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## 1 General

### 1.1 REFERENCES

- .1 This Section supplements Division 01 and forms part of every Section 26, 27, and 28.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23<sup>rd</sup> Edition), Safety Standard for Electrical Installations.
  - .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

### 1.2 RELATED SECTIONS

- .1 Section 07 84 00 – Fire Stopping.

### 1.3 DEFINITIONS

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

### 1.4 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

### 1.5 SCOPE OF WORK

- .1 This work includes, but is not limited to, the supply and installation of supervision, labour, permits, equipment, materials, and consumables necessary to provide this facility with complete and operational systems as listed below, as indicated on drawings, and as described in the specifications.
  - .1 Electrical services to the facility. Coordinate with NB Power and pay associated costs.
  - .2 New facility power and distribution systems including but not limited to, new service entrance, distribution panels, grounding, receptacles and outlets, connections to mechanical and other equipment, electric heat systems.

- .3 New facility emergency power systems, including but not limited to, automatic transfer switch and diesel generator.
- .4 New facility lighting systems, including but not limited to, interior and exterior lighting, site lighting, exit signage, emergency lighting, and lighting controls.
- .6 New facility data/telephone systems including but not limited to, utility services, raceway, cabling, patch panels, and outlets.
- .7 New facility radio systems including but not limited to, raceway, cabling, patch antenna, and outlets. Radio equipment to be supplied and installed Owner's Radio Group.
- .8 Contractor shall supply and install new conduit, wiring, and rough-in provisions for CCTV and microphone system. Cameras and equipment to be supplied and installed by Owner's Protective Technical Services Section (PTSS).
- .9 Contractor shall supply and install new conduit, wiring, and rough-in provisions for access control system in coordination with Division 08. Devices, controllers, and equipment supplied and installed by Owner's PTSS.
- .10 Contractor shall supply and install new conduit, wiring, and rough-in provisions for Intrusion Detection System. Devices, controllers, and equipment supplied and installed by Owner's PTSS.
- .11 New building addressable fire alarm system and devices. This shall include auto-dialer located in room 120 with dedicated telephone line and power circuit.
- .12 New building CATV system including but not limited to, raceway, cabling, and outlets.
- .13 Start-up, testing, and commissioning of systems.
- .2 The Electrical Contractor shall fully review Architectural, Civil, Structural, and Mechanical drawings and specifications, as well as, Addendums associated with all trades to coordinate and determine work associated with electrical work prior to submitting tender price.
- .3 After review of documents associated with other trades, forward questions and obtain answers by Addendum, prior to tender submission.
- .4 Submission of Tender by Electrical Contractor acknowledges coordination with other trades as part of these contract documents.

## 1.6 EXAMINATION OF SITE AND DRAWINGS

- .1 The Contractor shall examine the site and local conditions affecting the work under this Contract. No additional costs will be considered due to existing site conditions.
- .2 The Departmental Representative reserves the right to alter locations of devices or

equipment without incurring additional costs provided such changes are made before the Contractor has begun fabrication of the work in question.

- .1 The Contractor shall carefully examine the Structural, Civil, Architectural, and Mechanical drawings and satisfy himself that the work under this division can be carried out without changes to the equipment as shown on the drawings. Before commencing the work, the Contractor shall examine the work of other trades and report at once any defect or interference affecting the work of this division.
- .2 Notes on the drawings are intended to form a part of this specification and shall be examined by the Contractor.

#### 1.7 DESIGN DOCUMENTS

- .1 The drawings and these specifications are complementary each to the other and what is called for by one shall be binding as if called for by both.
- .2 Drawings for the electrical work are, in part diagrammatic. They are intended to convey the scope of work and to indicate the general arrangement of equipment, and outlets.
- .3 The drawings, which form an integral part of this contract, shall serve as the working drawings. They indicate the general layout of the complete electrical system, arrangement of feeders, circuits, outlets, switches, controls, panelboards, distribution centres, equipment, luminaires, and other work. The drawings indicate the general location and routes to be followed, but do not show all conduit and/or wiring or all the civil, structural, mechanical, and architectural details. Plan and install conduit runs respecting all applicable conditions including civil, structural, mechanical, and architectural details.
- .4 Communications systems drawings, which form an integral part of this contract, shall serve as the working drawings. They indicate general schematics and functionality of the systems, but do not show all wiring and devices. The Contractor shall be responsible for the proper installation of these systems to ensure proper interconnectivity and functionality.
- .5 Before carrying out the work, verify that there are no apparent obstructions or interferences. Changes to the work made necessary by failure to make this verification will not be considered for extra payment.
- .6 Coordinate the locations of outlets with architectural and structural details and elevations as well as millwork and pertinent furniture layouts, etc.
- .7 The location of equipment or outlets may be changed by Departmental Representative at any time prior to installation, within a radius of 3 metres from the location shown on the drawings, at no extra cost to the Contract.

