main switchboard.
- .3 Digital metering package must be compatible with the digital metering network and software package
- .4 Digital metering package to be suitable for the voltage, phase and current ratings of the equipment or loads in which it is metering.
- .2 Distribution panels
 - .1 Digital power and energy meter with the following features:
 - .1 4-line backlit LCD display which can present real-time and historical parameters.
 - .2 Power and energy.
 - .1 V L-L, L-N per phase, min/max, unbalance.
 - .2 Frequency: present, min/max
 - .3 Current per phase.
 - .4 Power: kW, kvar, kVA per phase and total.
 - .5 Demand: kW, kvar, kVA.
 - .6 Energy: kWh, kvarh, kVAh, rec/del.
 - .7 Power factor.
 - .3 Power quality measurements to include:
 - .1 Harmonics: individual, even, odd up to 15th.
 - .2 32 samples per cycle sampling rate.

- .4 Logging and recording to include:
 - .1 300kB memory.
 - .2 Min/max logging.
 - .3 Timestamp resolution in 0.001 seconds.
 - .4 Historical logs, maximum 32 channels.
- .5 Communications and I/O
 - .1 Two (2) x RS-485 port, one (1) Ethernet port, one (1) optical port.
 - .2 One (1) internal modem.
 - .3 Four (4) Analog inputs.
 - .4 Four (4) Analog outputs.
 - .5 Four (4) digital status inputs.
 - .6 Four (4) digital relay outputs.
 - .7 Onboard web server.
- .6 Setpoints, alarming and control
 - .1 One (1) setpoints/second.
 - .2 Math, logic, trig, log, linearization formulas.
 - .3 Single and multi-condition alarms.
- .2 Digital metering package to include all necessary CT's, PT's, test blocks, wiring, communications devices, terminal strips, etc. Metering equipment to be installed in the associated distribution panelboard.
- .3 Digital metering package must be compatible with the digital metering network and software package.
- .4 Digital metering package to be suitable for the voltage, phase and current ratings of the equipment or loads in which it is metering.
- .3 Branch Circuit Panelboards and Individual Metered Loads.
 - .1 Digital power and energy meter with the following features.
 - .1 4-line backlit LCD display which can present real-time and historical parameters.
 - .2 Power and energy.
 - .1 V L-L, L-N per phase, min/max, unbalance.
 - .2 Frequency: present, min/max.
 - .3 Current per phase.
 - .4 Power: kW, kvar, kVA per phase and total.
 - .5 Demand: kW, kvar, kVA.
 - .6 Energy: kWh, kvarh, kVAh, rec/del.
 - .7 Power factor.
 - .3 Power quality measurements to include:

- .1 Harmonics: individual, even, odd up to 15th.
 - .2 32 samples per cycle sampling rate.
- .4 Logging and recording to include:
 - .1 300kB memory.
 - .2 Min/max logging.
 - .3 Timestamp resolution in 0.001 seconds.
 - .4 Historical logs, maximum 32 channels.
- .5 Communications and I/O
 - .1 Two (2) x RS-485 port, one (1) Ethernet port, one (1) optical port.
 - .2 One (1) internal modem.
 - .3 Four (4) Analog inputs.
 - .4 Four (4) Analog outputs.
 - .5 Four (4) digital status inputs.
 - .6 Four (4) digital relay outputs.
 - .7 Onboard web server.
- .6 Setpoints, alarming and control.
 - .1 One (1) setpoint/second.
 - .2 Math, logic, trig, log, linearization formulas.
 - .3 Single and multi-condition alarms.
- .2 Install metering equipment including all necessary CT's, PT's, test blocks, wiring, communications devices, terminal strips, etc. in a CSA Type 1 cabinet. Mount digital meter displays in a CSA Type 1 cabinet. Coordinate cabinet locations and sizing with the Departmental Representative during the shop drawing process.
- .3 Digital metering package to be compatible with the digital metering network and software package.
- .4 Digital metering package to be suitable for the voltage, phase and current ratings of the equipment or loads in which it is metering.

2.2 DIGITAL METERING SOFTWARE

- .1 Digital metering package software to provide the following to local and remote workstations:
 - .1 Historical trend analyses.
 - .2 Alarms and control functions.
 - .3 Real-time display of data.
 - .4 Power quality analyses.
 - .5 Custom reporting.
- .2 Automated data acquisitions from various sites and devices.

- .3 SQL 2005 Express Edition database.
- .4 Web-enabled real-time monitoring.
- .5 Web-enabled real-time reporting.
- .6 Trend analysis.
- .7 Power quality analysis and compliance reporting.
- .8 Alarming and events.
- .9 Manual and automated control.
- .10 OPC DA client.
- .11 Software package to be most recent edition and support digital metering equipment.
- .12 Provide all necessary web-servers, modems, switches as necessary to make a fully operational and functional metering system. Note that PC's are not included in the scope of supply.
- .13 The metering system shall provide the following information for each meter to the building automation system (BAS) via BACnet interface:
 - .1 Voltage (V)
 - .2 Energy (kWh)

2.3 TEST TERMINAL BLOCKS

- .1 Test terminal blocks: provide as required.

2.4 SHOP INSTALLATION

- .1 Install meters and instrument transformers in separate compartment of switchboard and distribution panelboards, or in separate enclosure for branch panelboards and individual loads as required.
- .2 Provide adequate spacing between current transformers installed on each phase.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.
- .4 Have all items affecting CSA certification factory installed (CT's, PT's, etc.).

Part 3 Execution

3.1 METERING INSTALLATION

- .1 Install meters and instruments in location free from vibration and shock.
- .2 Make connections in accordance with manufacturers requirements.
- .3 Connect meter and instrument transformer cabinets to ground.
- .4 Install software on Owner supplied PC.
- .5 Program and calibrate all metering equipment.
- .6 Provide system programming as necessary to link meters to software. Connect meters to data system. Coordinate with the facility IT staff as necessary.

3.2 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00 and in accordance with manufacturer's recommendations.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.
- .4 Perform tests to obtain correct calibration.
- .5 Do not dismantle meters and instruments.

3.3 SET-UP AND COMMISSIONING

- .1 Refer to Section 01 91 15 - Electrical Systems Commissioning.
- .2 Set-up and commission complete metering system in accordance with the manufacturer's recommendations.
- .3 Set-up and commissioning to be completed by an authorized manufacturer's representative factory trained in the installation, set-up, commissioning and operation of the

equipment. Provide services for as long as necessary to fully commission the metering equipment and software.

- .4 Coordinate commissioning with the Commissioning Agent, perform all commissioning activities including functional performance testing in accordance with Commissioning specifications.

3.4 TRAINING

- .1 The Departmental Representative will provide selected operations and maintenance staff training in the operation, maintenance of the complete metering system.
- .2 Training to be provided by an authorized manufacturer's representative factory trained in the installation, set-up, commissioning and operation of the equipment.
- .3 Utilize Operation and Maintenance manual, on-site review of equipment and classroom style materials to provide training.
- .4 Allow for a minimum of 4 hours of site training on equipment and 8 hour of training related to the metering software. Coordinate training with the Commissioning Agent and schedule a minimum of three (3) weeks in advance at locations determined by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Indicate on shop drawings.
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
- .3 Include time-current characteristic curves for circuit breakers and fuses.

