

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Section 28 31 00.02 - Multiplex Fire Alarm and Voice Communications Systems.

**1.2 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations (24th Edition).
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE 100 CD (2013), Standards Dictionary: Glossary of Terms and Definitions.

**1.3 DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE 100 CD.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with project general requirements.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .3 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .4 Submit drawings and product data to authority having jurisdiction.
  - .5 If changes are required, notify Departmental Representative of these changes before they are made.
  - .6 Submit seismic restraint shop drawings, stamped by professional engineer.
- .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 authority having jurisdiction for special approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
- .6 Submit power shutdown schedule 15 days prior to service interruptions and obtain return approval from the Departmental Representative to do so including completing the de-energizing and re-energizing forms.
- .7 Apply and obtain ESA permit.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with project 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 off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect 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 Management Plan in accordance with project requirements.

#### 1.6 SITE COORDINATION

- .1 Coordinate work with all other trades to avoid interference.
- .2 Ensure electrical components (i.e.: Wiring, conduit, etc.) Relating to the area of work are independently secured to comply with code requirements. It is not acceptable to secure the components to ductwork, duct work to conduit, or any other systems.
- .3 Ensure all existing ceiling mounted boxes are closed prior to completion of project. Provide labelled and colour coded cover plates (i.e.: Panel name and circuit number) as required.
- .4 Minimum three (3) working days prior to closing ceiling, notify the department representative for ceiling inspection.
- .5 Construction phasing to be coordinated with department representative.

#### 1.7 DESIGNATED CONTRACTOR

- .1 Hire the services of Chubb Edwards to complete the work of Section 28 31 00.2 - Multiplex Fire Alarm and Voice Communications Systems.

**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 and French.
- .4 Use one nameplate or label for each language.

**2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with project requirements.
- .2 Factory assemble control panels and component assemblies.

**2.3 WIRING TERMINATIONS**

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

**2.4 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matte white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
  - .2 Sizes as follows:

**NAMEPLATE SIZE**

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	24 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 junction boxes to indicate system and/or voltage characteristics.

- .6 Identify equipment with labels engraved as directed by Departmental Representative. Red for fire alarm & emergency system, black for others.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.
- .10 Identification to be English and French.
- .11 Identification for receptacles and light switches using P-touch type labels and indicating panel and circuit numbers.

## 2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 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.

## 2.6 CONDUIT AND CABLE IDENTIFICATION

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

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

## 2.7 FINISHES

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

**PART 3 - EXECUTION****3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for 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 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

**3.3 NAMEPLATES AND LABELS**

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

**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.
- .5 Exact location and mounting heights of outlets to be coordinate with interior designer/architectural drawings prior to rough in. Refer to architectural/designer drawings for millwork, furniture, screens, components (i.e. TV, drinking fountain, etc.) for requirements.
- .6 Bring to the attention of the architect/interior designer any conflicts or required clarification.
- .7 Failing to coordinate, the contractor will modify the installation at his expense, if required.

**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: 1100 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.
- .3 Telephone and interphone outlets: 400 mm.
- .4 Wall mounted telephone and interphone outlets: 1200 mm.
- .5 Fire alarm stations: 1200 mm.
- .6 Fire alarm speaker: 2300 mm or ceiling mounted.
- .7 Television outlets: 400 mm oar as per drawing.
- .8 Wall mounted exit light: 2300 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 project requirements.
  - .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 sequence 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.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - 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 representative 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 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 - General Instructions, 1.15 Cleaning.
  - .1 Leave Work area clean at end each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with project requirements.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with project requirements.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### 3.10 DEMOLITION

- .1 Unless otherwise noted, materials for removal become the contractor's property and shall be taken from site and disposed of in accordance with all applicable codes, standards and regulations.
- .2 Disconnect and make safe all systems to be demolished including panels, feeders, branch circuits and equipment by other divisions. Coordinate with other divisions.
- .3 Maintain existing remaining circuits, systems, etc., which pass through area of construction and in close proximity. Provide necessary components to maintain systems. Ensure components will be concealed when construction is complete.
- .4 Reinstate immediately any remaining existing systems inadvertently interrupted during construction.
- .5 The drawings indicate known conditions and may not indicate all demolition requirements, electrical contractor shall visit the site prior to tender submission and verify requirements and include all costs in tender.
- .6 Remove redundant conduit and wiring back to source unless otherwise noted, and make safe.
- .7 Devices from demolition are not to be reused unless noted otherwise. New devices shall be supplied where necessary.

- .8 All fire alarm devices to remain in operation. Provide temporary covers for devices during dusty operations and protect smoke detectors from dust exposure during construction. Ensure all protective dust covers are removed at end of each shift.
- .9 Ensure fire alarm system is operational at the end of each shift.
- .10 After demolition work is complete and minimum three (3) working days prior to proceeding with new work, notify Departmental Representative for inspection.

END OF SECTION



## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 CSA International
  - .1 CSA C22.2 No. 18.4-15 (2018) - Hardware for the Support of Conduit, Tubing, and Cable
  - .2 CSA C22.2 No. 65-18, Wire Connectors.
- .2 National Electrical Manufacturers Association (NEMA)

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Pressure type wire connectors to: CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, flexible conduit, as required to: CSA C22.2 No. 18.4.

## **PART 3 - EXECUTION**

### **3.1 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 CSA C22.2 No. 65.
  - .2 Install fixture type connectors and tighten to CSA C22.2 No. 65. Replace insulating cap.
  - .3 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- .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.

**PART 2 - PRODUCTS****2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

**2.2 ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

**PART 3 - EXECUTION****3.1 GENERAL CABLE INSTALLATION**

- .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 to be 2-wire + G circuits only, i.e. common neutrals not permitted.

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### 3.2 INSTALLATION OF BUILDING WIRES

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

### 3.3 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
- .2 Armoured cable to be used for final connection only, and not to exceed 2.5 metres.

END OF SECTION

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers ( ANSI/IEEE)
  - .1 ANSI/IEEE 837-14, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA Group (CSA)
  - .1 CSA Z32-15, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

**PART 2 - PRODUCTS****2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as required.
- .3 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
- .4 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .5 Insulated grounding conductors: green, copper conductors, size as indicated.
- .6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

**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 and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 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.
- .7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .8 Install grounding resistance bank where required.
- .9 Connect building structural steel and metal siding to ground by welding copper to steel.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.
- .12 Ground secondary service pedestals.

**3.3 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of primary 2300 V system, secondary 600 V system.

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3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, starters, control panels, distribution panels.

3.5 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

**PART 1 - GENERAL****1.1 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA)
  - .1 CSA S832-14, Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.
- .2 Ontario Regulation
  - .1 ONTARIO OBC-2012, 2012 Ontario Building Code.
- .3 National Research Council Canada
  - .1 NRCC NBCC-2015, National Building Code of Canada 2015.