#### 1.7 PERMITS, FEES, AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.

- .3 Departmental Representative will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
- .4 Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes.
- .5 Furnish Certificates of Acceptance from Electrical Inspection Department and Authorities Having Jurisdiction upon completion of work to The Departmental Representative.

## 1.8 SUBMITTALS

- .1 Submittals: in accordance with Section 01 10 01 – General Requirements.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 01 10 01 – General Requirements.
- .3 Submit for review single line electrical diagram laminated and mounted in main electrical room.
  - .1 Electrical distribution system in main electrical room.
  - .2 B1 size (707mm x 1000mm).
- .4 Submit for review; fire alarm riser diagram, plan and zoning of building at fire alarm control panel.
- .5 Shop drawings:
  - .1 Submit drawings in accordance with Section 01 10 01 – General Requirements and per technical section requirements as indicated below:
    - .1 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets
    - .2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fitting
    - .3 Section 26 12 17 – Dry Type Transformers up to 600V Primary
    - .4 Section 26 24 01 - Load Transfer Equipment
    - .5 Section 26 24 02 - Service Entrance Board
    - .6 Section 26 24 17 - Panelboards Breaker Type
    - .7 Section 26 26 23 - Disconnect Switches Fused and Non-Fused
    - .8 Section 26 27 26 - Wiring Devices
    - .9 Section 26 28 14 - Fuses Low Voltage
    - .10 Section 26 28 21 - Moulded Case Circuit Breakers
    - .11 Section 26 29 10 - Motor Starters to 600V
    - .12 Section 26 32 17 – Power Generation Diesel
    - .13 Section 26 50 00 - Lighting
    - .14 Section 26 51 01 - Lighting Controls
    - .15 Section 26 52 01 - Unit Equipment for Emergency Lighting
    - .16 Section 26 53 00 - Exit Lights
    - .17 Section 26 82 33 – Electric Heaters
    - .18 Section 27 05 28 – Pathways for Communications Systems
    - .19 Section 27 11 16 - Communications Cabinets, Racks, Frames and Enclosures
    - .20 Section 27 13 00 - Communications Backbone Cabling
    - .21 Section 27 15 00 - Communications Horizontal Cabling
    - .22 Section 27 15 01 – Antenna Communications Cabling

- .23 Section 28 10 00 - Electronic Access and Intrusion Detection
  - .24 Section 28 23 00 - Video Surveillance System
  - .25 Section 28 31 00 - Fire Detection and Alarm
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- .2 Indicate details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment and material.
  - .3 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 coordinated installation.
  - .4 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .5 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
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- .6 Record drawings:
    - .1 Prior to start of testing and commissioning; finalize production of as-built drawings.
    - .2 Identify each drawing in lower right hand corner in red ink as follows: - "RECORD DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
    - .3 Submit to Departmental Representative for review and make corrections as directed.
    - .4 Submit completed reproducible record drawings with Operating and Maintenance Manuals in accordance with Section 01 10 01 – General Requirements.
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- .7 Operation and Maintenance Data:
    - .1 Provide operation and maintenance data for electrical work for incorporation into maintenance manual in accordance with 01 10 01 – General Requirements.
    - .2 Include in operations and maintenance data:
      - .1 Details with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
      - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.
      - .3 Wiring and schematic diagrams and performance curves.
      - .4 Names and addresses of local suppliers for all items included in maintenance manual.
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- .8 Operating Instructions:
    - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
    - .2 Operating instructions to include following:
      - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
      - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
      - .3 Safety precautions.
      - .4 Procedures to be followed in event of equipment failure.

- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Post instructions where directed.