1.2 RELATED SECTIONS

- .1 Section 26 09 23 – Digital Metering System.
- .2 Section 26 28 21 – Moulded Case Circuit Breakers.

1.3 REFERENCES

- .1 ANSI/IEEE C62.41.1-2002, Guide on the Surge Environment by Low-Voltage (1000V or less) AC Power Circuits.
- .2 ANSI/IEEE C62.41.2-2002, Recommended Practice on Characterization of Surges in Low Voltage (1000V or less) AC Power Circuits.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED (Leadership in Energy and Environmental Design) Green Building Rating System for New Construction and Major Renovations: LEED Canada-NC – 2009.
- .4 UL 1283-2015, Electromagnetic Interference Filters.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for service entrance board for incorporation into manual specified in Section 01 78 00 – Closeout Submittals

1.5 MAINTENANCE MATERIALS

- .1 Include manufacturer recommended maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 SERVICE ENTRANCE BOARD

- .1 Rating: 208 V, 3 phase, 4 wire, amperage as indicated, short circuit rating as indicated.
- .2 Cubicles: free-standing, dead front, front access only, minimum 610 mm deep, maximum 750 mm deep, provision for addition of future distribution sections, NEMA 1 with drip shield.
- .3 Main breaker and metering section shall be installed adjacent and bussed to the distribution section.
- .4 Service entrance rated main breaker, 100%-rated, solid-state type overcurrent protective trip unit with independently adjustable LSIG settings.
- .5 Owner's digital metering section.
- .6 Barrier metering sections from adjoining sections.
- .7 Distribution breaker section.
- .8 Hinged access panels with captive knurled thumb screws.
- .9 Bus bars and main connections: tin-plated or silver flashed 99.3% copper.
- .10 Identify bus bars with phase color coding.
- .11 Provide service entrance board complete with bussed wireway section for terminating incoming conductors. Bussed wireway section to be not less than 610 mm in width.

2.2 MOULDED CASE CIRCUIT BREAKERS

- .1 To Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Provide extension handles for all circuit breakers rated 225 A and above.

2.3 OWNERS METERING

- .1 Per Section 26 09 23 – Digital Metering System.

2.4 SURGE PROTECTION DEVICE

- .1 Provide integral SPD protection as follows:
 - .1 Operation and Environment:
 - .1 Maximum Continuous Operating Voltage MCOV. The maximum continuous operating voltage of the suppressor unit must be greater than 115%.
 - .2 Protection Modes. Transient voltage surge suppression paths shall be provided for all possible common and normal modes (between each line and ground, neutral and ground, line to line, and each line and neutral).
 - .2 Suppression:
 - .1 The maximum peak surge current capacity per phase of the specified units, based on the standard 8 x 20 microsecond current waveform (described in ANSI/IEEE C62.41.1), is not less than 240,000 Amps.
 - .2 Unit must be able to withstand 1,000 sequential impulses using the category C1, 6 kV/3 kA, 8 x 20 waveform as described in ANSI/IEEE C62.41.2. The interval between impulses shall not exceed 30 seconds. The resultant peak let-through voltage of the last impulse must not vary from the first impulse by more than 10%.
 - .3 Suppression System: unit to include an engineered solid-state high-performance suppression system, utilizing non-linear voltage dependent metal oxide varistors or selenium cells. The suppression system's components must not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow or cause system upset of connected loads.
 - .4 The SPD clamping components must have a response time rated less than 1 nanosecond. Filter components must respond instantaneously.
 - .3 Filtering:
 - .1 Noise Attenuation: unit to be listed under UL 1283 and contain a high-frequency extended range tracking filter. Filter to reduce fast rise-time, high-frequency, error-producing transients and electrical line noise to harmless levels thus eliminating disturbances which may lead to system

upset. Noise attenuation must be a minimum of 45 dB at 100 kHz based on standardized insertion loss data obtained utilizing the MIL-STD-220A, 50 ohm insertion loss methodology. Only manufacturers providing a documented attenuation value at 100 kHz will be considered. Spectrum analysis data may be required for support.

- .2 Bandwidth. The SPD unit(s) for main entrance panel application shall have an effective filtering bandwidth of 180 Hz to 50 MHz.
- .4 General Features:
 - .1 Connectors: Provide terminals for all of the necessary input and output power and ground connections on the SPD.
 - .2 Internal Connections: All surge current diversion connections will be by way of low impedance wiring. Wire surge current diversion components for reliable low impedance connections. Do not use printed circuit boards for surge suppression paths.
 - .3 Enclosure: provide in a heavy duty NEMA 12 dust tight, enclosure with no ventilation openings. Indication of surge current module status must be visible without opening the door.
 - .4 Unit Status Indicators. Provide red status indicators on the hinged front cover to indicate unit phase status. The absence of the red light must reliably indicate that one or more surge current diversion phases have failed and that service is needed to restore full operation.
 - .5 Fuses: Unit to utilize internal fuses rated 208 VAC or greater and with a minimum interrupting capability of 200,000A or greater.
 - .6 Identification: include manufacturer's nameplate, UL rating, and a CSA approval on the exterior of the enclosure.
 - .7 Warranty: provide a Five-Year Manufacturer's Warranty from date of shipment.
 - .8 Quality: Testing of each unit to include but not be limited to quality assurance checks, a Hi-pot test at two times rated voltage plus 1000 volts per UL requirements, and operational and calibration tests. Make test results available to the Departmental Representative upon request.

2.5 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.

- .2 Lugs at each end for size #4/0 grounding cable.

2.6 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 – Common Work Results for Electrical.
 - .1 Service entrance board exterior: gray.

2.7 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 – Electrical Identification.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.
 - .2 Complete board labelled: 208 V.
 - .3 Main disconnect labelled: "Main Breaker".
 - .4 Branch disconnects labelled: as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate service entrance board on and secure to concrete housekeeping pad.
- .2 Connect main secondary service to line terminals of main breaker.
- .3 Connect load terminals of distribution breaker's to feeders.
- .4 Check factory-made connections for mechanical security and electrical continuity.
- .5 Ground service entrance board in accordance with Section 26 05 28 – Grounding – Secondary and as indicated on the drawings.
- .6 Set breaker trip settings to manufacturer recommended settings from the Protection Coordination Study.
- .7 Test electronic trip units to ensure proper working and protection of components. Provide test results to the Commissioning Agent and for inclusion in the Operation and Maintenance Manual.
- .8 Calibrate and commission the facility's digital metering system including remote communications and associated programming.

3.2 SOURCE QUALITY CONTROL

- .1 Notify the Departmental Representative in writing a minimum of two (2) weeks in advance that service entrance board is ready for testing.
- .2 Perform standard factory tests. Provide test results to Commissioning Agent and for inclusion in Operation and Maintenance Manual.

3.3 COMMISSIONING

- .1 Refer to Section 01 91 15 – Electrical Systems Commissioning.

END OF SECTION

1 GENERAL

1.01 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of panel, branch breaker type, breaker quantity, ampacity, short circuit rating, bus materials and enclosure dimension.

1.02 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for panel boards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals
- .2 Include panel schedules.

2 PRODUCTS

2.01 PANEL BOARDS

- .1 Panel boards: provide the product of one (1) manufacturer.
- .2 208V panel boards: bus and breakers rated 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 Panel boards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Provide two (2) keys for each panel board, and key panel boards alike.
- .6 Tin-plated copper bus. Neutral bus to have same rating as mains, except where noted otherwise.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked grey enamel.

