

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS**
- .1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
 - .2 Section 26 29 03 - Control Devices.
- 1.2 REFERENCES**
- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
 - .2 Reference Standards:
 - .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
 - .2 CSA Group
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No. 0-10, General Requirements - Canadian Electrical Code, Part II, Includes Update No. 1 (2011).
 - .3 CSA C22.3 No. 1-10, Overhead Systems.
 - .4 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS**
- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit for review single line electrical diagrams under plexiglass and locate within each electrical room.
 - .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit required number of copies of drawings and product data to inspection authorities.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
 - .4 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.

1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)	<div>.4</div> <div>Certificates:(Cont'd)</div> <div><div>.3</div><div>Submit test results of installed electrical systems and instrumentation.</div></div> <div><div>.4</div><div>Permits and fees: in accordance with General Conditions of contract.</div></div> <div><div>.5</div><div>Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.</div></div> <div><div>.6</div><div>Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative .</div></div> <div><div>.5</div><div>Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.</div></div>
1.4 CLOSEOUT SUBMITTALS	<div>.1</div> <div>Submit in accordance with Section 01 78 00 - Closeout Submittals.</div> <div>.2</div> <div>Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.</div> <div><div>.1</div><div>Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.</div></div> <div><div>.2</div><div>Operating instructions to include following:</div><div><div>.1</div><div>Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.</div></div><div><div>.2</div><div>Start up, proper adjustment, operating, lubrication, and shutdown procedures.</div></div><div><div>.3</div><div>Safety precautions.</div></div><div><div>.4</div><div>Procedures to be followed in event of equipment failure.</div></div><div><div>.5</div><div>Other items of instruction as recommended by manufacturer of each system or item of equipment.</div></div></div> <div><div>.3</div><div>Print or engrave operating instructions and frame under glass or in approved laminated plastic.</div></div> <div><div>.4</div><div>Post instructions where directed.</div></div> <div><div>.5</div><div>For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.</div></div> <div><div>.6</div><div>Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.</div></div>
1.5 DELIVERY, STORAGE AND HANDLING	<div>.1</div> <div>Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.</div> <div>.2</div> <div>Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.</div> <div>.3</div> <div>Storage and Handling Requirements:</div> <div><div>.1</div><div>Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.</div></div> <div><div>.2</div><div>Store and protect all materials from nicks, scratches, and blemishes.</div></div> <div><div>.3</div><div>Replace defective or damaged materials with new.</div></div>
1.6 Arc Flash Hazard Analysis	<div>.1</div> <div>Arc Flash Hazard Analysis</div> <div><div>.1</div><div>The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.</div></div> <div><div>.2</div><div>The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear,</div></div>

1.6 Arc Flash
Hazard Analysis
(Cont'd)

- .1 (Cont'd)
 - .2 (Cont'd)

motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
 - .3 The Arc-Flash Hazard Analysis shall include all locations in the systems.
 - .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
 - .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
 - .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
 - .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
 - .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
 - .9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
 - .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
 - .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific situation.
- .2 The electrical contractor shall ensure that the recommendations of the study are implemented as part of the contract.

PART 2 - PRODUCTS

- 2.1 DESIGN REQUIREMENTS**
- .1 Operating voltages: to CAN3-C235.
 - .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
 - .3 Language operating requirements: provide identification nameplates and labels for control items in English.
- 2.2 MATERIALS AND EQUIPMENT**
- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .3 Factory assemble control panels and component assemblies.
- 2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**
- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
 - .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices.
- 2.4 WARNING SIGNS**
- .1 Warning Signs: in accordance with requirements of Departmental Representative.
 - .2 Decal signs, minimum size 175 x 250 mm.
- 2.5 WIRING TERMINATIONS**
- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.
- 2.6 EQUIPMENT IDENTIFICATION**
- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamcoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

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

**2.6 EQUIPMENT
IDENTIFICATION
(Cont'd)**

- .1 (Cont'd)
- .2 Sizes as follows:(Cont'd)
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|--------|-------------|---------|--------------------|
| Size 6 | 25 x 100 mm | 1 line | 12 mm high letters |
| Size 7 | 25 x 100 mm | 2 lines | 6 mm high letters |
- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO." as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

**2.7 WIRING
IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

**2.8 CONDUIT AND
CABLE
IDENTIFICATION**

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

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue
Communication Systems		
Fire Alarm	Red	
Emergency Voice	Red	Blue

2.8 CONDUIT AND
CABLE
IDENTIFICATION
(Cont'd)

.3 Colours:(Cont'd)

Other Security Systems	Red	Yellow
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2.9 FINISHES

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

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND
LABELS

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

3.3 CONDUIT AND
CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
- .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF
OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
- .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

**3.5 MOUNTING
HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1200 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Data outlets: 400 mm.
 - .5 Fire alarm stations: 1200 mm.
 - .6 Fire alarm bells: 2100 mm.

**3.6 CO-ORDINATION
OF PROTECTIVE
DEVICES**

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

**3.7 FIELD QUALITY
CONTROL**

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.7 FIELD QUALITY CONTROL (Cont'd)	.5	Manufacturer's Field Services: <ul style="list-style-type: none">.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS..2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
3.8 SYSTEM STARTUP	.1	Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
	.2	Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
	.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 aspects of its care and operation.
3.9 Arc Flash Warning Labels	.1	The contractor of the Arc Flash Hazard Analysis shall provide a 89 mm x 127 mm (3.5 in. x 5 in.) thermal transfer type label of high adhesion polyester for each work location analyzed.
	.2	All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
	.3	The label shall include the following information, at a minimum: <ul style="list-style-type: none">.1 Location designation.2 Nominal voltage.3 Flash protection boundary.4 Hazard risk category, PPE.5 Incident energy.6 Working distance.7 Engineering report number, revision number and issue date..8 Labels shall be machine printed, with no field markings.
	.4	Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings. <ul style="list-style-type: none">.1 For each 600, and applicable 208 volt panelboard, one arc flash label shall be provided..2 For each motor control center, one arc flash label shall be provided..3 For each low voltage switchboard, one arc flash label shall be provided..4 For each switchgear, one arc flash label shall be provided..5 For medium voltage switches one arc flash label shall be provided.
3.10 CLEANING	.1	Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. <ul style="list-style-type: none">.1 Leave Work area clean at end of each day.
	.2	Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.10 CLEANING
(Cont'd)

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

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Section 26 05 00 - Common Work Results for Electrical.
<u>1.2 DEFINITIONS</u>	.1	Priority Two (P2) Buildings: buildings in which life safety is paramount concern. It is not necessary that P2 buildings remain operative during or after an earthquake.
	.2	SRS: acronym for Seismic Restraint System.
<u>1.3 GENERAL DESCRIPTION</u>	.1	This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project. This includes electrical light fixtures, conduit, electrical equipment and systems, both vibration isolated and statically supported.
	.2	SRS to be fully integrated into, compatible with: .1 Noise and vibration controls specified elsewhere in this project specification. .2 Structural, mechanical, electrical design of project.
	.3	During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
	.4	Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Division 26 to include all costs associated with this work as it relates to Division 26 installations. Submit design sketches c/w professional stamp prior to start of installations, c/w installation requirements.
<u>1.4 SUBMITTALS</u>	.1	Submit shop drawings and product data in accordance with Section 26 05 00 - Common Work Results for Electrical.
	.2	Submittals to include: .1 Full details of design criteria.
	.3	Submit additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.
<u>1.5 MAINTENANCE DATA</u>	.1	Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 26 05 00 - Common Work Results for Electrical.