## 1.9 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
  - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
  - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
  - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only use products.
  - .3 For products not identified on list, source products with highest recycled content available when practical.
  - .4 Include following information with product data submission.
    - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
  - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Required to be Locally Sourced".
  - .2 If products within this section are indicated on the "List of Products Required to be Locally Sourced", include following information with Product Data submission:
    - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
  - .1 Include following information with Product Data submission for materials specified under this section:
    - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.
- .5 Paints and Coatings.
  - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
  - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
    - .1 Interior and Exterior Paints: GS-11
    - .2 Anti-Corrosive Paint: GS-11
    - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
  - .3 Submit manufacturer's certification indicating VOC limits of Products.
  - .4 Submit manufacturer's certification indicating no added urea formaldehyde.
- .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.

### 1.10 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES

- .7 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
  - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
    - .1 General maximum VOC 25g/L.
    - .2 Electrical apparatus components and electronic components.
    - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
  - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.
  - .3 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.

### 1.11 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 10 01 – General Requirements.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians in accordance with authorities having jurisdiction.
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- .4 Lock-out tag-out Requirements: do work in accordance with Section 01 35 25 - Special Lockout Procedures.
- .5 Submit applicable manufacturer's test reports and certificates in accordance with 01 10 01 – General Requirements.

### 1.12 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.

### 1.13 WARRANTY

- .1 Prior to expiration of the construction contract warranty, the Departmental Representative will carry out functional performance testing (FPT). The Contractor will cooperate with the Departmental Representative's request for warranty service and pay for associated costs.

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## 2 Products

### 2.1 GENERAL REQUIREMENTS

- .1 Materials and products in accordance with Section 01 10 01 – General Requirements.
- .2 Do verification requirements in accordance with Section 01 10 01 – General Requirements.

### 2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 10 01 – General Requirements.
- .2 Provide CSA certified equipment and material. Where CSA certification is not available, obtain special approval from Electrical inspection Department before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.
- .4 Equipment and materials specified to conform to an applicable code and/or standard shall be listed and labelled under the provisions of such code.
- .5 Electrical equipment and enclosures to be suitable for environment in which it is to be installed.

### 2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated. Supplier, installer, and wiring responsibility is indicated on electrical drawings and related mechanical responsibility is indicated on mechanical drawings.
- .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections which are related to control systems specified in mechanical division and shown on mechanical and controls drawings and specifications as being by the mechanical division.
- .3 Coordinate final connection to mechanical equipment and controls with mechanical and controls divisions.

### 2.4 WARNING SIGNS

- .1 Warning Signs: in both official languages and in accordance with requirements of Electrical Inspection Authorities.
- .2 Porcelain enamel decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.
- .2 Provide, install, terminate, and identify phone cables and BIX termination panels.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: Lamacoid 3mm thick plastic engraving sheet, black face, white core, attached with adhesive.
  - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .4 Nameplates for distribution switchboards and panelboards shall indicate designated name of equipment, overcurrent protection device rating, voltages, number of phases and wires.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters, VFDs, and contactors: indicate equipment being controlled and voltage.
- .7 Transformers: indicate designation, capacity, primary and secondary voltages.
- .8 Receptacles shall be labeled indicating panel and circuit designation (i.e. PA-4).
- .9 Junction and/or pull boxes shall be marked with an indelible ink marker to designate the circuit number of enclosed wiring, the designated panel name.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or 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.

## 2.8 CONDUIT AND CABLE IDENTIFICATION

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

Service	Prime	Auxiliary
50 V to 249 V Normal	Green	
50 V to 249 V Emergency	Orange	
250 V to 749 V Normal	Blue	
250 V to 749 V Emergency	Yellow	
750 V and up	Grey	
Fire Alarm	Red	
Emergency Voice	Red	Black
Intrusion Alarm	Red	Blue
CCTV	Red	Green
Door Access	Red	Orange
Medical Gas Alarms	Red	Yellow
Telephone	White	
Nurse Call	White	Red
Television	White	Black
Data	White	Yellow
Public Address	White	Green
Intercom (Point to Point)	White	Blue
Controls	Brown	Orange

## 2.9 FINISHES

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

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### 3 Execution

#### 3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Comply with CSA Certification Standards and Electrical Bulletins in force at time of tender submission.
- .3 Do overhead and underground systems in accordance with:
  - .1 CSA C22.3 No.1.
  - .2 Current edition of Énergie NB Power Standard Construction Practices Underground.
  - .3 Current edition of Énergie NB Power utility Service Entrance Standards.