- .10 Minimum of one (1) terminal screw on factory installed neutral bar for each circuit breaker position.
- .11 Panel boards rated 400A and below to be minimum 508 mm wide.
- .12 Panel boards rated above 400A shall be minimum 279 mm deep and 914 mm wide, complete with drip hood.
- .13 Panel boards to have 20% minimum spare breakers.

2.02 BREAKERS

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panel boards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to the Departmental Representative.
- .5 Breakers installed in panel boards rated above 400A must be capable of being padlocked in the on or off position.

2.03 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical Identification.
- .2 Nameplate for each panel board size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panel boards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

3 EXECUTION

3.01 INSTALLATION

- .1 Locate panel boards as indicated and mount securely, plumb, true and square, to adjoining surfaces. Provide plywood backboards as per Section 26 05 00 - Common Work Results for Electrical

- .2 Mount panel boards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Where more than one (1) bonding terminal strip is present in one panel, hardwire both together using same size bonding conductor as the one that accompanies the panel feeder conductors.

3.02 COMMISSIONING

- .1 Refer to Section 01 91 13 - Commissioning General Requirements.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 CSA C22.2 No. 111-10 (R2015), General-use Snap Switches.
- .2 CSA C22.2 No. 55-15, Special Use Switches.
- .3 CSA C22.2 No. 42-10 (R2015), General use Receptacles, Attachment Plugs, and Similar Wiring Devices

1.02 SHOP DRAWINGS

- .1 Submit shop drawings for each device and cover plate type as per specification Section 01 33 00 - Submittal Procedures.

1.03 OPERATIONAL AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for wiring devices for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 PRODUCTS

2.01 SWITCHES

- .1 20 A, 120 V, specification grade single pole, two way switches.
- .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 molding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory nylon, heavy duty toggle.
 - .6 Integral ground terminal.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Use the switches of one (1) manufacturer throughout project.

2.02 RECEPTACLES

- .1 Type 1:
 - .1 General purpose duplex receptacles, specification grade CSA type 5- 15R, 125 V, 15 A, U ground, with following features:
 - .1 Ivory urea molded housing for all power receptacles.
 - .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 riveted grounding contacts.
- .2 Type 2:
 - .1 Duplex receptacles, specification grade CSA type 5-20R (T-Slot), 125 V, 15/20A, U ground, with following features:
 - .1 Ivory urea molded 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 riveted grounding contacts.
- .3 Type 3:
 - .1 GFI duplex receptacles, specification grade CSA type 5-15R, 125 V, 15 A, U ground, with following features:
 - .1 Ivory urea molded housing for all power receptacles.
 - .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 riveted grounding contacts.
 - .6 GFI test and reset buttons.
- .4 Type 4:
 - .1 GFI duplex receptacles, specification grade CSA type 5-20R (T-Slot), 125 V, 15/20A, U ground, with following features:
 - .1 Ivory urea molded 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 riveted grounding contacts.
 - .6 GFI test and reset buttons.
- .5 Other receptacles with ampacity and voltage as indicated.
- .6 Provide the receptacles of one (1) manufacturer throughout project.

2.03 EXTERIOR RECEPTACLES

- .1 Provide UV-resistant polycarbonate lockable cover.
- .2 Provide two (2) keys to the Departmental Representative.

2.04 COVER PLATES

- .1 Cover plates for wiring devices.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Brushed stainless steel plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof while-in-use cover, complete with neoprene gaskets and enclosure key, for duplex receptacles mounted on exterior of building.

3 EXECUTION

3.01 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 as indicated.
- .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 as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Mount receptacles with "U" ground up for vertically mounted and neutral slot at top for horizontally mounted receptacle.
 - .5 Install pigtail type leads on conductors in all device or outlet boxes where feeding through to other receptacles. Daisy-chaining or looping through of conductors from one device to another is not acceptable. Provide separate pigtail conductor leads for final termination to each receptacle for phase, neutral and bond conductors.
 - .6 Test all receptacles for polarity.
- .3 Cover plates:
 - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.

- .2 Install suitable common cover plates where wiring devices are grouped.
- .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .4 Device leveller and retainer is an approved accessory for securing devices to flush installed device boxes.
- .5 Single gang adjustable box extension is an approved accessory for extending single gang box openings a maximum of 22mm. Their use is acceptable in non-combustible type walls where front edges of boxes have not been installed greater than 28mm from wall surface.

3.02 COMMISSIONING

- .1 Refer to Section 01 91 13 - Commissioning General Requirements.

END OF SECTION

1 GENERAL

1.01 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include circuit breaker types, ratings, magnetic adjustment ranges and time-current characteristic curves for breakers with ampacity of 225 A and over. LSIG adjustment ranges to be included for LSIG breakers.

1.02 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for circuit breakers for incorporation into Manual specified in Section 01 78 00 - Closeout Submittals
- .2 Include matrix of individual circuit breaker settings for all breakers with adjustable settings.

2 PRODUCTS

2.01 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Multiple breakers to have single handle.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Circuit breakers to have interrupting capacity as indicated on the drawings. Circuit breakers are not to utilize series rating in determining their interrupting capacity.
- .6 Circuit breakers rated 225 A and above are to be complete with adjustable magnetic trip units.

2.02 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.03 MAGNETIC BREAKERS

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

2.04 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self- powered shunt trip to provide inverse time current trip under overload condition, and long-time short time instantaneous tripping for phase ground fault short circuit protection. Settings to be individually adjustable.

2.05 OPTIONAL FEATURES

- .1 Include:
 - .1 On-off locking device for 10% of branch breakers and all breakers supplying emergency lighting battery units and fire alarm devices.

2.06 GROUND FAULT CIRCUIT INTERRUPTER CIRCUIT BREAKERS

- .1 Moulded case thermal magnetic circuit breaker with Class A ground fault protection

3 EXECUTION

3.01 INSTALLATION

- .1 Install circuit breakers as required, factory install breakers in all panelboards, switchboards MCC's and distribution panels.
- .2 Adjust circuit breaker settings to the values indicated on the manufacturer's supplied Coordination Study.
- .3 Install individual circuit breakers in CSA Type 1 enclosures complete with bonding and neutral connections.

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MOULDED CASE CIRCUIT BREAKERS

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END OF SECTION

1 GENERAL

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
 - .1 Dimensions.
 - .2 Enclosure type.
 - .3 Rating.
 - .4 Accessories.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for disconnect switches for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

2 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Heavy duty, fusible and non-fusible, horsepower-rated disconnect switch in CSA enclosure type as indicated (minimum CSA type 1 with driphood); size as indicated.
- .2 Provision for padlocking in off switch position by three (3) locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuse holders: suitable without adaptors, for type and size of fuse indicated.
- .5 Quick-make, quick-break action.
- .6 ON-OFF switch position indication on switch enclosure cover.
- .7 Auxiliary contacts for all disconnect switches supplying elevator equipment.

- .8 Disconnect switches which serve motors fed from variable frequency drives (VFDs) are to be complete with "early break" auxiliary contacts to disable the VFD when the switch is opened.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical Identification.
- .2 Indicate name of load controlled voltage panel designation and circuit numbers on size 4 nameplate.