**PART 2 - PRODUCTS****2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended set in poured concrete walls and ceilings.

**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 hangers and supports 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 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole 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.

- .5 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.
- .6 For surface mounting of two or more conduits use channels at 1.2 m on centre spacing.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

### 3.3 SEISMIC RESTRAINT SYSTEMS (SRS)

- .1 SRS Manufacturer:
  - .1 SRS to be from one manufacturer regularly engaged in production of same, 5 years experience.
- .2 General:
  - .1 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.
  - .2 SRS to be fully integrated into, compatible with:
    - .1 Noise and vibration controls specified elsewhere in this project specification, telecommunications.
    - .2 Structural, mechanical, electrical design of project.
  - .3 During seismic event, SRS to prevent systems and equipment from causing personal injury, interfering with other systems, and from moving from normal position.
  - .4 Design and installation in accordance with OBC, NBCC, CSA S832.
  - .5 SRS to provide gentle and steady cushioning action and avoid high impact loads
  - .6 SRS to restrain seismic forces in all directions.
  - .7 Fasteners and attachment points to resist same load as seismic restraints.
  - .8 SRS of conduit systems to be compatible with:
    - .1 Expansion, anchoring and guiding requirements.
    - .2 Equipment vibration isolation and equipment SRS.
  - .9 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
  - .10 Attachments to RC structure:
    - .1 Use high strength mechanical expansion anchors.
    - .2 Drilled or power driven anchors not permitted.
  - .11 Seismic control measures not to interfere with integrity of firestopping.
- .3 SRS for Static Equipment, Systems:
  - .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.
- .4 SRS for Vibration Isolation Equipment
  - .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 Departmental Representative, 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.
  - .2 Suspended equipment, systems:
    - .1 Use one or combination of following methods:
      - .1 Slack cable restraint system.
      - .2 Brace back to structure via vibration isolators and snubbers.
- .5 Installation:
  - .1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.
  - .2 Install SRS at least 25 mm from all other equipment, systems, services.
  - .3 Co-ordinate connections with all disciplines.
- .6 Inspection and Certification:
  - .1 SRS to be inspected and certified by Manufacturer upon completion of installation.
  - .2 Seismic Design Engineer shall provide written report to Departmental Representative certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.
- .7 Commissioning Documentation:
  - .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

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

### **1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations (24th Edition).

## **PART 2 - PRODUCTS**

### **2.1 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 flat covers.

## **PART 3 - EXECUTION**

### **3.1 JUNCTION AND PULL BOXES INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Provide additional pull boxes as required by CSA C22.1.

### **3.2 IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

**PART 1 - GENERAL****1.1 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations (24th Edition).

**PART 2 - PRODUCTS****2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

**2.2 GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

**2.3 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

### **PART 3 - EXECUTION**

#### **3.1        INSTALLATION**

- .1       Support boxes independently of connecting conduits.
- .2       Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3       For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4       Provide correct size of openings in boxes for conduit and armoured cable connections. Do not install reducing washers.
- .5       Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6       Identify systems for outlet boxes as required.
- .7       Coordinate box sizes with furniture and modular wall assembly.

END OF SECTION

**PART 1 - GENERAL****1.1 NOT USED**

- .1 Not used.

**PART 2 - PRODUCTS****2.1 RACEWAY**

- .1 Dual channel stainless steel raceway complete with associated component as per electrical drawings.

**2.2 JUNCTION BOXES DISTRIBUTION LEVEL**

- .1 Welded steel rectangular boxes 6 mm thick minimum painted with chromate primer and grey enamel with removable plate on front side, designed for through run of main cable and porcelain enclosed disconnecting branches of single conductor cables, using pothead plug and socket disconnectors enclosed in porcelain tubes and caps, standard designed for no voltage disconnecting.

**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 raceway and boxes 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 Install raceway as per manufacturer's installation manual.
- .2 Install distribution level steel boxes on walls of maintenance holes. Splice main cable in box and connect branch feeder. Fasten cover and fill with compound.
  - .1 Ground steel boxes as required.

END OF SECTION

**PART 1 - GENERAL****1.1 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No. 18.3-12 (R2017) - Conduit, Tubing, and Cable Fittings.
  - .2 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .3 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.
- .2 Telecommunications Industry Association (TIA)
  - .1 TIA 569-C, Telecommunications Pathways and Spaces.

**PART 2 - PRODUCTS****2.1 CONDUITS**

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

**2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
  - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

**2.3 CONDUIT FITTINGS**

- .1 Fittings: to CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

**2.4 FISH CORD**

- .1 Polypropylene.

**PART 3 - EXECUTION****3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use electrical metallic tubing (EMT) except in cast concrete.
- .4 Use flexible metal conduit for connection to motors in dry areas.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations. Length not to exceed 2.5 metres.
- .6 Minimum conduit size for lighting and power circuits: 21 mm.
- .7 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm diameter.
- .9 Install fish cord and nylon bushing at each end in empty conduits.
- .10 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .11 Dry conduits out before installing wire.
- .12 Communication (Telephone/Data) and Television conduit infrastructure to be installed in accordance with TIA-569-C. All wiring by others.

**3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on channels.
- .5 Do not pass conduits through structural members except as indicated.

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

### 3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### 3.5 COMMUNICATION CONDUITS

- .1 Unless otherwise noted provide plaster rings for outlets with outlet boxes 100 mm<sup>2</sup> square x 63 mm deep each with 21 mm empty conduit to ceiling space c/w bushing and pull strings. New tel. and/or data cables, terminal devices and coverplates will be supplied and installed by others.

### 3.6 PATHWAYS

- .1 Conduits:
  - .1 All conduits and pull boxes shall be installed in accordance with CEC, part 1, TIA-569-C Commercial Building Standard for Telecommunications Pathways and Spaces and applicable building codes. Conduit shall be rigidly fastened and adequately supported to withstand pulling tensions.
  - .2 The inside radius of a bend in a conduit shall be not less than six times the internal diameter when the conduit is less than 50 mm in diameter and ten times the internal diameter when conduit is 50 mm in diameter or larger.
  - .3 All conduits shall originate and be physically connected to the telecom backboards in the TRs, cable tray and pull box.
  - .4 All metallic parts of the cable distribution supporting system shall be bonded together mechanically, including at all transition points (i.e. cable tray and distribution conduit not mechanically connected) using a #6 AWG green jacketed stranded copper ground wire. The metallic components of the cable distribution system shall be bonded together at the MTR and TR's and then bonded to their respective telecom ground bus bars.
  - .5 All fittings, connectors and couplings are to be steel.
  - .6 All conduits/sleeves that enter the TR shall be fitted with an approved ground bushing c/w ground lug and bonded together mechanically (one continuous piece preferred). This shall be connected to the approved building ground by means of a #6 AWG green jacketed stranded copper ground wire to the grounding bus bar.
  - .7 All conduits entering or exiting through the ceiling or walls of the TR shall protrude into the room 25-50 mm or as designated by the Departmental Representative.
  - .8 Riser sleeves in the Telecommunication Rooms shall protrude through the floor 50-75 mm above finished floor (AFF).
  - .9 All conduit runs shall follow building grid lines and shall be concealed where possible.
  - .10 All conduits shall be thin wall EMT, reamed and bushed at both ends and bonded to the distribution system. Rigid PVC or flexible metallic conduits are acceptable in limited situations.
  - .11 Unless otherwise specified, all conduit runs shall be a maximum of 30 metres (100 ft.) in length with a maximum of two 90-degree bends between pull points.
  - .12 A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30 m, or if there is a reverse bend in the run.