PART 2 - PRODUCTS

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| <u>2.1 SRS
MANUFACTURER</u> | .1 | SRS to be from one manufacturer regularly engaged in production of same. |
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| <u>2.2 GENERAL</u> | .1 | SRS to provide gentle and steady cushioning action and avoid high impact loads |
| | .2 | SRS to restrain seismic forces in all directions. |
| | .3 | Fasteners and attachment points to resist same load as seismic restraints. |
| | .4 | SRS of conduit systems to be compatible with:
.1 Expansion, anchoring and guiding requirements.
.2 Equipment vibration isolation and equipment SRS. |
| | .5 | SRS utilizing cast iron, threaded pipe, other brittle materials not permitted. |
| | .6 | Attachments to RC structure:
.1 Use high strength mechanical expansion anchors.
.2 Drilled or power driven anchors not permitted. |
| | .7 | Seismic control measures not to interfere with integrity of firestopping. |
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| <u>2.3 SRS FOR STATIC
EQUIPMENT, SYSTEMS</u> | .1 | Floor-mounted equipment, systems:
.1 Anchor equipment to equipment supports.
.2 Anchor equipment supports to structure.
.3 Use size of bolts scheduled in approved shop drawings. |
| | .2 | Suspended equipment, systems:
.1 Use one or combination of following methods:
.1 Install tight to structure.
.2 Cross-brace in all directions.
.3 Brace back to structure.
.4 Slack cable restraint system.
.2 SRS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
.3 Hanger rods to withstand compressive loading and buckling. |
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| <u>2.4 SRS FOR
VIBRATION ISOLATED
EQUIPMENT</u> | .1 | Floor mounted equipment, systems:
.1 Use one or combination of following methods:
.1 Vibration isolators with built-in snubbers.
.2 Vibration isolators and separate snubbers.
.3 Built-up snubber system approved by Engineer, consisting of structural elements and elastomeric layer.
.2 SRS to resist complete isolator unloading.
.3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
.4 Cushioning action to be gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads. |

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| <u>2.4 SRS FOR
VIBRATION ISOLATED
EQUIPMENT
(Cont'd)</u> | <ul style="list-style-type: none">.2 Suspended equipment, systems:<ul style="list-style-type: none">.1 Use one or combination of following methods:<ul style="list-style-type: none">.1 Slack cable restraint system..2 Brace back to structure via vibration isolators and snubbers. |
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PART 3 - EXECUTION

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| <u>3.1 INSTALLATION</u> | <ul style="list-style-type: none">.1 Attachment points and fasteners:<ul style="list-style-type: none">.1 To withstand same maximum load that seismic restraint is to resist and in all directions..2 Install SRS at least 25 mm from all other equipment, systems, services..3 Miscellaneous equipment not vibration-isolated:<ul style="list-style-type: none">.1 Bolt through house-keeping pad to structure..4 Co-ordinate connections with all disciplines. |
| <u>3.2 INSPECTION AND
CERTIFICATION</u> | <ul style="list-style-type: none">.1 SRS to be inspected and certified by Manufacturer upon completion of installation..2 Provide written report stamped by professional Engineer licensed in Ontario to Engineer with signed certificate of compliance with the SRS design requirements. |
| <u>3.3 COMMISSIONING
DOCUMENTATION</u> | <ul style="list-style-type: none">.1 Upon completion and acceptance of certification, hand over to Engineer complete set of construction documents, revised to show "as-built" conditions. |

PART 1 - GENERAL

- 1.1 REFERENCES**
- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
 - .2 CSA International
 - .1 CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No. 65-13, Wire Connectors (Tri-national standard, with UL 486A-486B and NMX-J-543- ANCE), Includes Update No. 1 (2013).
 - .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
 - .4 National Electrical Manufacturers Association (NEMA)
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS**
- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.3 CLOSEOUT SUBMITTALS**
- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.
- 1.4 DELIVERY, STORAGE AND HANDLING**
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Pressure type wire connectors to: CAN/CSA-C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2, NEMA to consist of:
- .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors bar.
 - .5 Bolts for aluminum conductors bar.
 - .6 Sized for conductors tubes bars as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable flexible conduit, as required to: CAN/CSA-C22.2 No. 18.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Remove insulation carefully from ends of conductors and cables and:
- .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No. 65.
 - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No. 65. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2 & NEMA.
- 3.3 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

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| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 26 05 00 - Common Work Results for Electrical. |
| | .2 | Section 26 05 20 - Wire and Box Connectors - (0-1000 V). |
| | .3 | Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. |
| | .4 | Section 26 05 36 - Cable Trays for Electrical Systems. |
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| <u>1.2 PRODUCT DATA</u> | .1 | Provide product data in accordance with Section 01 33 00 - Submittal Procedures. |
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| <u>1.3 DELIVERY, STORAGE AND HANDLING</u> | .1 | Packaging Waste Management: remove for reuse and return of pallets, crates and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal. |

PART 2 - PRODUCTS

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| <u>2.1 BUILDING WIRES</u> | .1 | Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG. |
| | .2 | Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted for 120/208V circuits. Use 1000V conductor for 600V circuits. |
| | | |
| <u>2.2 TECK 90 CABLE</u> | .1 | Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical. |
| | .2 | Conductors: |
| | .1 | Grounding conductor: copper. |
| | .2 | Circuit conductors: copper, size as indicated. |
| | .3 | Insulation: |
| | .1 | Cross-linked polyethylene XLPE. |
| | .2 | Rating: 600 or 1000 V. |
| | .4 | Inner jacket: polyvinyl chloride material. |
| | .5 | Armour: flat interlocking aluminum. |
| | .6 | Overall covering: thermoplastic polyvinyl chloride. |
| | .7 | Fastenings: |
| | .1 | One hole zinc straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm. |
| | .2 | Channel type supports for two or more cables at 1500 mm centers. |
| | .3 | Threaded rods: 6 mm diameter to support suspended channels. |

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| <u>2.2 TECK 90 CABLE
(Cont'd)</u> | .8 | Connectors:
.1 Watertight, approved for TECK cable. |
| <u>2.3 ARMoured
CABLES</u> | .1 | Conductors: insulated, copper, size as indicated. |
| | .2 | Type: AC90. |
| | .3 | Armour: interlocking type fabricated from galvanized steel strip. |
| | .4 | Connectors: anti short connectors. |
| <u>2.4 CONTROL CABLES</u> | .1 | Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT: 4 soft annealed copper conductors, sized as indicated:
.1 Insulation: TW 40 degrees C.
.2 Shielding: tape coated with diamagnetic material wire metallized tapes over each conductor.
.3 Overall covering: polyethylene jackets. |