3 EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses where required.
- .2 For disconnect switches serving motors which are fed from VFDs, wire auxiliary contacts to the VFD's 'enable' input terminal to prevent operation of the VFD with the disconnect switch in the open position.

3.2 COMMISSIONING

- .1 Refer to Section 01 91 13 -Commissioning General Requirements.

END OF SECTION

1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include operation and maintenance data for each type and style of starter.

2 PRODUCTS

2.1 MATERIALS

- .1 Starters: EEMAC E14-1
 - .1 Half size starters are not acceptable.
 - .2 IEC equipment not acceptable.

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 All phase conductors to have overload heaters, manual reset, and trip indicating handle.
- .2 Accessories:
 - .1 Toggle switch: heavy duty labelled as indicated.
 - .2 Indicating light: LED and colour as indicated.

- .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .5 Hand-off-auto selection switch in cover.
 - .6 LED pilot light indicating coil is energized.
 - .7 LED pilot light indicating unit is powered.
- .2 Combination-type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:
 - .1 Locking in "OFF" position with up to three (3) padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 All combination-type starters are to be complete with solid-core current sensors. Wire all connections to a factory-installed terminal strip.
- .4 All combination-type starters are to be complete with mechanical relay and relay base. Relay to be DPDT with 12 VDC coil and 120 VAC, 6 A contacts. Wire all connections to a factory-installed terminal strip.
- .5 Accessories:
 - .1 Selector switches: heavy duty labelled as indicated.
 - .2 Indicating lights: L.E.D. type and color as indicated.
 - .3 One (1)-N/O and one (1)-N/C spare auxiliary contacts unless otherwise indicated.
 - .4 Provide solid state protection complete with single phasing protection.
 - .5 Provide one (1) 24 VAC interposing relay complete with two (2) normally open and two (2) normally closed contacts mounted in starter cell. Connect relay as indicated.

2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 FINISHES

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

2.6 EQUIPMENT IDENTIFICATION

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

3 EXECUTION

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Confirm fuses and overload elements are correct for the actual loads. Obtain correct information from Divisions 21, 22 and 23 prior to ordering and setting overloads.
- .3 Coordinate with Controls contractor.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as required.
- .5 Provide test forms to Commissioning Agent for each motor starter confirming operation and settings.

3.3 COMMISSIONING

- .1 Refer to Section 01 91 13 - Commissioning - General Requirements.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 ANSI C62.41.1-2002, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ANSI C62.45-2002, IEEE Guide on Surge Testing for Equipment Connected to Low- Voltage AC Power Circuits.
- .3 CSA C22.2 No. 250.13-14, Light Emitting Diode (LED) Equipment for Lighting Applications.
- .4 NECA/ESNA 500-2006, Recommended Practice for installing indoor commercial lighting systems.
- .5 ASTM F 1137-2011; American Society for Testing and Materials Specification for phosphate/oil and phosphate/organic corrosion protective coatings for fasteners.
- .6 FCC CFR47; USA Federal Communications Commission Frequency allocations and radio treaty matters; general rules and regulations.
- .7 IESNA LM-79-08, Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
- .8 IESNA LM-80-08, Approved Method: Measuring Lumen Maintenance of LED Light Sources.
- .9 NEMA SSL 1-2010, Electronic Drivers for LED Devices, Arrays, or Systems.

1.02 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 01 91 13 - Commissioning General Requirements

1.03 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings for the following:

- .1 Luminaire.
- .2 Driver for each luminaire type.
- .3 Shop Drawings:
 - .1 Shop drawings to clearly indicate the following:
 - .1 Luminaire ID number as identified in contract documents.
 - .2 Fixture specification as identified in Part 2 and on the drawings.
 - .3 Driver specification as identified in Part 2 and on the drawings.
 - .4 Photometric data for each luminaire type.
 - .5 Energy data for luminaires.
- .4 Catalogue cuts lacking sufficient detail to indicate compliance with Contract Documents will not be acceptable.
- .5 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by the Departmental Representative. Photometric data to include:
 - .1 VCP Table, spacing criterion.
 - .2 Total input watts.
 - .3 Candlepower summary, candela distribution, zonal lumen summary.
 - .4 Luminaire efficiency, C.I.E. type, coefficient of utilization.
 - .5 Lamp type.
 - .6 Lumen ratings.
 - .7 Summary in accordance with IES procedures.
 - .8 Electronic IES file (provide on CD).

1.04 OPERATION AND MAINTENANCE

- .1 Provide operation and maintenance data for inclusion in the manual specified in Section 01 78 00 - Closeout Submittals.

2 PRODUCTS

2.01 LED DRIVERS

- .1 Electronic LED drivers:
 - .1 Performance requirements:
 - .1 Voltage: 120 V, 60 Hz.
 - .2 Power factor: greater than 0.90.
 - .3 Total harmonic distortion: less than 20%.
 - .4 Efficiency: 85% or greater.
 - .2 Regulatory requirements:

- .1 Underwriters Laboratories (UL) listed and Canadian Standards Association (CSA) approved.
- .2 Meet or exceed ANSI C62.41 Category A for transient protection.
- .3 Meet or exceed NEMA SSL 1 where applicable.
- .4 Meet or exceed the requirements of the Federal Communications commission (FCC) rules and regulations, Title 47 CFR part 15, non-consumer (Class A) for EMI/RFI (conducted and radiated).

2.02 SPARES

- .1 For LED fixtures, provide 10% spare LED lamp modules for each type and 5% spare drives for each type.

2.03 LUMINAIRES

- .1 Luminaires are specified on the drawings.
- .2 Paint interior troffers after fabrication.
- .3 Recessed troffers, in order to eliminate raw edges and corrosion and to maximize efficiency, paint the fixture housing and driver cover with a baked white polyester enamel powder coat with 90% minimum reflectivity after fabrication using an electrostatic process. This need not include the lens frame.

3 EXECUTION

3.01 INSTALLATION

- .1 Locate and install luminaires as indicated. Provide and install all necessary hangars, supports, fittings, etc. as necessary for a complete installation.
- .2 Coordinate installation with all other services.
- .3 For open ceilings where there are pipes running through the ceiling, mount luminaires to accommodate pipes and be flush for maximum illumination performance.

3.02 WIRING

- .1 Connect luminaires to lighting circuits as indicated.
- .2 Provide separate neutrals for all lighting circuits.

- .3 Each light fixture must have a separate fixture power drop installed and connected to hard wired junction box or outlet box in ceiling space.
- .4 Recessed and/or surface type light fixtures are not to be wired in a daisy-chain manner or have their power sources looped between fixtures, unless the fixtures are installed end-to-end or house an integral junction box.
- .5 Provide suspended fixtures mounted in continuous rows with a separate #12 AWG bonding conductor in the fixture raceway.

3.03 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling using an approved supporting method. Supporting luminaires from any part of the ceiling system is strictly prohibited.
- .2 Recessed Down Lights:
 - .1 Non-accessible Ceilings:
 - .1 If the luminaire opening is less than 150mm in diameter, a separate fixture drop shall be provided.
 - .2 Fixture drops shall be run to an accessible junction box above an accessible ceiling or an access panel.
 - .2 Fixture drops must not exceed 5m in length.
 - .3 Accessible T-bar Ceilings:
 - .1 Notwithstanding item 3.3.1 above, securely fasten fixtures to the T-bar ceiling grid. No part of the fixture is to derive support from the T-bar ceiling tiles.
- .3 Refer to drawings for support details for other fixtures. Provide all required mounting hardware.