- .13 Pull boxes shall be made of code gauge steel and shall have a rust resistant finish. Locations and sizes of all pull boxes shall be as indicated on the design submission.
- .14 In all instances pull boxes shall be placed in straight sections of conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings shall not be used in place of pull boxes or bends.
- .15 Pull boxes shall be installed at a reasonable height, in an exposed location such that access for installation of cables is not prohibited. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel. Provide indicator decals on ceiling T-bar rail or ceiling tiles showing location of pull box or splice box. Refer to the Design Authority for details.
- .16 The minimum size (inside diameter) for EMT conduit running between the Telecommunications Room and the telecommunications outlet at an outlet location is twenty-seven millimetres (27 mm).
- .17 A pull cord or fish tape shall be installed in all conduits.
- .18 The telecommunications outlet conduit system shall be labelled green.
- .19 Place pull boxes in readily accessible locations only.
- .20 The use of C, LB, LL, LR and T type fittings or elbow fittings is not permitted.
- .21 Conduits ending in the vicinity of a cable tray shall be terminated at a height of no less than 100 mm and no more than 150 mm from the top of the cable tray. Conduit runs shall not be punched through the side of the cable tray. Conduit ends are to be bonded to the cable tray. Installer is to ensure that the bonding cable is secured to the outside of the cable tray.
- .22 Flexible Conduit:
  - .1 The use of liquid tight flexible conduit is no longer encouraged; liquid tight flex cannot be used in a plenum.
  - .2 Where liquid tight flexible conduit is installed, it is to be used in lengths not to exceed three metres (10 feet) unless authorized by the Design Authority.

END OF SECTION

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- .1 Section 07 84 00 - Firestopping.

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.1 No.126.1-17, Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA VE 1-2017, Metal Cable Tray Systems.
  - .2 NEMA VE 2-2013, Cable Tray Installation Guidelines.

**PART 2 - PRODUCTS****2.1 CABLETROUGH**

- .1 Cabletroughs and fittings: to NEMA VE 1 and CSA C22.1 No. 126.1.
- .2 Ladder type, Class C1 to CSA C22.1 No.126.1.
- .3 Trays: stainless steel, 305 mm wide with depth of 100 mm.
- .4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
  - .1 Radii on fittings: 305 mm minimum.
- .5 Solid covers for complete cabletrough system including fittings.
- .6 Barriers where different voltage systems are in same cabletrough.
- .7 Ground cable trays with #6 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.
- .8 Fire stop system at penetrations of fire separations in accordance with Section 07 84 00 - Firestopping.

**2.2 SUPPORTS**

- .1 Provide splices, supports for a continuously grounded system as required.

### **PART 3 - EXECUTION**

#### **3.1        INSTALLATION**

- .1        Install complete cabletrough system in accordance with NEMA VE 2.
- .2        Support cabletrough on both sides.
- .3        Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

#### **3.2        CABLES IN CABLETROUGH**

- .1        Install cables individually.
- .2        Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3        Secure cables in cabletrough at 6 m centres, with nylon ties.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No. 100-14, Motors and Generators.

## **PART 2 - PRODUCTS**

### **2.1 FRACTIONAL HORSEPOWER MOTOR**

- .1 Non-hazardous locations: to CSA C22.2 No. 100.
- .2 Refer to drawings for ratings.
- .3 Motor with inherent overheating protectors.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

END OF SECTION

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

**PART 2 - PRODUCTS****2.1 MATERIALS**

- .1 Control system: by one manufacturer and assembled from compatible components.

**PART 3 - EXECUTION****3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

**3.2 INSTALLATION**

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

**3.3 FIELD QUALITY CONTROL**

- .1 Site Tests:
  - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Actuate control units in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.
- .3 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Section 01 33 00 - Submittal Procedures.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in Section 01 45 00 Quality Control.

END OF SECTION

**PART 1 - GENERAL****1.1 SUMMARY**

- .1 Section includes a networked lighting control system comprised of the following components:
  - .1 System Software Interfaces:
    - .1 Management Interface
    - .2 Visualization Interface
    - .3 Personal Control Applications
    - .4 Smartphone Programming Interface for wired devices
    - .5 Smartphone Programming Interface for wireless devices
  - .2 System Backbone and Integration Equipment:
    - .1 System Controller
    - .2 Open ADR Interface
  - .3 Wired Networked Devices
    - .1 Wall Stations
    - .2 Occupancy and Photocell Sensors
    - .3 Wall Switch Sensors
    - .4 Power Packs and Secondary Packs
- .2 The networked lighting control system shall meet all the characteristics and performance requirements specified herein.
- .3 The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

**1.2 RELATED DOCUMENTS**

- .1 Section 26 09 24 - Lighting Control Devices - Low Voltage.
- .2 Section 26 27 26 - Wiring Devices.

**1.3 REFERENCE STANDARDS**

- .1 CSA International
- .2 Underwriters Laboratories (UL)
  - .1 UL 916, Energy Management Equipment.
  - .2 UL 924, Emergency Lighting and Power Equipment.

**1.4 SUBMITTALS**

- .1 Submittal shall be provided including the following items:
  - .1 Bill of Materials necessary to install the networked lighting control system.
  - .2 Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
  - .3 Riser Diagrams showing device wiring connections of system backbone and typical per room/area type.

- .4 Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
- .5 Other Diagrams and Operational Descriptions - as needed to indicate system operation or interaction with other system(s).
- .6 Contractor Startup/Commissioning Worksheet (must be completed prior to factory start-up).
- .7 Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
- .8 Hardware and Software Operation Manuals.

#### 1.5 APPROVALS

- .1 Prior approval from owner's representative is required for products or systems manufactured by companies not specified in the Network Lighting Controls section of this specification.