#### 3.2 NAMEPLATES AND LABELS

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

#### 3.3 CONDUIT AND CABLE INSTALLATION

- .1 Conduit and wiring shall be concealed in walls and boxes shall be recessed throughout the building with the exception of the electrical and mechanical rooms. Conduit and wiring in ceiling spaces shall be installed tight to building steel and as high as possible. Coordinate with other trades.
- .2 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: sized for free passage of conduit, and protruding 50 mm.
- .3 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .4 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .5 Firestopping shall be by Division 07 – Firestopping. This Contractor shall be responsible for firestop preparation and coordination of locations related to conduit, cable, and equipment supplied and installed by Division 26 requiring firestopping with Division 07.

#### 3.4 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .2 Change location of outlets (wiring devices, telecommunications outlets) at no extra cost or credit, providing distance does not exceed 3 m, and information is given before installation.
- .3 Locate light switches on latch side of doors unless otherwise indicated.

### 3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 450 mm.
    - .2 Above top of counters or counter splash backs: 150 mm.
    - .3 In garage bays and service rooms: 1200 mm.
  - .3 Panelboards: 1500 mm or as required by Code.
  - .4 TV, telephone, and data outlets:
    - .1 General: 450 mm.
    - .2 Above top of counters or counter splash backs: 150 mm.
    - .3 In bays and service rooms: 1200 mm.
  - .5 Fire alarm pull stations: 1200 mm.
  - .6 Fire alarm horn/strobes: 250 mm below ceiling or minimum 2300 mm.
  - .7 Card readers: minimum 1025 mm.
  - .8 Door Operator pushbuttons: 865 mm minimum, 1200 mm maximum and as per barrier-free requirements.
  - .9 Emergency lights: 2700 mm.

### 3.6 FIRESTOPPING

- .1 Electrical penetrations to be fire stopped by Section 07 84 00 – Firestopping
- .2 Electrical Contractor shall be responsible for verifying size, type and number of locations required for electrical systems and advising fire stopping contractor.
- .3 Communications cables (data, phone, radio) penetrations shall be installed through a cable management sleeve. Identify number and types of cables that will be passed through each sleeve.

### 3.7 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 Submit, at completion of work, report listing phase and neutral currents on panelboards, and dry-core transformers operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

### 3.8 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark all live parts "LIVE 600 VOLTS" or with appropriate voltage in English and French.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

### 3.9 CO-ORDINATION OF PROTECTIVE DEVICES

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

### 3.10 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
  - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and lighting controls.
  - .4 Communication Systems: fire alarm system, communications, and data systems.
  - .5 Backup power system including Generator and Automatic Transfer Switches.
  - .6 Other systems as indicated by individual technical sections.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 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.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Data communications system to be tested by certified installer.
- .6 Complete in accordance with Section 01 10 01 – General Requirements.
- .7 Submit test results in accordance with Section 01 10 01 – General Requirements.

### 3.11 COMMISSIONING

- .1 Commissioning of systems is required. Functionality of systems, equipment, and sequences of operations will need to be verified and reported on. Trades will need to collaborate with the others involved to ensure complete system check.
- .2 Testing sequences shall cover full range of operation. Coordinate with other contractors.

- .3 Departmental Representative will be monitoring energy consumption and reserves the right to question performance during the warranty period.
- .4 Perform Commissioning in accordance with requirements of Section 01 91 13 – General Commissioning Requirements.

### 3.12 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .3 At time of final cleaning, clean lighting reflectors, lenses, pot lights, and other lighting surfaces that have been exposed to construction dust, dirt and fingerprints.
- .4 Reference Section 01 10 01 – General Requirements for further requirements.

### 3.13 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 20 – Wires and Cables 0-1000V.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2 No.65-93 (R1999), Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

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, as required to: CAN/CSA-C22.2 No.18.

3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 20 – Wire and Box Connectors 0-1000V.

### 1.2 REFERENCES

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-M89 (R1994), Type Teck90 Cable.

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with 01 10 01 – General Requirements.