3.04 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.

3.05 COMMISSIONING

- .1 Refer to Section 01 91 13 - Commissioning General Requirements.

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Queens Co., PEI
Project No. R.081199.001

Section 26 50 00
LIGHTING EQUIPMENT

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END OF SECTION

1 GENERAL

1.1 GENERAL DESCRIPTION

- .1 The building consists of an exhibit hall, meeting rooms, service rooms, storage rooms, corridor/lobby spaces, and gift shop area.

1.2 DESCRIPTION OF WORK

- .1 Supply, install and commission complete system for the control of lighting and other equipment as indicated on the lighting and lighting control system (LCS) drawings and as further defined herein. LCS to be based on addressable device technology and allow individual luminaire control. All devices such as ballasts, drivers, relay packs, etc., must be compatible and fully function with the LCS.
- .2 Verify quantity of specific devices and equipment required for this project. Provide all components and accessories necessary to ensure a fully functional lighting control system.
- .3 The system includes but is not limited to: Pre-wired, microprocessor control panels controlled via a complete list of communication based accessories including digital switches, digital photocells, dual technology occupancy sensors, Digital Time Clock (DTC) and interface cards to external dimming systems, building automation systems, fire alarm system, security/intrusion alarm system, access control system, Crestron control system and other devices as indicated herein or as necessary for the proper operation of the lighting control system.
- .4 The lighting control system must utilize wired components to achieve the functionality required; systems which rely on wireless communications for any function will not be accepted.

1.3 CONSTRUCTION SUBMITTALS

- .1 Shop Drawings: submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to: control panels, controllers, control stations, switches, DTC, photocells, occupancy sensors and other interfaces. Shop drawings to indicate locations of each device. Include a unique identifier for each switch.
- .2 One Line Diagram: submit a one- line diagram of the system configuration indicating the type, size and number of conductors

between each component. The one line diagram shall also indicate all auxiliary system interface components. Submittals that show typical riser diagrams are not acceptable.

- .3 Separate Price List: submit with the shop drawings separate pricing for individual components (and associated auxiliaries). Submit pricing for any other components which may be deemed necessary not included in the base design. Pricing to include for the supply, delivery as well as any associated programming of such components. The submitted pricing must be valid until the Substantial Completion of the project.
- .4 Provide information on the Manufacturer including head office location, Canadian office locations, local sales representative and local service representative.
- .5 Submit individual engraving sheets for each lighting control switch. Provide each engraving sheet complete with room number, and a unique switch identifier. Cross reference each switch on the dimensioned lighting control drawings as noted in section 1.3.1.

1.4 MAINTENANCE MATERIALS

- .1 Provide the following information for maintenance materials as per Section 01 78 00 - Closeout Submittals.
 - .1 Provide, at the completion of the project, operation and maintenance materials for inclusion in the Operation and Maintenance Manual. These materials, at a minimum, include product data, shop drawings, updated single line diagram (indicating any modifications, additions or subtractions made from the time of Tender to the completion of construction), CD version of the operating software including graphical interface software, letter verifying installation, letter verifying start-up and commissioning. Provide quantity of Operation and Maintenance materials as required, however, not more than three (3) copies.
- .2 Provide, at the completion of the project, separate pricing for individual components (and associated auxiliaries). Submit pricing for any other components or services which may be deemed necessary. Pricing to include for the supply, delivery as well as any associated programming of such components. Submitted pricing must be valid for one (1) year from the date of Substantial Completion and be specifically identified by the Vendor.
- .3 Provide, at the completion of the project, a listing of recommended spare components with which may be deemed necessary under normal operation of:

- .1 1000 hours
- .2 One (1) year
- .3 Three (3) years
- .4 Five (5) years

1.5 QUALITY ASSURANCE

- .1 Products to be manufactured by a firm regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in successfully used in similar service for not less than five (5) years.

1.6 SUBSTITUTIONS

- .1 Submit pricing based on the performance specification and drawings provided however alternate lighting control systems and associated products may be proposed provided they meet the requirements of the specifications. For all systems and/or products proposed, include a complete description of the system and operation as well as a description of variances from the specified system.
- .2 Identify any discrepancies between the specifications and proposed products and system, with full description of the variance from the specifications as well as reference to the specification item.
- .3 Alternate system pricing must include all associated modifications and additions related to materials, labour, wiring, etc., necessary for a fully installed, functional and commissioned system.

1.7 SYSTEM DESCRIPTION

- .1 Lighting control system specified in this section to provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
- .2 System must be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Specific dimmers will be capable of dimming lights to off.
- .3 System devices to be networked together, enabling digital communication between devices, and shall be individually addressed.

- .4 System architecture must be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity, even if network connectivity to the greater system is lost.
- .5 System architecture to facilitate remote operation via a computer connection.
- .6 System must not require any centrally hardwired switching equipment.
- .7 All components must be hard wired. Systems which rely on wireless communication of any type will not be accepted.
- .8 System software must provide real time status of each device, each zone, and each group.
- .9 Lighting control system must be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on line PC or server for normal operation are not acceptable
- .10 Have all devices pre-addressed at the factory. Field addressing is not acceptable.
- .11 All programs, schedules, time of day, etc., must be held in non-volatile memory for a minimum of ten (10) years at power failure. At restoration of power, lighting control system must implement programs required by current time and date without external support from PC or servers.
- .12 System must be capable of flashing lights Off/On any relay or any zone prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal must be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.
- .13 System must be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, specification grade line voltage type wall switches, photocell, occupancy sensor, web based software or other devices connected to programmable inputs in a lighting controllers.
- .14 System may consist of centralized controllers, relay/dimming packs, digital switches, photocells, occupancy sensors and various digital interfaces. Verify exact type and quantity of system components which are required based on the lighting

controls design and the proposed lighting control system. Wire all devices connected to the lighting control system as per lighting control manufacturer's instructions.

- .15 Equip the system with a minimum of 10% spare capacity for addition of future devices.
- .16 The following section describes the general system operation and control requirements for the majority of the building spaces, specifics regarding quantities, controls and locations of required devices are indicated on the drawings. Note that it is intended that all lighting control zones shall have the ability to be controlled from the time clock for both on and off functions:
 - .1 Exterior Lighting: In general the exterior lighting will be switched LED luminaires. Exterior lighting to be controlled via the digital time clock based on sunrise and sunset times for Cavendish, PEI.
 - .2 Perimeter Office/Meeting Rooms: In general equip perimeter spaces with access to daylight with dimmable LED luminaires and photocell(s) to provide continuous analog dimming based on available ambient lighting. A programmable switch will provide manual override of the automatic daylight harvesting, allowing the user to manually turn the lights on, increase the artificial lighting level, decrease the artificial lighting level and turn the lighting off. An occupancy sensor will automatically turn the lighting off after an adjustable time delay.
 - .3 Interior Office: In general equip interior office and meeting rooms with limited or no direct access to daylight with dimmed LED luminaires. Programmable switch(es) will provide manual control to turn the lighting on or off and raise/lower the lighting levels. Occupancy sensor(s) will automatically turn the lighting off after an adjustable time delay.
 - .4 Interior Corridors/Lobby Area: In general equip interior corridors and lobby spaces with dimmed LED luminaires. Provide lighting control from the digital time clock to turn the lighting on during normal working hours. Outside normal working hours occupancy sensor(s) will automatically turn the lighting on and off after an adjustable time delay. Manual override to raise lower lighting.
 - .5 Service Rooms: In general, equip the service spaces such as electrical, mechanical and telecommunications rooms with switched LED luminaires. Programmable switch(es) will provide manual control to turn the lighting on or off, no automated control (time clock or occupancy sensor) for these spaces is required unless specifically identified otherwise on the drawings.