#### 1.6 QUALITY ASSURANCE

- .1 Product Qualifications:
  - .1 System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labelled with required markings as applicable.
  - .2 System shall be listed as qualified under Design Lights Consortium Networked Lighting Control System Specification V2.0.
  - .3 System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
  - .4 All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
  - .5 All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- .2 Installation and Startup Qualifications:
  - .1 System startup shall be performed by qualified personnel approved or certified by the manufacturer.
- .3 Service and Support Requirements:
  - .1 Phone Support: Toll free technical support shall be available.
  - .2 Remote Support: The bidder shall offer a remote support capability.
  - .3 Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
  - .4 Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

#### 1.7 PROJECT CONDITIONS

- .1 Only install indoor equipment after the following site conditions are maintained:
  - .1 Ambient Temperature: 14 to 105 degrees F (-10 to 40 degrees C)
  - .2 Relative Humidity: less than 90% non-condensing
- .2 Equipment shall not be subjected to dust, debris, moisture, or temperature and humidity conditions exceeding the requirements indicated above or as marked on the product, at any point prior to installation.
- .3 Only properly rated equipment and enclosures, installed per the manufacturer's instructions, may be subjected to dust and moisture following installation.

## 1.8 WARRANTY

- .1 The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.
- .2 The hardware warranty shall cover repair or replacement any defective products within the warranty period.

## 1.9 MAINTENANCE & SUSTAINABILITY

- .1 The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

## **PART 2 - PRODUCTS**

### 2.1 SYSTEM COMPLIANCES

- .1 System components shall comply with UL 916 and UL 924 standards where applicable.
- .2 System components shall comply with CFR Title 47, Part 15 standards where applicable.
- .3 System components shall comply with ISED Canada RSS-247 standards where applicable.

### 2.2 SYSTEM PERFORMANCE REQUIREMENTS

- .1 System Architecture:
  - .1 System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) optional system backbone for remote, time based and global operation.
  - .2 Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
  - .3 System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see Control Zone Characteristics sections for each type of network connection, wired).
  - .4 Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.
  - .5 Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as "distributed intelligence."
    - .1 Lighting control zones (wired) of at least 128 devices per zone shall be supported.
  - .6 Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.



- .7 Lighting control zones shall be capable of being networked with a higher-level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.
  - .8 The system may include one or more system controllers that provide time-based control. The system controller also provides a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.
  - .9 All system devices shall support firmware update, either remotely or from within the applications space, for purposes of upgrading functionality at a later date.
- .2 Wired Networked Control Zone Characteristics:
- .1 Connections to devices within a wired networked lighting control zone and to backbone components shall be with a single type of low voltage network cable, which shall be compliant with CAT5e specifications or higher. To prevent wiring errors and provide cost savings, the use of mixed types of low voltage network cables shall not be permitted.
  - .2 Devices in an area shall be connected via a "daisy-chain" topology; requiring all individual networked devices to be connected back to a central component in a "hub-and-spoke" topology shall not be permitted, so as to reduce the total amount of network cable required for each control zone.
  - .3 System shall provide the option of having pre-terminated plenum rated low voltage network cabling supplied with hardware so as to reduce the opportunity for improper wiring and communication errors during system installation.
  - .4 Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g. software application, handheld remote, pushbutton). The "out of box" default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
  - .5 Once software is installed, system shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
  - .6 All networked devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.
  - .7 Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL 924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    - .1 Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    - .2 UL 924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL 924 standard, and shall automatically close the load control relay and provide 100% light output upon detection of loss of power sensed via line voltage connection to normal power.
  - .8 Networked luminaires and intelligent lighting control devices located in different areas shall be able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. Occupancy and photocell commands shall be available across a single controller, and switch commands shall be available across single or multiple controllers. These shall also be referred to as global control zones.
  - .9 Wired networked Wall stations shall provide the follow Scene Control Capabilities:
    - .1 Preset Scenes that can activate a specific combination of light levels across multiple local and global channels, as required.

- .2 Profile Scenes that can modify the sequence of operation for the devices in the area (group) in response to a button press. This capability is defined as supporting "Local Profiles" and is used to dynamically optimize the occupant experience and lighting energy usage. Wall stations shall be able to manually start and stop Local Profiles, or the local profile shall be capable of ending after a specific duration of time between 5 minutes and 12 hours. Parameters that shall be configurable and assigned to a Local Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.
  - .3 3-way/multi-way control: multiple wall stations shall be capable of controlling the same local and global control zones, so as to support "multi-way" preset scene and profile scene control.
- .3 System Integration Capabilities:
- .1 The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet MS/TP protocols. The following system integration capabilities shall be available via BACnet/IP and BACnet MS/TP protocols:
    - .1 The system shall support control of individual devices, including, but not limited to, control of relay and dimming output.
    - .2 The system shall support reading of individual device status information. The available status will depend on the individual device type and capabilities, which may include but not be limited to, relay state, dimming output, power measurement, occupancy sensor status, and photocell sensor states or readings. All system devices shall be available for polling for devices status.
    - .3 The system shall support activation of pre-defined system Global Profiles (see Supported Sequence of Operations for further definition of Global Profile capabilities).
  - .2 The system shall support activation of Global Profiles from third party systems by receiving dry contact closure output signals or digital commands via RS-232/RS-485. (See Supported Sequence of Operations for further definition of Profile and Scene Preset capabilities.)
  - .3 The system shall support activation of demand response levels from Demand Response Automation Servers (DRAS) via the OpenADR 2.0a protocol.
- .4 Supported Sequence of Operation:
- .1 Control Zones:
    - .1 Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) shall be capable of transmitting and tracking occupancy sensor, photocell sensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within the area. These shall also be referred to as local control zones.
  - .2 Wall station Capabilities:
    - .1 Wall stations shall be provided to support the following capabilities:
      - .1 On/Off of a local control zone.
      - .2 Continuous dimming control of light level of a local control zone.
    - .2 3-way/multi-way control: multiple wall stations shall be capable of controlling the same local control zones, so as to support "multi-way" switching and/or dimming control.
  - .3 Occupancy Sensing Capabilities:
    - .1 Occupancy sensors shall be configurable to control a local zone.
    - .2 Multiple occupancy sensors shall be capable of controlling the same local zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zones.
    - .3 System shall support the following types of occupancy sensing sequence of operations:
      - .1 On/Off Occupancy Sensing
      - .2 Partial-On Occupancy Sensing
      - .3 Partial-Off Occupancy Sensing
      - .4 Vacancy Sensing (Manual-On/Automatic-Off)