PART 3 - EXECUTION

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| <u>3.1 FIELD QUALITY
CONTROL</u> | .1 | Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical. |
| | .2 | Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation. |
| | .3 | Perform tests before energizing electrical system. |
| <u>3.2 GENERAL CABLE
INSTALLATION</u> | .1 | Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V). |
| | .2 | Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical. |
| | .3 | Conductor length for parallel feeders to be identical. |
| | .4 | Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points. |
| | .5 | Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated. |
| | .6 | Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted. |
| | .7 | Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring. |

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| <u>3.3 INSTALLATION
BUILDING WIRES</u> | .1 | Install wiring as follows: |
| | .1 | In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. |
|
 | | |
| <u>3.4 INSTALLATION OF
TECK 90 CABLE
(0-1000 V)</u> | .1 | Group cables wherever possible on channels. |
| | .2 | Install cable exposed, securely supported by straps. |
|
 | | |
| <u>3.5 INSTALLATION OF
ARMOURED CABLES</u> | .1 | Group cables wherever possible on channels. |
|
 | | |
| <u>3.6 INSTALLATION OF
CONTROL CABLES</u> | .1 | Install control cables in conduit. |
| | .2 | Ground control cable shield. |

PART 1 - GENERAL

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| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 26 05 00 - Common Work Results for Electrical. |
| | | |
| <u>1.2 REFERENCES</u> | .1 | Institute of Electrical and Electronics Engineers (IEEE) |
| | .1 | IEEE 837-2014, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding. |
| | .2 | CSA International |
| | .1 | CSA Z32-09 (R2014), Electrical Safety and Essential Electrical Systems in Health Care Facilities. |
| | | |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submit in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Product Data: |
| | .1 | Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations. |
| | | |
| <u>1.4 CLOSEOUT SUBMITTALS</u> | .1 | Submit in accordance with Section 01 78 00 - Closeout Submittals. |
| | .2 | Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual. |
| | | |
| <u>1.5 DELIVERY, STORAGE AND HANDLING</u> | .1 | Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions. |
| | .2 | Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address. |
| | .3 | Storage and Handling Requirements: |
| | .1 | Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area. |
| | .2 | Store and protect grounding equipment from nicks, scratches, and blemishes. |
| | .3 | Replace defective or damaged materials with new. |

PART 2 - PRODUCTS

- 2.1 EQUIPMENT**
- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
 - .2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
 - .3 Insulated grounding conductors: green, copper conductors, size as indicated.
 - .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
 - .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

PART 3 - EXECUTION

- 3.1 EXAMINATION**
- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied
- 3.2 INSTALLATION**
GENERAL
- .1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
 - .2 Install connectors in accordance with manufacturer's instructions.
 - .3 Protect exposed grounding conductors from mechanical injury.
 - .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to IEEE 837.
 - .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
 - .6 Soldered joints not permitted.
 - .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

<u>3.2 INSTALLATION GENERAL (Cont'd)</u>	.8	Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
	.9	Install separate ground conductor to outdoor lighting standards.
	.10	Install grounding resistance bank where required.
	.11	Connect building structural steel and metal siding to ground.
	.12	Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
	.13	Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.
<u>3.3 EQUIPMENT GROUNDING</u>	.1	Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, distribution panels, cable trays.
<u>3.4 GROUNDING BUS</u>	.1	Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
	.2	Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.
<u>3.5 COMMUNICATION SYSTEMS</u>	.1	Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
	.1	Telephones: make telephone grounding system in accordance with telephone company's requirements.
	.2	Sound, fire alarm, security systems, intercommunication systems as indicated.
<u>3.6 FIELD QUALITY CONTROL</u>	.1	Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
	.2	Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
	.3	Perform tests before energizing electrical system.
	.4	Disconnect ground fault indicator during tests.
<u>3.7 CLEANING</u>	.1	Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. .1 Leave Work area clean at end of each day.
	.2	Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.7 CLEANING
(Cont'd)

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

PART 1 - GENERAL

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| <u>1.1 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submit in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Product Data: <ul style="list-style-type: none">.1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations. |
| <u>1.2 DELIVERY, STORAGE AND HANDLING</u> | .1 | Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions. |
| | .2 | Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address. |
| | .3 | Storage and Handling Requirements: <ul style="list-style-type: none">.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area..2 Store and protect hangers and supports..3 Replace defective or damaged materials with new. |
| | .4 | Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal. |

PART 2 - PRODUCTS

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| <u>2.1 SUPPORT CHANNELS</u> | .1 | U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended. |
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PART 3 - EXECUTION

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|-------------------------|----|--|
| <u>3.1 EXAMINATION</u> | .1 | Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions. <ul style="list-style-type: none">.1 Visually inspect substrate in presence of Departmental Representative..2 Inform Departmental Representative of unacceptable conditions immediately upon discovery..3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative. |
| <u>3.2 INSTALLATION</u> | .1 | Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields. |
| | .2 | Secure equipment to poured concrete with expandable inserts. |

3.2 INSTALLATION
(Cont'd)

- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS .1 Section 26 05 00 - Common Work Results for Electrical.
- 1.2 REFERENCES .1 Canadian Standards Association (CSA International)
.1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.4 DELIVERY, STORAGE AND HANDLING .1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

- 2.1 SPLITTERS .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.
- 2.2 JUNCTION AND PULL BOXES .1 Construction:welded steel enclosure.
.2 Covers Flush Mounted: 25 mm minimum extension all around.
.3 Covers Surface Mounted: screw-on turned edge covers.
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PART 3 - EXECUTION

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| <u>3.1 SPLITTER
INSTALLATION</u> | .1 | Mount plumb, true and square to building lines. |
| | .2 | Extend splitters full length of equipment arrangement except where indicated otherwise. |
| | | |
| <u>3.2 JUNCTION, PULL
BOXES AND CABINETS
INSTALLATION</u> | .1 | Install pull boxes in inconspicuous but accessible locations. |
| | .2 | Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1. |
| | | |
| <u>3.3 IDENTIFICATION</u> | .1 | Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical. |
| | .2 | Identification Labels: size 2 indicating voltage and phase or as indicated. |
| | .3 | Identify junction boxes with panel/circuit/voltage. |

PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1	Canada Green Building Council (CaGBC)
	.1	LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
	.2	CSA International
	.1	CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
<u>1.2 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data:
	.1	Submit manufacturer's instructions, printed product literature and data sheets for network lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
	.3	Shop Drawings:
	.1	Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
	.2	Indicate on drawings:
	.1	Complete assembly.
	.2	Contact surfaces.
	.3	Construction features.
	.4	Wiring diagrams.
	.4	Samples:
	.1	Submit samples as follows:
	.1	1 of each type of control unit.
<u>1.3 CLOSEOUT SUBMITTALS</u>	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Operation and Maintenance Data: submit operation and maintenance data for network lighting controls for incorporation into manual.
<u>1.4 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.2	Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
	.3	Storage and Handling Requirements:
	.1	Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
	.2	Store and protect network lighting controls from nicks, scratches, and blemishes.
	.3	Replace defective or damaged materials with new.
	.4	Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste

**1.4 DELIVERY,
STORAGE AND
HANDLING
(Cont'd)**

- .4 Packaging Waste Management:(Cont'd)
Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 COMPONENTS

- .1 Components: to CSA C22.1.
- .2 Designed for lighting control for four switching zones via four relays.
- .3 Integrally moulded thermoplastic, colour coded black for normal and red for emergency circuits.
- .4 Certified to make or break under full rated load.
- .5 Quick change frames with pre-assembled relays, transformer rectification, multi-recessed control ports, and one power-in plug and five power-out receptacles.
- .6 Cable sets consisting of starter cables, joiner cables, and control cables.
- .7 Master Building Automation Control Panel (existing: presently located on penthouse floor east electrical room).
- .8 LIC covers shall be screw down split covers.
- .9 Lighting Integrated Control (LIC) modules shall have box dimensions of 450 mm x 500 mm.