- .6 Integration with Building Systems: incorporate separate control signal inputs from the various building systems into the lighting control system. The building systems include: fire alarm, security/intrusion alarm and access control. The inputs are to be N/O contacts and will be provided to the centralized relay panel located in the basement level. Each input is to act as a "master switch" turning on or off various lighting control circuits throughout the building. Include a total of twenty (20) inputs (and associated control outputs).

2 PRODUCTS

2.1 MATERIAL AND COMPONENTS

- .1 Low Voltage Control Stations:
 - .1 Devices to recess into single-gang switch box and fit a standard coverplate.
 - .2 Communication and low voltage power shall be delivered to each device via standard CAT6 low voltage cabling with RJ-45 connectors.
 - .3 All devices to have two (2) RJ-45 ports.
 - .4 All devices must provide push-button switch control for each zone. Devices controlling dimming zones to include raise/lower push buttons for each zone.
 - .5 Devices to be white.
 - .6 Devices with mechanical push-buttons shall provide tactile and LED user feedback.
 - .7 Devices with mechanical push-buttons to include custom button labeling. Confirm labeling requirements of all buttons with Owner prior to ordering.
 - .8 Devices with a single "on" button must be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
- .2 Networked Photocells (Daylight Sensors):
 - .1 Photocell to provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay to be incorporated into the photocell to prevent rapid response to passing clouds.
 - .2 Photocell and dimming sensor's set-point and deadband to be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

- .3 Program photocell and dimming sensor set points as a measured illuminance value (lux or foot-candle).
 - .4 Deadband setting will be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
 - .5 Equip photocell and dimming sensors with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
 - .6 Combination units that have all features of on/off photocell and dimming sensors must also be available.
 - .7 A dual zone option to be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone must be capable of being controlled as an "offset" from the primary zone.
- .3 Networked Occupancy Sensors:
- .1 Occupancy sensors to sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 - .2 Sensors to be of the dual-technology type.
 - .3 Dual technology sensors to have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
 - .4 All sensing technologies must be acoustically passive, meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
 - .5 Sensors to be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
 - .6 Sensors to be available with one or two occupancy "poles", each of which provides a programmable time delay.
 - .7 All occupancy sensors will be initially programmed for a 10 minute time delay.
 - .8 Sensors to be available in multiple lens options which are customized for specific applications.
 - .9 Sensors to have an optional photocell for dimming control. Photocell to meet the requirements of article 2.1.2 above.

- .10 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT6 low voltage cabling with RJ-45 connectors.
 - .11 Sensors to have two (2) RJ-45 ports or capable of utilizing a splitter.
 - .12 Sensors to have the ability to detect when it is not receiving valid communication (via CAT6 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
 - .13 Every sensor parameter must be available and configurable remotely from the software and locally via the device push-button.
 - .14 Sensors must be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT6 cabling.
 - .15 Equip sensors with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
- .4 Control Module (Gateway):
- .1 Control module to be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet network.
 - .2 The control module shall support native BACnetIP communications for integration with the building automation system (BAS).
 - .3 Devices to have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
 - .4 Control device to have three RJ-45 ports for connection to the graphic touch screen, other backbone devices bridges) or directly to lighting control devices (up to 128 per port).
 - .5 Device to automatically detect all devices downstream of it.
 - .6 Device to have a standard and astronomical internal time clock.
 - .7 Device to have one RJ-45 10/100 BaseT Ethernet connection.
 - .8 Device to have a USB port.
 - .9 Each control gateway device shall be capable of linking 1500 devices to the management software, with reduced memory version capable of support up to 400 devices.
 - .10 Device must be capable of using a dedicated static or DHCP assigned IP address.
- .5 Networked System Power (Relay) Packs:
- .1 Power Packs to incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system. Secondary Packs to incorporate the

- relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power. Power Supplies to provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
- .2 Power Packs must accept 120 VAC, be plenum rated, and provide Class 2 power to the system.
 - .3 All devices shall have two RJ-45 ports.
 - .4 Every Power Pack parameter must be available and configurable remotely from the software and locally via the device push-button.
 - .5 Securely mount the Power Pack to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring must pass through chase nipple into adjacent junction box without any exposure of wire leads.
 - .6 When required by local code, Power Pack must install inside standard electrical enclosure and provide ULC recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
 - .7 For switching-only zones, Power Packs to provide up to 16 Amp switching of all lighting load types.
 - .8 For dimming zones, Power Packs to provide up to 16 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
 - .9 Power Packs for emergency lighting to be UL924 listed for switching of Emergency Power circuits.
 - .10 Power (Secondary) Packs must be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.
- .6 Networked System Relay & Dimming Panels:
- .1 Panel to incorporate up to four (4) normally closed latching relays capable of switching 120 VAC or up to 2 Dual Phase relays capable of switching 208 VAC loads.
 - .2 Relays to be rated to switch up to a 30A ballast load at 277 VAC.
 - .3 Panel to provide one 0-10VDC dimming output paired with each relay.
 - .4 Panel to power itself from an integrated 120 VAC supply.
 - .5 Panel to be capable of operating as either two networked devices or as one.
 - .6 Panel to supply current limited low voltage power to other networked devices connected via CAT6.
 - .7 Panel to provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.

.7 Networked Auxiliary Input / Output (I/O) Devices:

- .1 Devices to be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a 12mm knockout.
- .2 Devices to have two (2) RJ-45 ports
- .3 Communication and low voltage power to be delivered to each device via standard CAT6 low voltage cabling with RJ-45 connectors.
- .4 Specific I/O devices to have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current.
- .5 Specific I/O devices to have an input that reads a 0-10 VDC signal from an external device.
- .6 Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
- .7 Specific I/O devices to sense state of low voltage outdoor photocells.
- .8 Specific I/O devices must enable RS-232 communication between lighting control system and a future Touch Screen based A/V control systems.
- .9 Specific I/O devices to sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).

.8 Communication Bridges:

- .1 Device to surface mount to a standard 100mm x 100mm square junction box.
- .2 Device to have eight (8) RJ-45 ports.
- .3 Device must be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
- .4 Device to be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT6 cabled connection.
- .5 Device must be capable of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

.9 Management Software:

- .1 Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.