- .4 On/Off, Partial-On, and Partial-Off Occupancy Sensing modes shall function according to the following sequence of operation:
  - .1 Occupancy sensors shall automatically turn lights on to a designated level when occupancy is detected. To support fine tuning of Partial-On sequences the designated occupied light level shall support at least 100 dimming levels.
  - .2 Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
  - .3 To provide additional energy savings the system shall also be capable of combining Partial-Off and Full-Off operation by dimming the lights to a designated level when vacant and then turning the lights off completely after an additional amount of time.
  - .4 Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under Photocell Sensing Capabilities.
  - .5 The use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
- .5 Vacancy Sensing mode (also referred to as Manual-On/Automatic-Off) shall function according to the following sequence of operation:
  - .1 The use of a wall station is required turn lights on. The system shall be capable of programming the zone to turn on to either to a designated light level or the previous user light level. Initially occupying the space without using a wall station shall not result in lights turning on.
  - .2 Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
  - .3 To provide additional energy savings and an enhanced occupant experience, the system shall also be capable of dimming the lights when vacant and then turning the lights off completely after an additional amount of time.
  - .4 To minimize occupant impact in case the area or zone is still physically occupied following dimming or shutoff of the lights due to detection of vacancy, the system shall support an "automatic grace period" immediately following detection of vacancy, during which time any detected occupancy shall result in the lights reverting to the previous level. After the grace period has expired, the use of a wall station is required to turn lights on.
  - .5 Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under Photocell Sensing Capabilities.
  - .6 At any time, the use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
- .6 To accommodate diverse types of environments, occupancy time delays before dimming or shutting off lights shall be specifiable for control zones between 15 seconds to 2 hours.
- .4 Photocell Sensing Capabilities (Automatic Daylight Sensing):
  - .1 Photocell sensing devices shall be configurable to control a local zone.

- .2 The system shall support the following type of photocell-based control:
  - .1 Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.
- .5 Schedule and Global Profile Capabilities:
  - .1 The system shall be capable of automatically modifying the sequence of operation for selected devices in response to any of the following: a time-of-day schedule, contact closure input state, manually triggered wired wall station input, RS-232/RS-485 command to wired input device, and BACnet input command. This capability is defined as supporting "Global Profiles" and is used to dynamically optimize the occupant experience and lighting energy usage.
  - .2 Global profiles may be scheduled with the following capabilities:
    - .1 Global Profiles shall be stored within and executed from the system controller (via internal timeclock) such that a dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
    - .2 Global Profile time of day schedules shall be capable of being given the following recurrence settings: daily, specific days of week, every "n" number of days, weekly, monthly, and yearly. Lighting control profile schedules shall support definition of start date, end date, end after "n" recurrences, or never ending. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
    - .3 Global Profile Holiday Schedules should follow recurrent settings for specific national and regional holiday dates regardless if they always occur on a specific date or are determined by the day/week of the month.
    - .4 Global Profiles shall be capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
    - .5 System shall support blink warning and timed extension capabilities. At the end of a scheduled period, the system shall be capable of providing a visible "blink warning" 5 minutes prior to the end of the schedule. Wall stations may be programmed to provide timed overrides that turn the lights on for an additional period of time. Timed override duration shall be programmable for each individual device, zone of devices, or customized group of devices, ranging from 5 minutes to 12 hours.
    - .6 Software management interface shall be capable of displaying a graphic calendar view of profile schedules for each control zone.
  - .3 System Global Profiles shall have the following additional capabilities:
    - .1 Global Profiles shall be capable of being manually activated directly from the system controller, specially programmed wired input devices, scene capable wired wall stations, and the software management interface.
    - .2 Global Profiles shall be selectable to apply to a single device, zone of devices, or customized group of devices.
    - .3 Parameters that shall be configurable and assigned to a Global Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.
  - .4 A backup of Local and Global Profiles shall be stored on the software's host server such that the Profile backup can be applied to a replacement system controller or wired wall station.
- .6 System shall support automated demand response capabilities with automatic reduction of light level to at least three levels of demand response.

## 2.3 SYSTEM SOFTWARE INTERFACES

- .1 Management Interface:
  - .1 System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
  - .2 Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
  - .3 Management interface shall require all users to login with a User Name and Password, and shall support creation of at least 100 unique user accounts.
  - .4 Management interface shall support at least three permission levels for users: read-only, read & change settings, and full administrative system access.
  - .5 Management interface shall be capable of restricting access for user accounts to specific devices within the system.
  - .6 All system devices shall be capable of being given user-defined names.
  - .7 The following device identification information shall be displayed in the Management interface: model number, model description, serial number or network ID, manufacturing date code, custom label(s), and parent network device.
  - .8 Management interface shall be able to read the live status of a networked luminaire or intelligent control device and shall be capable of displaying luminaire on/off status, dim level, power measurement, device temperature, PIR occupancy sensor status, microphonic occupancy sensor status, remaining occupancy time delay, photocell reading, and active Profiles.
  - .9 Management interface shall be able to read the current active settings of a networked luminaire or intelligent control device and shall be capable of displaying dimming trim levels, occupancy sensor and photocell enable/disable, occupancy sensor time delay and light level settings, occupancy sensor response (normal or vacancy), and photocell setpoints and transition time delays.
  - .10 Management interface shall be able to change the current active settings and default settings for an individual networked luminaire or intelligent control device.
  - .11 Management interface shall be capable of applying settings changes for a zone of devices or a group of selected devices using a single "save" action that does not require the user to save settings changes for each individual device.
  - .12 A printable network inventory report shall be available via the management interface.
  - .13 A printable report detailing all system profiles shall be available via the management interface.
  - .14 All sensitive information stored by the software shall be encrypted.
  - .15 All system software updates must be available for automatic download and installation via the internet.
- .2 Visualization and Programming Interfaces:
  - .1 System shall provide an optional web-based visualization interface that displays graphical floorplan.
  - .2 Graphical floorplan shall offer the following types of system visualization:
    - .1 Full Device Option - A master graphic of the entire building, by floor, showing each control device installed in the project with zones outlined. This shall include, but not be limited to, the following:
      - .1 Controls embedded light fixtures
      - .2 Controls devices not embedded in light fixtures
      - .3 Daylight Sensors
      - .4 Occupancy Sensors
      - .5 Wall Switches and Dimmers
      - .6 Scene Controllers
      - .7 Networked Relays
      - .8 Wired Bridges
      - .9 System Controllers
      - .10 Wired Relay Panels
      - .11 Group outlines
    - .2 Group Only Option - A master graphic of the entire building, by floor, showing only control