2.2 ENCLOSURES

- .1 Enclosures designed for ceiling mounting with stand-off uni-directional brackets. Hinged fail safe cover with interceptor openings. Constructed of metal with safety blue paint, ventilated back with side air inlets, and complete with provisions for 24 multi-pin outlets.

2.3 FRAMES

- .1 Quick change frames are pre-installed into the enclosure and complete with ten control ports, one three wire 120VAC power-in plug and one three wire 120 VAC power out plug. Four-5 wire power-out receptacles with integral dimming control conductors (Hot, neutral, ground and a pair for future 0-10V analogue dimming. Four of the Power-out receptacles are controlled by internal low voltage relays connected to the control ports and controlled by a microprocessor based control card. Each of four (4) power-out five (5) wire receptacles is controlled by the integral microprocessor card. This card in turn is controlled by the central lighting control panel. Local LIC direct control shall be achieved by using one low voltage switch, a multiscene dimmer and/or one occupancy sensor kit. The remaining two control ports are for connection to the lighting control panel.
- .2 There shall be two blanked off removable covers on each side of the enclosure to permit up to 12 female six pin mini-connectors for future use.
- .3 Each enclosure shall contain two (2) 100VA transformers 120VAC to 24 VAC. For external Mechanical equipment, one (1) 100VA transformer, 120VAC to 24 VAC for lighting Control card equipment. Cards supplied at no charge from the successful Building Automation supplier (Division 25).

2.3 FRAMES
(Cont'd)

- .4 Each enclosure shall contain a microprocessor based lighting controller card mounted on a removable backplate. All connections to this controller from any other components in the box shall be of plug-in type to permit future removal of the lighting control module.
- .5 The lighting control card will control the lights directly connected from each respective LIC module.
- .6 Each LIC module shall have a dimming card with a unique address.

2.4 CABLE SETS

- .1 Two to nine conductor - No. 12 to 18 stranded Ultralx-105 armoured cable c/w integrally moulded male and/or female caps.
- .2 Factory assembled and integrally moulded.
- .3 Allow 2 metres extra cable for relocation of fixtures and equipment where required.
- .4 Joiner cables: integrally moulded male cap on one end and integrally moulded female cap on the other end.
- .5 Low voltage cables: one end prepared for field installation with locknutless box connector and 150 mm tails with mini-quick connector prepared for connection to low voltage switch kit or occupancy sensors kit. Other end complete with mini quick-connector for connection to the Smart-Light enclosure control ports.

2.5 LOW VOLTAGE SWITCH KIT

- .1 Complete with low voltage push button switch, three position backplate, and single cover plate.
 - .1 Low voltage switch is provided with 150 mm tails and mini quick-connector ready for connection to low voltage cable.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install system and components in accordance with drawings and manufacturer's instructions.
- .2 Install LIC enclosures as shown on drawings and connect cables to power-in plug.
- .3 Connect five wire cables from each LIC five wire outlet to the slab mounted multi-tap adapter for lighting applications where more than one fixture is controlled by a single relay.
- .4 Install joiner cables between taps and plugs in fixtures or equipment. Allow extra cable to facilitate removal and relocation of fixtures or equipment.
- .5 Install blanking plugs in unconnected receptacles.
- .6 Integrally moulded thermoplastic components to match colour identification system (i.e. black for normal power).
- .7 Install low voltage switch kits and low voltage cables as shown on drawings and connect to control ports of the controlled circuits.

3.1 INSTALLATION
(Cont'd)

- .8 Refer to division 25 for central lighting control.
- .9 Designated boardrooms shall have multiscene four zone dimmers: one for the 120VAC fluorescent dimming ballasts, one for the downlights and another for the wall washers. Typical Dimmer connections are as per single line diagram detailed on drawings.
- .10 The contractor shall provide all necessary hardware and labour to permit local dimming and switching control independent of the central control panel.
- .11 All programming of the lighting control panel shall be included in this contract to ensure system is 100% operational. The open office areas shall be dimmed to a preset level. Once set, the open office low voltage control switches shall turn on lights to preset dimming levels.
- .12 On completion of the installation, the manufacturer representative shall be notified to carry out a site inspection and report any inconsistencies to the Engineer. Corrections are to be implemented to comply with manufacturer's report.
- .13 Unswitched fixture type 1 shown as night lights and on emergency power shall have emergency circuits fed via a conduit system with a 119 mm box within 2 metres of each designated fixture. The 119 mm box shall have a pre-manufactured 119 mm cover plate complete with knockouts for mounting a five wire moulded receptacle, two 6 pin quick connect female connectors for dimming control and c/w "WARNING DUAL SOURCE ENCLOSURE" label, supplied and installed by the electrical contractor. Supply and install a five wire male/female moulded cord from the five wire moulded receptacle in the 119 mm box to the pre-assembled type 1 fixture moulded plug and a 3 wire male/male quick connect cable length as required to nearest LIC box. The contractor shall install an additional 119 mm box c/w pre-manufactured 119 mm cover plate complete with knockouts for mounting a five wire moulded receptacle and complete with two 6 pin quick connect molex connectors every ten metres or centered between two nightlights for future use. When power fails, emergency fixtures return to full bright.
- .14 All exit signs shall be factory pre-assembled and pre-wired and connected in the same manner as the type 1 fixtures except that these fixtures shall have the outlet box close nipple to the exit fixture housing. Unswitched exit signs on emergency power shall have emergency circuits fed via a conduit system with a 119 mm box within 2 metres of each designated fixture. The 119 mm box shall have a pre-manufactured 119 mm cover plate complete with knockouts for mounting a three wire moulded receptacle supplied and installed by the electrical contractor. Supply and install a three metre-three wire male/female moulded cord from the three wire moulded receptacle in the 119 mm box to the pre-assembled type exit fixture moulded plug. The contractor shall install an additional 119 mm box c/w blank cover plate every ten metres or centered between two exit sign boxes for future use.
- .15 Exit sign fixtures shall be run in a separate conduit system than the conduit system for type 1 fixtures on emergency power.
- .16 Each LIC module shall be fed with a dedicated 20A 120V circuit. c/w separate neutral.
- .17 The contractor shall locate all LIC and PDM boxes in the ceiling spaces at the appropriate elevation such that there are no obstructions within 450 mm of any side that requires plug-in connections for all types of cable sets.
- .18 The electrical contractor shall coordinate the location and elevation and sequencing of all LIC, PDM and Consolidation boxes with other sub trades to prior to rough-in and installation to ensure specified clearances and future accessibility mandatory requirements are in compliance.