## 2 Products

### 2.1 BUILDING WIRES

- .1 Use standard building wire and conduits for branch circuits in corridors, into rooms, and in all open ceiling spaces and rooms unless otherwise indicated.
- .2 In rooms with dropped T-bar or accessible ceilings, AC90 shall be acceptable only for use for final 1.5 m of connection to light fixtures, devices, etc. All cables above T-bar ceilings to be properly secured.
- .3 Conductors: Stranded for 10 AWG and larger. Minimum size 14 AWG.
- .4 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90. Coloured green for bond wire.
- .5 Voltage drop shall not exceed 3% of line voltage. The following is for all 120V, 15A branch circuits and include horizontal and vertical conductor lengths.

Branch Circuit Length of Run	Phase Wire Size	Bond Size
1' to 80'	#12	#14
81' to 125'	#10	#12
126' to 185'	#8	#10

### 2.2 ARMOURED CABLE

- .1 Conductors: insulated, copper, quantity and size as indicated.
- .2 Type: AC90.

### 2.3 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, quantity, and size as indicated.
- .3 Insulation:
  - .1 Type: ethylene propylene rubber.
  - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Overall covering: thermoplastic material.
- .6 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .7 Watertight connectors approved for TECK cable.

### 2.4 CONTROL CABLE

- .1 Control wiring and cables shall be installed in EMT stubbed up to accessible ceiling space.
- .2 Control wire and cables installed in exposed areas shall be run in EMT.
- .3 Cable and wiring not in conduit shall be FT-6 rated and fastened to upper ceiling or walls above T-bar ceiling.
- .4 Copper conductors: quantity and size as indicated, minimum #18 AWG.
- .5 All controls cables to be identified as per Section 26 05 00 – General Work Requirements Electrical.

## 3 Execution

### 3.1 INSTALLATION OF BUILDING WIRES

- .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 As indicated in Part 2.1 of this section.
- .3 In underground duct as indicated in Section 26 05 44 – Installation of Cables in Trenches and Ducts.

### 3.2 INSTALLATION OF ARMOURED CABLE

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .3 Where AC90 is used for drops to lighting fixtures, install only from junction box to fixture, maximum 1.5m. Loops between fixtures are not acceptable.
- .4 All types of armoured cables are to be installed concealed, parallel, and perpendicular to building lines and shall be adequately secured to the building structure at no less than 1.5 m intervals or as otherwise indicated, protecting cables from mechanical damage.
- .5 The laying of un-supported cables directly on top of ceiling grid system is prohibited.

### 3.3 INSTALLATION OF TECK CABLE 0-1000V

- .1 Install cables.
- .2 Group cables wherever possible on channels.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

### 3.4 INSTALLATION OF CONTROL CABLE

- .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Ground control cable shield.

END OF SECTION

## 1 General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.2 No.0.4-M1982 (R1993), Bonding and Grounding of Electrical Equipment (Protective Grounding).

### 1.2 DESCRIPTION

- .1 Contractor is responsible for providing and installing a complete grounding system in accordance with CSA C22.1-15, Canadian Electrical Code, Part 1 (23<sup>rd</sup> Edition), Safety Standard for Electrical Installations.

## 2 Products

### 2.1 MATERIALS

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Rod electrodes: copper, 19 mm diameter by 3 m long.
- .3 Grounding conductors: bare stranded copper, soft annealed, size in accordance with CSA C22.1-15, Canadian Electrical Code, Part 1 (23<sup>rd</sup> Edition).
- .4 Insulated grounding conductors: green, type RW90, size as indicated.
- .5 Ground bus: copper, complete with insulated supports, fastenings, connectors, sized and installed as per CSA C22.1-15, Canadian Electrical Code, Part 1 (23<sup>rd</sup> Edition).
- .6 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
  - .1 Grounding and bonding bushings,
  - .2 Protective type clamps,
  - .3 Bolted type conductor connectors,
  - .4 Thermite welded type conductor connectors,
  - .5 Bonding jumpers, straps,
  - .6 Pressure wire connectors,

## 3 Execution

### 3.1 INSTALLATION

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories, as indicated to conform to requirements of Departmental Representative and local authority having jurisdiction over installation.
- .2 Install connectors in accordance with manufacturer's instructions.

- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermite process or permanent mechanical connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install an integral bonding wire in all flexible conduits, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Connect building structural steel to ground by welding copper to steel.
- .10 Make grounding connections in radial configuration only, with connections terminating at grounding point. Avoid loop connections.
- .11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .12 Ground secondary service pedestals.
- .13 Install a bonding conductor in all EMT and rigid aluminum conduit runs.