- .2 The following status monitoring information must be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- .3 The following device identification information to be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- .4 A printable network inventory report to be available via the software.
- .5 A printable report detailing all system profiles shall be available via the software.
- .6 Software to require all users to login with a User Name and Password.
- .7 Software to provide at least three (3) permission levels for users.
- .8 All sensitive stored information and privileged communication by the software shall be encrypted.
- .9 All device firmware and system software updates must be available for automatic download and installation via the internet.
- .10 Software shall be capable of managing systems interconnected via a WAN (wide area network).
- .11 Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- .12 Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- .13 All relays and dimming outputs must be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- .14 Specific device parameters (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- .15 All lighting control profiles to be stored on the network control gateway device, with a system backup on the software's host server.
- .16 Lighting control profiles must be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

- .17 Sunrise/sunset times to be automatically derived from location information using an astronomical clock.
 - .18 Daylight savings time adjustments shall be capable of being performed automatically, if desired.
 - .19 Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
 - .20 Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.
- .10 Building Automation System (BAS) Integration:
- .1 System to provide a BACnet IP gateway as an integral part of the system.
 - .2 BACnet IP connection to be utilize a BTL-listed gateway incorporated with the main system control module.
 - .3 BACnet IP hardware must be capable of supporting up to 1500 total devices across up to 5 total Gateways
 - .4 BACnet IP connection to communicate information gathered by networked system to other building management systems.
 - .5 BACnet IP connection to translate and forward lighting relay and other select control commands from BMS system to networked control devices via profiles stored in the system Gateway. All system devices must be available for polling for devices status.
 - .6 The following status monitoring information will be sent to the BAS system for all devices: current occupancy status, current occupancy sensor status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, and device relay state(s).
 - .7 The system must comply with the Owner's BACnet procedures and implementation requirements.

3 EXECUTION

3.1 EQUIPMENT INSTALLATION

- .1 Install and verify the lighting control system and associated components. Have this verification completed by a Factory trained manufacturer's representative.
- .2 Mount control cabinets in electrical rooms. Cabinet to be wall mounted or installed in ceiling spaces. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each panel and each digital switch from dust and debris. Repair or replace any damage done to electronic components due to non-protection.

- .3 Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. Supply and install the required low voltage cable, if required. Field-test all cables with a recognized cable tester. Run all low voltage wiring in conduit.
- .4 Wiring:
 - .1 Provide all wiring required for the system. Network cabling shall meet the requirements of Section 27 05 13 - Structured Cabling for Communications Systems. Other wiring shall meet the requirements of 26 05 21 - Wires and Cables (0 - 1000V).
 - .2 Install all low voltage wiring in accordance with Section 27 05 13 - Structured Cabling for Communications Systems.
 - .3 All Category 6 cabling used for the lighting control system network shall be Green in colour. Cables which connect the lighting control system to the Owner's IT network shall be blue in colour.
 - .4 All Category 6 cabling shall be fully terminated and tested prior to the initial system set-up. Tests are to be in accordance with the requirements of Section 27 05 13 - Structured Cabling for Communications Systems. Contractor to provide test results in writing to the Departmental Representative prior to scheduling the system set-up.
 - .5 Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
 - .6 Confirm low voltage conduits or control wires do not run parallel to current carrying conduits.
 - .7 Place manufacturer supplied terminators at each end of the system bus per manufacturers' instructions.
 - .8 Neatly lace and rack wiring in cabinets, as required.
 - .9 Do not exceed manufacturer's recommendations for wire length for the system bus.
 - .10 Install the specified lighting control system and make all necessary wiring connections to external devices and equipment, to include photocell. Wire per manufacturer instructions.

3.2 INSTALLATION AND SET-UP

- .1 Coordinate all programming and operation requirements with the Departmental Representative prior to programming of the lighting control system functions. Arrange a meeting with the Manufacturer's representative and the Departmental Representative at a location determined by the Owner to coordinate these requirements.

- .2 Prior to initial system set-up, arrange a meeting with the Manufacturer's representative, Departmental Representative, and Building Automation System (BAS) vendor to review the requirements.
- .3 Before Substantial Completion, arrange and provide a one-day instruction period to designated facility personnel provided by a Factory trained manufacturer's representative.
- .4 Set-up, commissioning of the lighting control system, and user instruction includes:
 - .1 Confirmation of entire system operation and communication to each device.
 - .2 Confirmation of operation of individual devices, switches, occupancy sensors and daylight sensors
 - .3 Confirmation of system Programming, photocell settings, override settings, etc.
 - .4 Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.
- .5 Request facility representation at the training by means of a project Request for Information, RFI and suggest at least four (4) dates with at least ten (10) working days' notice prior to the training.
- .6 Provide a written record of the training, including a copy of the sign-in sheet, to the Commissioning Agent for inclusion in the commissioning manual.
- .7 Service and Operation Manuals:
 - .1 Submit operation and service manuals. Submit complete manuals to the Electrical contractor for inclusion in a binder. Refer to other sections of the project specifications for numbers of required copies of the service and operation manuals. Provide at least one (1) electronic copy of the Service and Operations Manuals and submit it to the project Commissioning Agent.
 - .2 Manuals to include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals to include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Submit programming forms of systems with complete information.

- .8 Verify conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's plans and approved shop drawings for location of line and low-voltage areas. Verify with lighting control manufacturer all catalogue information and specific product acceptability.
- .9 Test all low voltage cable for integrity and proper operation prior to initial system set-up. Verify with system manufacturer all wiring and testing requirements. Test all Category 6 cables in accordance with the requirements of Section 27 05 13 - Structured Cabling for Communications Systems.
- .10 Locate panels and relay packs so that they are readily accessible and not exposed to physical damage. Mark location of all system components including sensors, relay packs, panels, etc. on the as-built drawings.
- .11 Furnish panel locations with sufficient working space around panels to comply with the Canadian Electrical Code.
- .12 Securely fasten panels to the mounting surface by at least four (4) points.
- .13 Unused openings in the cabinet must be effectively closed.
- .14 Ground cabinets as specified in the Canadian Electrical Code.
- .15 Lugs must be suitable and listed for installation with the conductor being connected.
- .16 Maintain conductor lengths to a minimum within the wiring gutter space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- .17 Maintain the required bending radius of conductors inside cabinets.
- .18 Clean cabinets of foreign material such as cement, plaster and paint.
- .19 Distribute and arrange conductors neatly in the wiring gutters.
- .20 Follow the manufacturer's torque values to tighten lugs.
- .21 Before energizing the panelboard, take the following steps:
 - .1 Retighten connections to the manufacturer's torque specifications. Verify required connections have been furnished.

- .2 Remove shipping blocks from component devices and the panel interior.
- .3 Remove debris from panelboard interior.
- .22 Follow manufacturers' instructions for installation and all low voltage wiring.

3.3 SEQUENCE OF OPERATION

- .1 General:
 - .1 Set lighting control zones controlled by occupancy sensors to 10 minute time delay.
 - .2 Set zones controlled by daylight sensors to 100% output when the lights are initially turned on. After a preset time delay, the lights must gradually dim to the level set by the daylight sensor in order to meet the configured illuminance level. The preset time delays and illuminance levels must be configurable.
 - .3 Refer to the Project Drawings for sequences of operation for each space type. Provide a detailed sequence of operation for each room in the building to the Departmental Representative for review prior to system installation.

3.4 BAS INTEGRATION

- .1 Complete integration of the lighting control system with the building automation system (BAS) in accordance with the Owner's BACnet procedures and implementation requirements.
- .2 Connect lighting control system to building automation system (BAS) via BACnet interface.
- .3 Provide all instance numbers required for the project.

Supervisory Level Controller (Device) Names (L2-BACNETIP panels):

VIS-123-LCDX, BUS 4 - Level 4 & 5

VIS = the visitor's centre

123 = the Room Number within the Building

X denotes sequential numbering.