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| <u>3.1 INSTALLATION
(Cont'd)</u> | .19 | All local dimming control fed via LIC module relays shall have their respective LIC relay programmed normally closed. |
| | .20 | The contractor shall run all networked LIC module cable plant and open office area zone switch cable plant to the existing lighting control panel located on the 2nd floor east electrical room. These cables shall be run to the second floor lighting control panel via an existing dual conduit riser located in the 1st floor East electrical room. Termination of all cables and conductors in the lighting control panel shall be done by others. |
| | .21 | Electrical contractor shall supply and install lamicoids for each LIC box indicating each LIC box number, source panelboard and room location, circuit. |
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| 3.2 FIELD QUALITY
CONTROL | .1 | On completion of installation, manufacturer representative shall be notified to carry out site inspection and report any inconsistencies to the Departmental Representative DCC Representative Consultant. Corrections are to be implemented to comply with manufacturer's report. |
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| 3.3 CLEANING | .1 | Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day. |
| | .2 | Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. |
| | .3 | Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility. |
| <hr/> | | |
| 3.4 PROTECTION | .1 | Protect installed products and components from damage during construction. |
| | .2 | Repair damage to adjacent materials caused by network lighting controls installation. |

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 26 05 00 - Common Work Results for Electrical.
	.2	Section 26 28 16.02 - Moulded Case Circuit Breakers.
<u>1.2 REFERENCES</u>	.1	CSA International
	.1	CSA C22.2 No. 29-11, Panelboards and Enclosed Panelboards.
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data:
	.1	Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
	.3	Shop Drawings:
	.1	Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.2	Include on drawings:
	.1	Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.2	Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
	.3	Storage and Handling Requirements:
	.1	Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
	.2	Store and protect panelboards from nicks, scratches, and blemishes.
	.3	Replace defective or damaged materials with new.

PART 2 - PRODUCTS

- 2.1 PANELBOARDS**
- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
 - .2 250V panelboards: bus and breakers rated for 10 kA (symmetrical) interrupting capacity or as indicated.
 - .3 600V panelboards: bus and breakers rated for 50 kA (symmetrical) interrupting capacity or as indicated.
 - .4 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.
 - .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
 - .6 Minimum of 2 flush locks for each panel board.
 - .7 Two keys for each panelboard and key panelboards alike.
 - .8 Copper bus with neutral of same ampere rating of mains.
 - .9 Mains: suitable for bolt-on breakers.
 - .10 Trim with concealed front bolts and hinges.
 - .11 Trim and door finish: baked enamel.
- 2.2 BREAKERS**
- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
 - .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
 - .3 Main breaker: 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 breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- 2.3 EQUIPMENT IDENTIFICATION**
- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Nameplate for each panelboard size 4 engraved as indicated.
 - .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
 - .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 40 00 - Architectural Woodwork. Where practical, group panelboards on common backboard.
 - .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
 - .4 Connect loads to circuits.
 - .5 Connect neutral conductors to common neutral bus.
- 3.3 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- 3.4 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 26 05 00 - Common Work Results for Electrical.
	.2	Section 26 28 16.02 - Moulded Case Circuit Breakers.
<u>1.2 REFERENCES</u>	.1	CSA International
	.1	CSA C22.2 No. 29-11, Panelboards and Enclosed Panelboards.
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data:
	.1	Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
	.3	Shop Drawings:
	.1	Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.2	Include on drawings:
	.1	Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.2	Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
	.3	Storage and Handling Requirements:
	.1	Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
	.2	Store and protect panelboards from nicks, scratches, and blemishes.
	.3	Replace defective or damaged materials with new.

PART 2 - PRODUCTS

- 2.1 PANELBOARDS**
- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
 - .2 250V panelboards: bus and breakers rated for 10 kA (symmetrical) interrupting capacity or as indicated.
 - .3 600V panelboards: bus and breakers rated for 50 kA (symmetrical) interrupting capacity or as indicated.
 - .4 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.
 - .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
 - .6 Minimum of 2 flush locks for each panel board.
 - .7 Two keys for each panelboard and key panelboards alike.
 - .8 Copper bus with neutral of same ampere rating of mains.
 - .9 Mains: suitable for bolt-on breakers.
 - .10 Trim with concealed front bolts and hinges.
 - .11 Trim and door finish: baked enamel.
- 2.2 BREAKERS**
- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
 - .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
 - .3 Main breaker: 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 breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- 2.3 EQUIPMENT IDENTIFICATION**
- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Nameplate for each panelboard size 4 engraved as indicated.
 - .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
 - .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.
 - .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
 - .4 Connect loads to circuits.
 - .5 Connect neutral conductors to common neutral bus.
- 3.3 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- 3.4 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

PART 1 - GENERAL

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| <u>1.1 ACTION AND INFORMATIONAL SUBMITTALS</u> | <ul style="list-style-type: none">.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures..2 Product Data:<ul style="list-style-type: none">.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations..3 Shop Drawings:<ul style="list-style-type: none">.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.<ul style="list-style-type: none">.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada..4 Samples:<ul style="list-style-type: none">.1 Provide samples in accordance with Section 01 33 00 - Submittal Procedures. |
| <u>1.2 DELIVERY, STORAGE AND HANDLING</u> | <ul style="list-style-type: none">.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements..2 Deliver to designated fixture or equipment manufacturer required quantity of interceptors, receptacles and/or plugs for installation and connection to fixture or equipment..3 Waste Management and Disposal:<ul style="list-style-type: none">.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal. |

PART 2 - PRODUCTS

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| <u>2.1 COMPONENTS</u> | <ul style="list-style-type: none">.1 Eight (8) circuit and ten (10) circuit PDM modules (i.e., P8 & P10) shall be supplied and installed as per the contract documents. Each PDM shall have seven wire outlets compatible with Teknion furniture systems. There shall be five 7 wire outlets and one duplex outlet per P10 PDM module and four 7 wire outlets and one duplex outlet per P8 PDM module..2 Integrally molded thermoplastic, color coded black for normal and red for emergency circuits. Special color for system identification i.e. blue, gray, yellow, white..3 Certified to make or break under full rated load..4 PDM boxes shall be pre-wired with terminal strip connecting the seven (7) wire receptacle with provisions for incoming branch circuits. Incoming branch circuits shall be connected and labeled by the Contractor for each (7) wire receptacle..5 Each 10 circuit Power Distribution Module (i.e., PDM) shall have three main terminal strips. Each PDM shall have five seven wire outlets factory connected to the terminal strips as follows:<ul style="list-style-type: none">.1 Right terminal strip: two seven wire outlets..2 Left terminal strip: two seven wire outlets. |
|-----------------------|--|