### 3.2 SYSTEM AND CIRCUIT GROUNDING

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

### 3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections as indicated to typical equipment.

### 3.4 NON-EQUIPMENT GROUNDING

- .1 Install grounding connections as required by CSA C22.1-15, Canadian Electrical Code Section 10-406. Including but not limited to:
  - .1 Continuous metal waste water piping systems.
  - .2 Interior metal gas piping systems.
  - .3 Interior metal refrigerant piping systems.

### 3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results Electrical.
- .2 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction.
- .3 Perform test before energizing electrical system.

- .4 Disconnect ground fault indicator during tests.

END OF SECTION

1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23<sup>rd</sup> Edition), Safety Standard for Electrical Installations.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.

2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 mm x 41 mm x 2.6 mm thick galvanized steel surface mounted / suspended as required.
- .2 Support and mounting hardware and accessories installed in the exterior storage building shall be corrosion resistant, suitable for exterior environments.

3 Execution

3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit, or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.

- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
  
- .8 For surface mounting of two or more conduits use channels.
  
- .9 Maximum conduit support spacing shall be:
  - .1 1.5 m for 16 mm and 21 mm conduit.
  - .2 2 m for 27 mm and 35 mm conduit.
  - .3 3 m for 41 mm conduit and larger.
  
- .10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
  
- .11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
  
- .12 Do not use wire lashing or perforated strap to support or secure raceways or cables.
  
- .13 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.
  
- .14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 20 – Wire and Box Connectors 0-1000V.

1.2 REFERENCES

.1 National Electrical Manufacturers Association (NEMA).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with 01 10 01 – General Requirements.

.2 Include dimensions and mounting information.

2 Products

2.1 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around for flush mounted pull and junction boxes.

2.2 CABINETS

.1 Sheet steel, hinged door and return flange overlapping sides, handle and catch, surface mount.

.2 Covers with 25 mm minimum extension all around for flush mounted pull and junction boxes

2.3 SPLITTER BOXES

.1 CSA C22.2 No. 76 Type 1, sheet steel enclosure, welded corners and formed hinged cover suitable for locking in closed position. Grey polyester finish inside and outside.

.2 Main lug and branch lug quantity and rating as indicated. Wire size range to suit incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

3 Execution

3.1 INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations. Do not exceed 30 m of conduit run between pull boxes.

.2 Mount cabinets with top not higher than 2 m above finished floor.

### 3.2 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

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

### 3.3 IDENTIFICATION

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

END OF SECTION

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## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 34 – Conduit, Conduit Fastenings, and Conduit Fittings.
- .2 Section 27 05 28 – Pathways for Communications Systems.

### 1.2 REFERENCES

- .69083776 CSA C22.1-15, Canadian Electrical Code, Part 1 (23<sup>rd</sup> Edition), Safety Standard for Electrical Installations.

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 10 01 – General Requirements:
  1. Floor boxes, covers, and devices.
  2. Recessed AV boxes.

## 2 Products

### 2.1 OUTLET AND CONDUIT BOXES

- .1 Size boxes in accordance with CSA C22.1, 23<sup>rd</sup> edition.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

### 2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multigang 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.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

### 2.3 MASONRY BOXES

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

## 2.4 FITTINGS

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## 2.5 CONCRETE FLOOR BOXES

- .1 Four gang flush cover box complete with:
  - .1 one (1) 20A, 120V duplex receptacles
  - .2 two (2) data connectors
  - .3 one (2) phone connectors
  - .4 one (1) "style line" AV opening
- .2 CSA listed, 4-gang, steel concrete floor box, complete with divider and separate power and communications entries.
- .3 Nominal size 250 x 250 x 100 mm.
- .4 Complete with screw type mounting plates and frames for connections as indicated.
- .5 Complete with heavy duty powder coat, flanged metal cover, for flush installation in flooring type as indicated. Colour to be confirmed with shop drawing review.
- .6 Standard of Acceptance: Hubbell part number HBLCFB301BASE.

## 2.6 RECESSED AV BOXES

- .1 CSA, recessed, heavy duty, low profile, white ABS entertainment box, for installation of 120 V duplex receptacle, one data outlet, and one CATV outlet. Colour to be confirmed with shop drawing review.
- .2 Complete with matching trim ring to cover rough-in.
- .3 Standard of acceptance: Leviton 001-47617-REB.