- .3 Allow for pan and zoom commands so smaller areas can be displayed on a larger scale simply
- .4 A mouse click on any control device shall display the following information (as applicable): by panning and zooming each floor's master graphic. groups outlined.
  - .1 The device catalogue number.
  - .2 The device name and custom label.
  - .3 Device diagnostic information.
  - .4 Information about the device status or current configuration is available with an additional mouse click
- .3 Personal Control Applications for Wired Devices:
  - .1 Software interface shall support personal control software applications that provide user-specific control of individual luminaires/control devices, control zones, global scene presets, and scene selector virtual button presses.
  - .2 The system administrator shall be capable of defining personal control permissions for each user account.
  - .3 Software interface shall provide a Microsoft Windows® operating system taskbar application for personal lighting control.
  - .4 Software interface shall provide an Apple iOS® operating system application (supported by mobile phones and mobile tablet devices) for personal lighting control.
- .4 Smartphone Programming Interface for Wired Devices:
  - .1 The lighting control card will control the lights directly connected from each respective LIC module.
  - .2 Each LIC module shall have a dimming card with a unique address.
    - .1 Application interface shall be provided for both Apple iOS® and Android operating systems that allows configuration of lighting control settings.
    - .2 The application shall support the configuration and control of wired networked control devices via a Bluetooth® Low Energy (BLE) Programming Device.
      - .1 Application shall support a security pin-code to access the zone of lighting control devices.
      - .2 The application shall provide indication of signal strength where multiple Bluetooth Low Energy Programming Devices are available for configuration.
      - .3 The application shall indicate the number of wired networked control devices connected to the local daisy-chain zone.
      - .4 The application shall provide on/off/dimming control of all control groups.
      - .5 The application shall provide the ability to identify all individual luminaires and control devices.
    - .3 Programming capabilities through the application shall include, but not be limited to, the following:
      - .1 Switch/occupancy/photosensor zone configuration
      - .2 Manual/automatic on modes
      - .3 Turn-on dim level
      - .4 Occupancy sensor time delays
      - .5 Dual technology occupancy sensors sensitivity
      - .6 Photosensor calibration adjustment and auto-setpoint
      - .7 Multiple photosensor zone offset
      - .8 Trim level settings
      - .9 Preset scene creation and copy for scene capable devices
      - .10 Application of custom device labels to the Bluetooth Low Energy Programming Devices and individual connected lighting control devices.
- .5 Smartphone Programming Interface for Wireless Devices:
  - .1 Application interface shall be provided for both Apple iOS® and Android operating systems that allows configuration of lighting control settings.

- .2 The application shall support the configuration of wireless networked control devices:
  - .1 Application shall limit access with a user name and password
  - .2 Access to the program information will be governed by a permission system that allows users to share access with other users and restrict access to those who should not be able to reconfigure the equipment
  - .3 The application shall provide indication of signal strength where multiple Bluetooth Low Energy Programming Devices are available for configuration.
- .3 Programming capabilities through the application shall include, but not be limited to, the following:
  - .1 Switch/occupancy/photosensor group configuration
  - .2 Manual/automatic on modes
  - .3 Turn-on dim level
  - .4 Occupancy sensor time delays
  - .5 Dual technology occupancy sensors sensitivity
  - .6 Photosensor calibration adjustment and auto-setpoint
  - .7 Multiple photosensor zone offset
  - .8 Trim level settings

## 2.4 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

- .1 System Controller:
  - .1 System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies
  - .2 System Controller shall have 32-bit microprocessor operating at a minimum of 1 GHz.
  - .3 System Controller shall have minimum of 512 MB memory, with a minimum of 4 GB non-volatile flash, to support its own operating system and databases.
  - .4 System Controller shall perform the following functions:
    - .1 Time-based control of downstream wired network devices.
    - .2 Linking into an Ethernet network.
    - .3 Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
    - .4 Connection to various software interfaces, including management interface, historical database and analytics interface, and visualization interface.
  - .5 System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.
  - .6 Device shall have option for a graphical touch screen to support configuration and diagnostics.
  - .7 Device shall have three RJ-45 networked lighting control ports for connection to any of the following:
    - .1 The graphical touch screen
    - .2 Wired communication bridges
    - .3 Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port)
  - .8 Device shall automatically detect all networked devices connected to it.
  - .9 Device shall have an internal time clock used for astronomical and standard schedules.
  - .10 Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection.
    - .1 Ethernet connection shall support daisy chain wiring to other lighting control system LAN devices.
    - .2 Ethernet connection shall support IPv4 and shall be capable of using a dedicated static or DHCP assigned IP address.
  - .11 Device shall have 2 x USB 2.0 Expansion ports for 802.11 Wi-Fi Adapter enabling wireless connectivity including:
    - .1 Hot Spot
    - .2 Access Point

- .3 Client
- .12 Each System Controller shall be capable of managing and operating at least 750 networked devices (wired or wireless).
  - .1 Multiple System Controllers may be networked together via LAN connection to scale the system up to 20,000 networked devices.
- .13 System Controller shall support BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
  - .1 BACnet MS/TP shall support 9600 to 115200 baud rate.
  - .2 System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- .14 System controller shall contain a "FIPS 140-2 Level 1 Inside" cryptographic module.
- .15 System controller shall be available within a NEMA 1 enclosure with Class 1 and Class 2 separation:
  - .1 Enclosure shall support power input power of 120-277VAC, or optional 347VAC
- .2 OpenADR Interface:
  - .1 System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
  - .2 OpenADR interface shall meet all the requirements of OpenADR 2.0a Virtual End Nodes (VEN), including:
    - .1 Programmable with the account information of the end-user's electrical utility DRAS account credentials.
  - .3 OpenADR interface shall support the activation of demand response levels defined in the utility demand response program.

## 2.5 WIRED NETWORKED DEVICES

- .1 Wired Networked Wall Switches, Dimmers, Scene Controllers:
  - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
  - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
  - .3 All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  - .4 Devices with mechanical push-buttons shall provide tactile and LED user feedback.
  - .5 Devices with mechanical push-buttons shall be made available with custom button labelling.
  - .6 Wall switches & dimmers shall support the following device options:
    - .1 Number of control zones: 1, 2 or 4
    - .2 Control Types Supported:
      - .1 On/Off
      - .2 On/Off/Dimming
      - .3 On/Off/Dimming/Correlated Colour Temperature Control for specific luminaire types
    - .3 Colours: Black
  - .7 Scene controllers shall support the following device options:
    - .1 Number of scenes: 1, 2 or 4
    - .2 Control Types Supported:
      - .1 On/Off
      - .2 On/Off/Dimming
      - .3 Preset Level Scene Type
      - .4 On/Off/Dimming/Preset Level for Correlated Colour Temperature
      - .5 Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.



- .6 Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
      - .3 Colours: Black
- .2 Wired Networked Occupancy and Photosensors:
  - .1 Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
  - .2 Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
  - .3 For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
  - .4 Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
  - .5 All sensing technologies shall be acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
  - .6 System shall have ceiling, fixture, recessed & corner mounted sensors available, with multiple lens options available customized for specific applications.
  - .7 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
  - .8 All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  - .9 Sensor programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
  - .10 Ceiling mount occupancy sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
  - .11 Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
  - .12 Sensors shall have optional features for photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.
  - .13 Photosensor shall provide for an on/off set-point, and a dead band to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
  - .14 Photosensor and dimming sensor's set-point and dead band shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
  - .15 Dead band setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
  - .16 A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The secondary daylight zone shall be capable of being controlled as an "offset" from the primary zone.
  - .17 Ceiling mounted sensors to be white finish.
- .3 Wired Networked Wall Switch Sensors:
  - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.