2.1 COMPONENTS
(Cont'd)

- .5 (Cont'd)
 - .3 Front terminal strip: one seven wire outlet and dual outlet.
 - .4 PDM Terminal strips shall be able to accept no. 8 AWG copper conductors on the line side of the terminal blocks and two no. 12 AWG on the load side.
 - .5 All conduit entries into the PDM boxes shall be at the rear end of the box where there are no terminal strips.
- .6 Each 8 circuit Power Distribution Module (i.e., PDM) shall have three terminal strips. Each PDM shall have four seven wire outlets factory connected to the terminal strips as follows:
 - .1 Right terminal strip: two seven wire outlets
 - .2 Left terminal strip: two seven wire outlets
 - .3 Front terminal strip: dual outlet
 - .4 PDM Terminal strips shall be able to accept no. 8 AWG copper conductors on the line side of the terminal blocks and two no. 12 AWG on the load side.
 - .5 All conduit entries into the PDM boxes shall be at the rear end of the box where there are no terminal strips.
- .7 All PDM boxes shall have an additional 120 VAC dual outlet in the front of the box adjacent to the front seven wire outlet. This additional three wire dual outlet shall each be fed from one of the terminal strips from separate circuits. The dual receptacle circuits shall be factory connected from the last two circuits of a terminal strip grouping. This 120 VAC dual outlet shall serve as the 120 VAC source for receptacles mounted in drywall walls and fixed partitions that have circuits designated in the PDM boxes. Supply and install four meter three wire cords that have a pre-molded end to plug into the respective PDM box with the other end for termination in a junction box. The designated wall receptacles shall be then run via conduit from this junction box to the respective receptacle.
- .8 Some receptacles mounted in drywall walls and fixed partitions in one room have more than one circuit that have been dedicated in the PDM boxes. Supply and install four meter seven wire cords that have a pre-moulded end to plug into the respective PDM box with the other end for termination in a junction box. The designated wall receptacles shall then be run via conduit from this junction box to the respective receptacle.

2.2 CABLE SETS

- .1 Five conductor armoured cable sets shall be supplied and installed as part of this contract. The contractor shall be responsible for all coordination with the systems furniture supplier for receipt of the cable set product for installation on site.
- .2 Factory assembled and integrally moulded.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install system and components in accordance with manufacturer's instructions.
- .2 Install and connect branch feeders from electrical panel to the ceiling power distribution module assemblies as indicated.
- .3 The contractor shall run a dedicated home run conduit to each respective panelboard with the appropriate number of conductors to the appropriate PDM module.
- .4 There shall be a shared neutral for every three circuits run to a PDM box. A P8 PDM box with eight circuits shall have a minimum four separate neutrals run with the phase conductors. A P10 PDM box with ten circuits shall have a minimum five separate neutrals run with the phase conductors. Conductors shall be sized per appropriate table on drawings.
- .5 Termination of branch circuit wiring in PDM boxes shall be as per manufacturer's shop drawings.
- .6 Integrally moulded thermoplastic components to match color identification system (ie. black for normal power, red for emergency power).
- .7 All cable sets shall be supported via L-brackets. L-brackets shall be installed in a grid fashion throughout the entire ceiling area. The spacing between the L-brackets shall be 1.5 metres. Cable sets shall not derive their support from the T-bar ceiling or its supports.
- .8 On completion of the installation, the manufacturer representative shall be notified to carry out a site inspection and report any inconsistencies to the Engineer. Corrections are to be implemented to comply with manufacturer's report.
- .9 The contractor shall locate all LIC and PDM boxes in the ceiling spaces at the appropriate elevation such that there are no obstructions within 450 mm of any side that requires plug-in connections for all types of cable sets.
- .10 The electrical contractor shall coordinate the location and elevation and sequencing of all LIC, PDM and Consolidation boxes with other sub trades to prior to rough-in and installation to ensure specified clearances and future accessibility mandatory requirements are in compliance.
- .11 The contractor shall supply and install lamicoids identifying each PDM box. Source panelboard and room location, circuits, and number of neutrals.

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 26 05 00 - Common Work Results for Electrical.
<u>1.2 REFERENCES</u>	.1	Canada Green Building Council (CaGBC) .1 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
	.2	CSA International .1 CSA C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Devices. .2 CAN/CSA C22.2 No. 42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D). .3 CSA C22.2 No. 55-M1986(R2012), Special Use Switches. .4 CSA C22.2 No. 111-10, General-Use Snap Switches (Bi-national standard, with UL 20).
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data: .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
	.3	Shop Drawings: .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Submit in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
	.2	Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
	.3	Storage and Handling Requirements: .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area. .2 Store and protect wiring devices from nicks, scratches, and blemishes. .3 Replace defective or damaged materials with new.

1.5 DELIVERY,
STORAGE AND
HANDLING
(Cont'd)

- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SWITCHES

- .1 20 A, 120 V or 347 V, single pole, double pole, three-way, switches to: CSA C22.2 No. 55 and CSA C22.2 No. 111.
- .2 Manually-operated general purpose AC switches with following features:
- .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Low voltage on-off switches.
- .5 Multi-scene dimmer switches:
- .1 Minimum of four (4) preset scene levels.
 - .2 Designated button for each individual scene.
 - .3 Compatible with 0-10 V analogue control of fluorescent and compact fluorescent dimming ballasts.
 - .4 Compatible with T5 HO dimming ballast and compact fluorescent ballasts.
 - .5 Compatible for integration with modular wiring system and Lighting and Integrated Control (LIC) modules.
- .6 Single scene dimmers and power extender modules for fluorescent fixture dimming in designated areas.
- .1 Compatible for integration with modular wiring system and Lighting and Integrated Control (LIC) modules.
- .7 Single scene dimmers for downlights in designated areas.
- .8 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

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

2.2 RECEPTACLES
(Cont'd)

- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, 1 mm thick cover plates, thickness 2.5 mm 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.

2.4 SOURCE QUALITY
CONTROL

- .1 Cover plates from one manufacturer throughout project.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical and 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 in accordance with Section 26 05 00 - Common Work Results for Electrical and as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA International
.1 CSA C22.2 No. 5-13, Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures (Tri-national standard, with UL 489 and NMX-J-266-ANCE-2013), Update No. 1 (2014).
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.3 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
.3 Storage and Handling Requirements:
.1 Store circuit breakers in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect circuit breakers from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

- 2.1 BREAKERS GENERAL .1 Moulded-case circuit breakers, Circuit breakers, and ground-fault circuit-interrupters, and: to CSA C22.2 No. 5
.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
.3 Common-trip breakers: with single handle for multi-pole applications.
.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
.5 Circuit breakers to have minimum 10,000 symmetrical rms interrupting capacity rating.
- 2.2 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.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install circuit breakers as indicated.

3.2 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

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

PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 26 09 43 - Network Lighting Control
	.2	Lighting - Appendix Luminair Description Section 26 50 00.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA International)
	.2	Underwriters' Laboratories of Canada (ULC)
	.3	Illuminating Engineering Society of North America (IESNA)
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data:
	.1	Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
	.2	Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
	.3	Photometric data to include: spacing criterion.
	.3	Complete Photometric Layout:
<u>1.4 QUALITY ASSURANCE</u>	.1	Provide a fully complete plan with lighting levels indicated at work plane level using IESNA photometric files for all submitted light fixtures. Luminaire type and mounting height to be indicated. CAD Plans will be provided by Departmental Representative.
	.4	Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
	.1	Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.1	Provide mock-ups (initial installation) in accordance with Section 01 45 00 - Quality Control.
	.1	Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
	.2	Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
	.3	Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
	.4	Divert unused metal materials from landfill to metal recycling facility.