BUS 4 - Level 4 & 5 = BUS Number and Description of
Areas Serviced

Object Names:

DOS.LTG.RM-135.ZnX

Relay Status. (On/Off). X denotes geographical
reference N, S, E, or W

DOS.LTG.RM-135.OccSensor

Occupancy Sensor Status (On/Off). Physically the status of a Ghost Relay that is controlled by a Scene.

DOS.LTG.RM-135.ZnXDIM
Dimming Output (0 - 100%). LCP output to the ballast (0% = Off, 100% = Full Illumination). A conversion from the field 0 - 10 VDC will be required to comply with the standard of displaying the capacity in 0 - 100%.

DOS.LTG.RM-135.PhCell
Photocell Level (0 - 1000)

DOS.LTG.RM-135.PhCell_START
Photocell START Trigger (0 - 1000)

DOS.LTG.RM-135.PhCell_OFF
Photocell OFF Trigger (0 - 1000)

Where:

DOS = Acronym for the Building Name.

RM-135 = Room number (confirm with Owner prior to system integration)

X = Zone within the Room

3.5 DOCUMENTATION

- .1 Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" must indicate the loads controlled by each relay and the identification number for placement of switches and location of photocell. Give the original to the Departmental Representative and place copies inside the Communications Room.

3.6 COMMISSIONING

- .1 Refer to Section 01 91 13 -Commissioning General Requirements.

3.7 SERVICE AND SUPPORT

- .1 Start Up: At least seven (7) days before turnover of project, have the vendor run diagnostics and confirm system programming. This can be done on site or remotely via telephone or data connection.
- .2 Telephone factory support must be available at no additional cost to the Contract both during and after the warranty period. Factory to pre-program the lighting control system per plans and approved submittal, to the extent data is available. Have the specified manufacturer, at no added cost, provide additional

remote programming via modem as required by the Departmental Representative for the operation life of the system. Upon request manufacturer to provide remote dial up software at no added cost to the Contract. No exceptions.

- .3 Provide a factory trained representative for on-site training of the owners' representatives and maintenance personnel. Coordinate timing with the Departmental Representative a minimum of three (3) weeks in advance. Provide a minimum of two (2) days of factory on-site training.
- .4 Provide one (1) additional site visit after building occupancy to review daylight sensor set-points once Owner-supplied furniture, fittings, and equipment have been installed.

3.8 WARRANTY

- .1 Provide a minimum of one (1) year warranty on the entire lighting control system including components, software and hardware. The warranty will begin on the date of substantial completion as agreed by the Departmental Representative and Contractor.

END OF SECTION

1 GENERAL

1.01 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Fittings

1.02 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

1.03 OPERATION AND MAINTENANCE DATA

- .1 Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00 - Closeout Submittals.

1.04 REFERENCES

- .1 CAN/CSA C22.2 No. 141-15, Emergency Lighting Equipment

2 PRODUCTS

2.01 BATTERY UNIT

- .1 Supply voltage: 120 VAC.
- .2 Output voltage: 12 VDC.
- .3 Operating time: 90 min. based on actual DC load plus.
- .4 Battery: sealed, maintenance free, ten (10) year life warranty.
- .5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .6 Solid state transfer circuit.

- .7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .8 Signal lights: LED solid state, for 'AC Power ON' and 'High Charge'.
- .9 Lamp heads: integral on unit, 345 horizontal and 180 vertical adjustment. Lamp type: LED.
- .10 Cabinet: surface mounted steel cabinet, suitable for wall mounting.
- .11 Finish: white.
- .12 Auxiliary equipment:
 - .1 Test switch.
 - .2 Self-Diagnostic circuitry.

2.02 REMOTE UNIT

- .1 12Vdc double head remote units, suitable for wall or ceiling mounting.
- .2 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: LED MR16.

2.03 INVERTER SYSTEM

- .1 Input supply voltage: 120 VAC, 1 phase, 2 wire, plus ground.
- .2 Output voltage: 120 VAC, 1 phase, 2 wire, plus ground.
- .3 Pure sine wave inverter.
- .4 Operating Time: minimum 30 minutes based on rated capacity.
- .5 Capacity: minimum 300W, or as indicated. Capacity of the inverter and associated batteries shall match the connected load plus 10% spare capacity minimum. Sizing to be based on manufacturers standard production products.
- .6 Feed the emergency lighting inverter from Panel LP.1 and supply power to lighting circuits all emergency lighting circuits. Refer to panel schedules on drawings for quantity and size of output breakers.
- .7 Unit be certified to CSA C22.2 No. 141 requirements and be suitable for use as an emergency power source for emergency

lighting in Canada, meeting or exceeding the requirements of the National Building Code and the Canadian Electrical Code.

- .8 Auto test self diagnostics.
- .9 Test switch, momentary contact type.
- .10 Surface mounted steel housing. Mount inverter on wall in Electrical Room.
- .11 Lighting fixtures in which the inverter system serves to operate under normal conditions from lighting system control inputs. Inverter systems which require a separate fixture control or additional fixtures to achieve emergency lighting requirements are not acceptable.
- .12 Upon utility power loss, the inverter will deliver 100% of its rated output to the emergency fixtures.

3 EXECUTION

3.01 INSTALLATION

- .1 Install equipment and fixtures as indicated.
- .2 Make connections.
- .3 Test and verify operation of units upon loss and restoration of normal ac power. Verify 60 minute battery life upon loss of power.
- .4 Feed the emergency lighting system from the same circuit which feeds the normal lights in that area or as indicated on the drawings.
- .5 Install mini-inverter systems on the wall or manufacturer provided mounting shelf in electrical rooms. Connect to emergency lighting circuit and loads as indicated on the drawings.
- .6 Provide the necessary quantity and capacity of inverter systems to service the connected emergency lighting load for the floor area in which each unit(s) are intended to service and for the specified time and capacity.

END OF SECTION

1 GENERAL

1.01 PRODUCT DATA

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

1.02 OPERATION AND MAINTENANCE DATA

- .1 Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00 - Closeout Submittals

1.03 REFERENCE

- .1 CAN/CSA-C860-11 (R2016), Performance of Internally Lighted Exit Signs.
- .2 CAN/CSA C22.2 No. 141-10 (R2015), Emergency Lighting Equipment.

2 PRODUCTS

2.01 STANDARD UNITS

- .1 Housing: extruded, one-piece aluminum housing and face plates.
- .2 Lamps: One (1) LED-2W panel 120Vac, 219,000 h.
- .3 Operation: designed for 219,000 h, LED panel only, 120Vac/12 V dc, self-powered for 2 hours operation upon power failure.
- .4 "Running Man" type face plates per NBCC and CSA C22.2 No. 141, with arrows as indicated on the drawings.
- .5 Housing finish: white.
- .6 Unit to operate on 12 V DC under emergency conditions.
- .7 Mounting: unit to have universal mounting position and single or double face with arrows as indicated.
- .8 Ten (10) year life warranty.

3 EXECUTION

3.01 INSTALLATION

- .1 Install exit lights.
- .2 Connect fixtures to exit light circuits as indicated on the drawings.
- .3 Confirm exit light circuit breaker is locked in the "on" position.

3.02 COMMISSIONING

- .1 Refer to Section 01 91 13 - General Commissioning Requirements.

END OF SECTION