- .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
- .3 All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
- .4 Devices with mechanical push-buttons shall provide tactile user feedback.
- .5 Wall switches sensors shall support the following device options:
  - .1 User Input Control Types Supported: On/Off or On/Off/Dimming
  - .2 Occupancy Sensing Technology: PIR only or Dual Tech acoustic
  - .3 Daylight Sensing Option: Inhibit Photosensor
  - .4 Colours: Black
- .4 Wired Networked Power Packs and Secondary Packs:
  - .1 Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
  - .2 Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
  - .3 Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power
  - .4 Power Supplies shall provide system power only, but are not required to switch line voltage circuit.
  - .5 Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
  - .6 Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
  - .7 Power Pack programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
  - .8 Power Pack shall securely mount through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast/driver channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
  - .9 When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
  - .10 Power/Secondary Packs shall be available with the following options:
    - .1 Power Pack capable of full 16-Amp switching of all normal power lighting load types, with optional 0-10V dimming output capable of up to 100 mA of sink current
    - .2 Secondary Pack with UL 924 listing for switching of full 16-Amp Emergency Power circuits, with optional 0-10V dimming output capable of up to 100mA of sink current.
    - .3 Power and Secondary Packs capable of full 20-Amp switching of general purpose receptacle (plug-load) control.
    - .4 Secondary Pack capable of full 16-Amp switching of all normal power lighting load types.
    - .5 Secondary Pack capable of 5-Amps switching and dimming of 120/277 VAC magnetic low voltage transformers.
    - .6 Secondary Pack capable of 4-Amps switching and dimming of 120 VAC electronic low voltage transformers.
    - .7 Secondary Pack capable of louvre/damper motor control for skylights.
    - .8 Secondary Pack capable of providing a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
    - .9 Secondary Pack capable of switching 1 amp at 40 VAC/VDC (resistive only) with the intent to provide relay signal to auxiliary system (e.g. BMS).
    - .10 Power Supply capable of providing auxiliary bus power (no switched or dimmed load).

**PART 3 - EXECUTION****3.1 INSTALLATION REQUIREMENTS**

- .1 Installation Procedures and Verification:
  - .1 The successful bidder shall review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
  - .2 The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
  - .3 The successful bidder shall be responsible for testing of all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
    - .1 Wire Map (continuity, pin termination, shorts and open connections, etc.)
    - .2 Length
    - .3 Insertion Loss
- .2 Coordination with Owner's IT Network Infrastructure:
  - .1 The successful bidder is required to coordinate with the owner's representative to secure all required network connections to the owner's IT network infrastructure.
    - .1 The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
    - .2 The bidder shall provide to the manufacturer's representative all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
- .3 Documentation and Deliverables:
  - .1 The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.
  - .2 The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization/graphical floorplan software is provided as part of bid package:
    - .1 As-Built floor plan drawings showing device address locations required above. All documentation shall remain legible when reproducing/scanning drawing files for electronic
    - .2 As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions. submission.
      - .1 CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
        - .1 Titleblock
        - .2 Text- Inclusive of room names and numbers, fixture tags and drawings notes
        - .3 Fixture wiring and homeruns
        - .4 Control devices
        - .5 Hatching or poché of light fixtures or architectural elements
      - .2 CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

**3.2 SYSTEM START-UP**

- .1 Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed.
  - .1 For CAT5 wired devices, low voltage network cable testing shall be performed prior to system startup.

- .2 System start-up and programming shall include:
  - .1 Verifying operational communication to all system devices.
  - .2 Programming the network devices into functional control zones to meet the required sequence of operation.
  - .3 Programming and verifying all sequence of operations.
- .3 Initial start-up and programming is to occur on-site.

### 3.3 PROJECT TURNOVER

- .1 System Documentation:
  - .1 Submit software database file with desired device labels and notes completed. Changes to this file will not be made by the factory.
  - .2 Installing contractor to grant access to the owner for the programming database, if requested.
- .2 Owner Training:
  - .1 Provisions for onsite training for owner and designated attendees to be included in submittal package.

END OF SECTION

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA).

**PART 2 - PRODUCTS****2.1 DESIGN DESCRIPTION**

- .1 Design 1.
  - .1 Type: ANN.
  - .2 3 phase, 600 V input, 120/208V output, 60 Hz, kVA as indicated.
  - .3 Voltage taps: standard.
  - .4 Insulation: Class 220, 150°C temperature rise.
  - .5 Basic Impulse Level (BIL): standard.
  - .6 Hipot: standard.
  - .7 Average sound level: standard
  - .8 Impedance at 17 degrees C: standard
  - .9 Enclosure: CSA, removable metal front panel.
  - .10 Mounting: as indicated.
  - .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical .
  - .12 Copperwindings.
  - .13 Winding configuration to be as noted on drawings.
  - .14 Harmonic Mitigating Phase Shifting transformers as indicated on drawings.
  - .15 KL-Rated Transformers as indicated on drawings.
  - .16 Voltage Regulation to be 4% or better.
  - .17 Neutral assemblies shall be 200% rated.

**2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.
- .3 Nameplate wording: wording to stie standards.

**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 dry type transformers 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 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

**3.3 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 28 - Grounding - Secondary.
- .2 Section 26 05 31 - Junction and Pull Boxes.
- .3 Section 26 24 16.01 - Panelboards Breaker Type.
- .4 Section 26 28 16.02 - Moulded Case Circuit Breakers.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**PART 2 - PRODUCTS****2.1 EQUIPMENT**

- .1 Enclosed circuit breaker: in accordance with Section 26 28 16.02 - Moulded Case Circuit Breakers, rating as indicated in electrical drawings.
- .2 Panelboard breaker type: in accordance with Section 26 24 16.01 - Panelboards Breaker Type, rating as indicated in electrical drawings.
- .3 Junction box and pull box: in accordance with Section 26 05 31 - Junction and Pull Boxes.

**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 service 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 and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Install service equipment.

- .2 Connect to incoming service.
- .3 Connect to outgoing load circuits.
- .4 Install ground fault equipment.
- .5 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .6 Make provision for power supply authority's metering.

END OF SECTION



**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers.

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No. 29-15, Panelboards and Enclosed Panelboards.

**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.
- .2 208 V panelboards: bus and breakers rated for 10 kA (symmetrical) interrupting capacity or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Isolated ground bus.
- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

## 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.

## 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, to match building standard.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved, to match building standard.
- .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 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.

## 3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

**PART 1 - GENERAL****1.1 NOT USED**

- .1 Not used.