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| 1.5 DELIVERY,
STORAGE AND
HANDLING
(Cont'd) | .5 | Disposal and recycling of fluorescent lamps as per local regulations. |
| | .6 | Disposal of old PCB filled ballasts as per local regulations. |

PART 2 - PRODUCTS

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| 2.1 FIXTURE TYPES | .1 | Refer to Lighting - Appendix Luminaire Description Section 26 50 00. |
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| 2.2 LAMPS | .1 | Fluorescent lamps to be - T5HO, 49 Watt, medium bi-pin, rapid-start, 3500 K, 30,000 hour lamp life, 5000 initial lumens, CRI 80; or as indicated. |
| | .2 | Compact fluorescent lamps to be - 18 Watt, G24q-2 base, 12,000 hour lamp life, 12,000 initial lumens, 3500 K, CRI 80; or as indicated. |

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| 2.3 BALLASTS | .1 | Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic IC electronic dimmable. |
| | .1 | Rating: voltage as indicated, for use with 2-54W, rapid start lamps. |
| | .2 | Totally encased and designed for 40 degrees Celsius ambient temperature. |
| | .3 | Power factor: minimum 95% with 95% of rated lamp lumens. |
| | .4 | Current crest factor: 1.7 maximum. |
| | .5 | Harmonics: 10 % maximum THD. |
| | .6 | Operating frequency of electronic ballast: 20 kHz minimum. |
| | .7 | Total circuit power: 62 Watts. |
| | .8 | Ballast factor: greater than 0.90. |
| | .9 | Sound rated: Class A. |
| | .10 | Mounting: integral with luminaire. |

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| 2.4 LED LIGHT
SOURCES | .1 | Solid state lighting devices c/w integrated optical assemblies. |
| | .2 | Minimum 70 CRI. Minimum 90% LLF @ 50,000 hrs. power factor 90%. THD > 20%. |
| | .3 | 3500 K colour temperature. |

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| 2.5 FINISHES | .1 | Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation. |
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| 2.6 OPTICAL CONTROL
DEVICES | .1 | As indicated in Appendix - Luminaire Description. |
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2.7 LUMINAIRES .1 As indicated in Appendix - Luminaire Description.

PART 3 - EXECUTION

3.1 DEMOLITION .1 Dispose of old PCB filled ballasts as per local regulations.
.2 Recycle lamps and ballasts removed from demolition as per local regulations.

3.2 INSTALLATION .1 Locate and install luminaires as indicated.
.2 Provide adequate support to suit ceiling system.

3.3 WIRING .1 Connect luminaires to Lighting Integrated Control (LIC) boxes in ceilings with five wire connector cables for all offices, boardrooms and file storage areas and three for the Exit lighting.
.1 Through armoured cable for fixture drops in base building corridors and service rooms where relocation will not be required. Maximum permissible length of armoured cable drops is 3 metres.
.2 All suspended fluorescent fixtures serving as night lights and/or emergency lighting shall be connected with a modular cabling system as per Section 26 09 43 - Network Lighting Control, such that unswitched fixtures can be relocated in the T-bar ceiling without any hardwire requirements. Color coding for emergency power cabling connectors shall be red.
.3 Connect directly (without Modular cabling) luminaire in base building corridors, and service rooms, where relocation will not be required through armoured cable for fixture drops. Maximum permissible length of armoured cable drops is 3 metres.

3.4 LUMINAIRE SUPPORTS .1 For suspended ceiling installations support luminaires independently of ceiling.

3.5 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 or as indicated.

3.6 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.
.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Type:	1
Location:	Open office, boardrooms, office areas.
Description:	Direct/Indirect fluorescent light fixture with perforated overlay.
Dimensions:	1219 mm long.
Housing:	One piece aluminum construction.
Finish:	White.
Mounting:	Suspended from T-Bar ceiling with underside of fixture at 2180 mm above finished floor even with top of door frame. Make necessary adjustment on site to meet this requirement.
Ballast:	0-10V dimming ballast for T5HO lamps.
Input Voltage:	120 V
Input Wattage:	108 W maximum
Lamps:	2 x T5HO, 49 W
Circuits:	2
Light Distribution:	Shall be IESNA RP-1 Compliant.
Colour Temperature:	3500 K
Remarks:	5 wire power/control cord (30") white colour suspension kit. 5 wire cord shall terminate in J-box c/w caddy clip for T-bar mounting with modular connector compatible with connection requirements to LIC modules in ceiling. Entire cord assembly/J-box shall be factory assembled and connected for field installation without disconnecting for reconnecting wiring terminations. Cord assembly shall pass through the respective canopy cover. Entire cord assembly, canopy, J-box, receptacle shall be completely factory assembled to the fixture housing such that the contractor has no wiring termination requirements on site. The contractor to be able to simply physically mount the fixture to the T-bar ceiling and plug in the power source for energizing. Entire fixture/cord assembly shall be such that the complete assembly can be relocated within T-bar grid system without any wiring changes. Tie rap cord to suspension cable at location along the cable. Maximum weight: 15 lbs. Minimum efficiency of 85%.

Photometric Distribution:

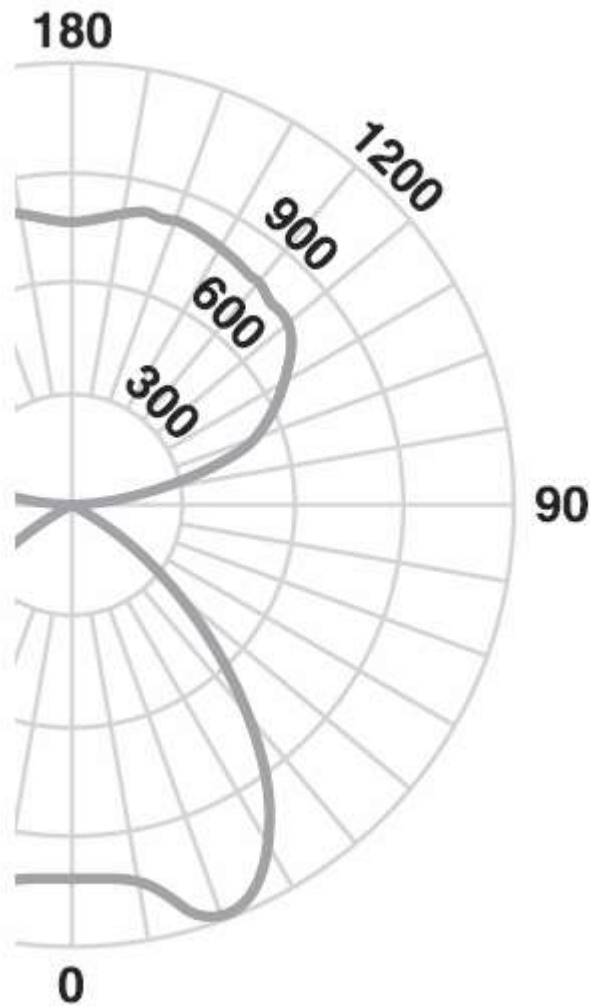
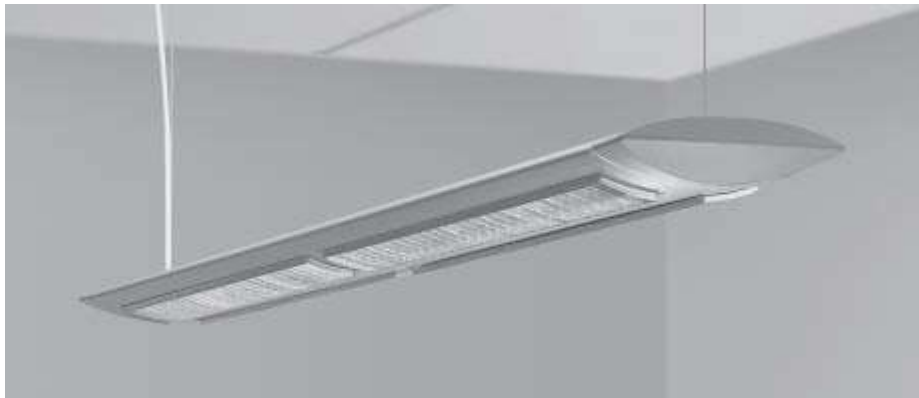
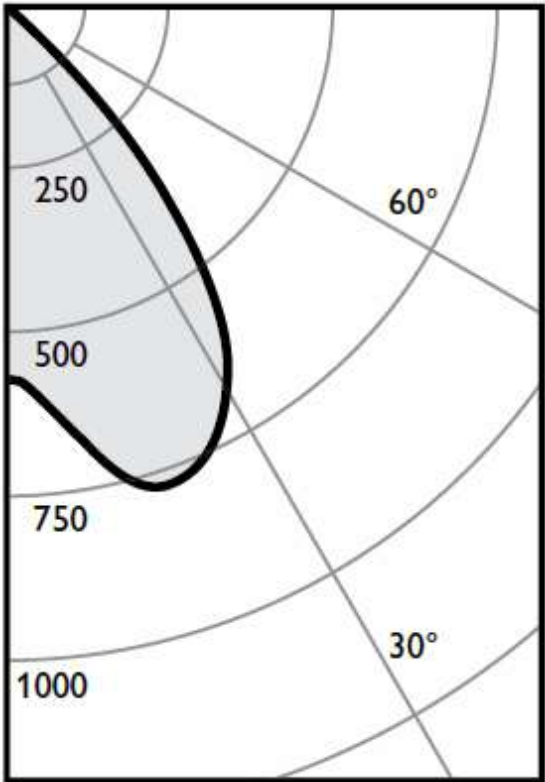


Photo:



Type:	2
Location:	Boardrooms.
Description:	Wall washer downlight fixture.
Dimensions:	114 mm wide.
Housing:	Aluminum.
Finish:	White.
Mounting:	Recessed.
Driver:	0-10V dimming
Input Voltage:	120 V
Input total Wattage:	17 W maximum
Total Lumen Output:	500 minimum
Lamps:	LED
Circuits:	1
Colour Temperature:	3500 K

Photometric Distribution:



Type:	3
Location:	Hall lobby entrance.
Description:	Compact fluorescent downlight fixture.
Dimensions:	337 mm x 334 mm x 104 mm deep.
Louver:	4 cell deep parabolic louver provides 55 degree cut-off angle.
Housing:	20 ga. galvanised formed steel housing.
Finish:	Clear finish.
Mounting:	Recessed.
Ballast:	Electronic ballast thermally protected class P, high power factor, internally fused and protection circuit for end of lamp life, sound rated 'A'.
Input Voltage:	120 V
Input Wattage:	50 W maximum
Lamps:	2 x 24 PL-L 24W tubes
Base:	2G 11
Circuits:	1
Colour Temperature:	3500 K
Photometric Distribution:	

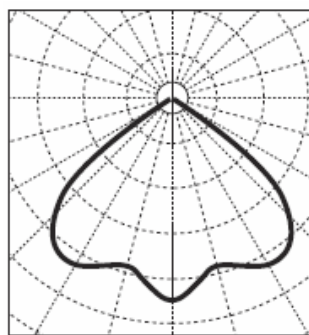
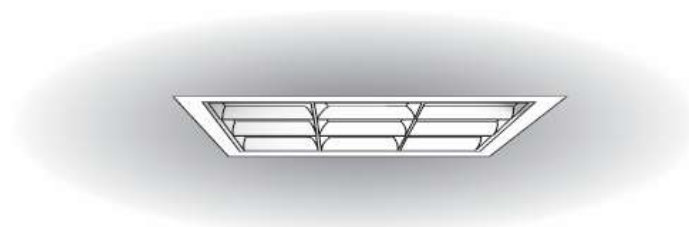


Photo:



Type:	4
Location:	Telecom room.
Description:	Fluorescent light fixture.
Dimensions:	1219 mm Long.
Housing:	Rigid die-formed cold rolled finished steel housing.
Finish:	Minimum 85% reflectance finish.
Mounting:	Suspend below cable tray with chains.
Ballast:	Electronic ballast.
Input Voltage:	120 V
Input Wattage:	54 W maximum
Total Lumen Output:	2900 minimum
Lamps:	2 x T8, 28 W
Circuits:	1
Colour Temperature:	3500 K
Remarks:	Wrap around Holophane high efficiency lens. Swing down lens hinges from either side. Lens retained by four spring loaded pins.
Photometric Distribution:	

Type:	5
Location:	Electrical rooms.
Description:	Fluorescent strip light fixture.
Dimensions:	1219 mm Long.
Housing:	Rigid die-formed cold rolled finished steel housing.
Finish:	Minimum 85% reflectance white finish.
Mounting:	Surface mounted on suspended unistrut.
Ballast:	Electronic ballast.
Input Voltage:	120 V
Input Wattage:	54 W maximum
Total lumen output:	2900 minimum
Lamps:	2 x T8, 28 W
Circuits:	1
Colour Temperature:	3500 K
Remarks:	c/w wire guard
Photometric Distribution:	

Type:	6
Location:	Main entrance.
Description:	Compact fluorescent wall sconce fixture.
Dimensions:	337 mm x 330 mm x 102 mm deep.
Housing:	Aluminum.
Finish:	mat white glass.
Mounting:	Wall mounted.
Ballast:	Electronic ballast.
Input Voltage:	120 V
Input Wattage:	13 W maximum
Lamps:	2 x CFL double twin tube
Circuits:	1
Colour Temperature:	3500 K

Photo:



Type:	7
Location:	Corridors
Description:	Compact fluorescent downlight fixture.
Dimensions:	187 mm aperture.
Housing:	Aluminum.
Finish:	Comfort clear reflector with white moulded trim ring.
Mounting:	Recessed.
Ballast:	Electronic ballast. Thermally protected class P, high power factor, internally fused and protection circuit for end of life, sound rated 'A'.
Input Voltage:	120 V
Input Wattage:	40 W maximum
Lamps:	2-18W Quad, 4 pin base, 2 QT horizontal lamps c/w retrofit kit.
Circuits:	1
Colour Temperature:	3500 K
Remarks:	Socket: moulded thermoplastic. Pre-wired 18 ga. SEW leads to junction box. Junction box: 14 ga. Steel, 102mm x 89mm x 51mm
Photo:	