**PART 2 - PRODUCTS****2.1 COMPONENTS**

- .1 Integrally molded thermoplastic, color coded black for normal and red for emergency circuits. Special color for system identification i.e. blue, gray, yellow, white.
- .2 Certified to make or break under full rated load.
- .3 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.
- .4 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:
  - .1 Right terminal strip: two seven wire outlets.
  - .2 Left terminal strip: two seven wire outlets.
  - .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.
- .5 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.
- .6 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.

- .7 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 Departmental Representative. 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.

END OF SECTION

**PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 CSA International
  - .1 CSA C22.2 No. 42-10 (R2015), General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA C22.2 No. 42.1-13 (R2017), Cover Plates for Flush-Mounted Wiring Devices.
  - .3 CSA C22.2 No. 55-15, Special Use Switches.
  - .4 CSA C22.2 No. 111-18, General-Use Snap Switches.

**PART 2 - PRODUCTS****2.1 SWITCHES**

- .1 15, 20 A, 120 V, 347 V, single pole, switches to: CSA C22.2 No. 55 and CSA C22.2 No. 111.
- .2 Manually-operated general purpose, brushed metal finish, 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 Black finish toggle.
- .3 Switches of one manufacturer throughout project.
- .4 Motion switch: Dual technology infra rad, ultrasonic, 360 degree coverage, wall or ceiling mounted as indicated.
- .5 Specification grade.

**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 Black finish 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 riveted grounding contacts.
- .2 GFI receptacles, CSA type 5-20R-125V, 20A, Class A.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

- .5 Specification grade.

### 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 Brushed metal finish, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS type conduit boxes.
- .5 All cover plates to be provided with panel name and circuit numbers.

### 2.4 STANDALONE EMERGENCY CALL SYSTEMS

- .1 Provide new standalone emergency call system in universal washroom c/w all required hardware and accessories. Provide interconnection between each device as per manufacturer's recommendation to render a fully functional system. When emergency call push button is pushed, an alarm is sound in the unit washroom and corridor. Provide a means to silence the alarm. Provide lamacoid sign containing the words "in the event of an emergency push emergency button and audible and visual signal will activate" in both English and French at least 25 mm high with a 5 mm stroke, red lettering on white background. Coordinate work and elevation with door hardware installer and architectural drawing prior to installation.

### 2.5 OCCUPANCY SENSOR ND PHOTO CONTROL

- .1 Provide occupancy sensor and photo control as indicated in electrical drawings.
- .2 White finish.

### 2.6 DIMMING CONTROL

- .1 Provide dimming control as indicated in electrical drawings.
- .2 Brushed metal finish cover plate.
- .3 Black device.

### 2.7 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .4 Ensure existing remaining outlets in affected area are functional.
  - .5 Do not mount wall outlets back to back. Leave minimum 300mm space between outlets. Stagger outlets within alternate stud cavities. Do not anchor back to back outlets to the same stud.
- .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 as indicated.
  - .3 Install GFI type receptacles.
- .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 surfaced mounted boxes.
  - .3 All cover plates to be provided with panel name and circuit number.
- .4 Standalone Emergency Call Systems:
  - .1 Install standalone emergency call systems in accordance with drawings and manufacturer's instructions.
  - .2 All mounting heights and final locations to be coordinated with Architectural drawings and Departmental Representatives.
- .5 Occupancy Sensor and Photo Control:
  - .1 Install occupancy sensor and photo control in accordance with drawings and manufacturer's instructions.
  - .2 All final locations to be coordinated with Departmental Representative.

**3.2 PROTECTION**

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

END OF SECTION



**PART 1 - GENERAL****1.1 REFERENCE STANDARDS**

- .1 CSA International
  - .1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

**PART 2 - PRODUCTS****2.1 BREAKERS GENERAL**

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient to match existing system.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Contractor to include certificate of origin for new breakers from manufacturer.

**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.

**2.3 GROUND FAULT MOULDED CASE CIRCUIT BREAKERS**

- .1 Bolt-on moulded case circuit breaker: quick- make, 5 mA, indicator light, reset/test switch, quick-break type for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 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.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International).
- .2 Underwriters' Laboratories of Canada (ULC).

## **PART 2 - PRODUCTS**

### **2.1 LAMPS**

- .1 Lamps as per light fixture schedule in electrical drawing.

### **2.2 LED DRIVER**

- .1 Programmable output current through SimpleSet.
- .2 Operating window, with max current of 1.5A.
- .3 0-10V Dimming.
- .4 Output Voltage Range 27Vdc to 54Vdc.
- .5 Operating Ambient Temp. Range 20°C to +55°C.
- .6 Output Current Tolerance <5%.
- .7 Audible Noise <24dB Class A.

### **2.3 FINISHES**

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

### **2.4 FIXTURE TYPE**

- .1 Refer to light fixture schedule.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.

- .2 Provide adequate support to suit ceiling system.
- .3 Clean lamps, lenses, interior and visible surfaces of luminaires. Replace defective lamps, ballast and damaged lenses in area of construction.
- .4 Luminaires in construction area are to be independently supported, including existing to remain, relocated and new, to comply with code requirements.
- .5 Add, relocate and connect light fixtures to suit indicated layout, extend conduit and wiring as necessary and connect luminaires to existing circuits. Turn over surplus fixtures to Departmental Representative.
- .6 Where air supply troffers are being relocated by mechanical contractor to existing light fixture, electrical contractor to coordinate disconnection and reconnection as required.

### 3.2 WIRING

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

### 3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling.

### 3.4 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.

END OF SECTION

**PART 1 - GENERAL****1.1 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CSA C22.2 No. 141-15, Emergency Lighting Equipment.
  - .2 CSA C860-11 (R2016), Performance of Internally-Lighted Exit Signs.
- .2 International Organization for Standardization (ISO)
  - .1 ISO 3864-1 2011, Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings.
  - .2 ISO 7010 2011, Safety colours and safety signs - Registered safety signs.
- .3 National Research Council Canada
  - .1 NRCC NBCC-2015, National Building Code of Canada.

**PART 2 - PRODUCTS****2.1 EXIT LIGHTS**

- .1 Exit lights: to CSA C22.2 No. 141 and CSA C860.
- .1 Pictogram: Aluminum frame, opal diffuser panel, pictogram panel with multiple films for direction selection, and clear protective panel. Pictogram panel shall consist of green pictogram and white graphic symbol meeting the visibility specifications referred to in ISO 3864-1, and conform to the dimensions indicated in ISO 7010.
- .2 Suitable for 347V or 120V normal supply
- .3 Die cast mounting bracket for wall, ceiling, or end mounting as indicated.
- .4 Provide circuit labels at all exit signs.

**PART 3 - EXECUTION****3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NBC and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.

- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Lock exit light circuit breaker in on position.

END OF SECTION