## 3 Execution

### 3.1 INSTALLATION

- .1 Wall boxes to be recessed except in electrical and mechanical room.
- .2 Support boxes independently of connecting conduits.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .6 Floor Boxes:
  - .1 Install in concrete floor in accordance with manufacturer's instructions.
  - .2 Adjust heights to suit final flooring finishes and applications in areas of installation.
  - .3 Protect boxes from ingress of debris and damage during construction.
  - .4 Install dividers, device plates and frames, covers, and flanges as required.
  - .5 Install devices, modules, and wiring as indicated.

END OF SECTION

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## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 45 – Underground Cable Ducts.
- .2 Section 26 05 21 – Wires and Cables 0-1000V.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA):
  - .1 CAN/CSA C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45-M1981 (CR 1999), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-1977 (R1999), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985 (R1999), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-M1984 (R1999), Rigid PVC Conduit.
  - .6 CAN/CSA C22.2 No. 227.3-M91 (R1999), Flexible Nonmetallic Tubing.

### 1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 10 01 – General Requirements.

### 1.4 CONDUIT LOCATIONS

- .1 Drawings do not show all conduit runs. Conduit runs indicated are shown diagrammatically. Contractor shall verify, field route, and support as required.

## 2 Products

### 2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with steel set-screw couplings and connectors.
- .2 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .3 Rigid PVC conduit: to CSA C22.2 No. 211.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .5 Rigid PVC ducts Type DB2 for direct burial to CSA C22.2 No. 211.1.

### 2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
- .2 Two hole steel straps for conduits larger than 50 mm.

- .3 Beam clamps to secure conduits to exposed steel work.
- .4 Channel type supports for two or more conduits, maximum spacing:
  - .1 1.5 m for 16 mm and 21 mm conduit.
  - .2 2 m for 27 mm and 35 mm conduit.
  - .3 3 m for 41 mm conduit and larger.
- .5 6 mm diameter threaded rods to support suspended channels.

## 2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.  
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

## 2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 20 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## 2.5 FISH CORDS

- .1 Polypropylene.

## 3 Execution

### 3.1 INSTALLATION

- .1 Install conduits as high as possible and tight to building steel.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use electrical metallic tubing (EMT) for branch circuit work except in poured concrete or underground unless indicated otherwise. Install a separate integral bond wire sized in accordance with 2105 CEC.
- .4 Use rigid PVC conduit underground, under floor slab, and in poured concrete unless indicated otherwise.
- .5 Minimum conduit size for lighting and power circuits: 16 mm.
- .6 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .7 Mechanically bend steel conduit over 21 mm diameter.

- .8 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .9 Install fish cord in empty conduits.
- .10 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .11 Dry conduits out before installing wire.

### 3.2 MANUFACTURER'S INSTALLATION

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

### 3.3 SURFACE CONDUIT INSTALLATION

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on suspended surface channels.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not pass conduits through structural members except as indicated. 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 CONDUIT INSTALLATION

- .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 CONDUIT IN CAST IN PLACE CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one-third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Where conduits pass through waterproof membrane, provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Encase conduits completely in concrete.

3.6 CONDUIT IN CAST IN PLACE SLABS ON GRADE

- .1 Run conduits 27 mm and larger below slab. Provide 50 mm of sand over conduits below floor slab.

3.7 UNDERGROUND CONDUIT

- .1 Slope conduits to provide drainage.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results Electrical.
- .2 Section 26 05 42 – Incoming Telephone Service.
- .3 Section 26 05 45 – Underground Cable Ducts.

1.2 REFERENCES

- .1 Énergie NB Power Standard Construction Practices Underground.
- .2 Énergie NB Power utility Service Entrance Standards.

1.3 COORDINATION WITH POWER SUPPLY AUTHORITY

- .1 Coordinate and meet requirements of local power supply Authority. Ensure availability of power when required.
- .2 Arrange for primary line extensions, utility installation, and energization.

1.4 UTILITY COSTS

- .1 The Contractor is to provide civil work for the connection to utility pole via underground ducts as indicated in the Contract Drawings.
- .2 The Contractor is to coordinate with the Power Utility for the supply, installation, and connection of the primary cable at the pole and at the transformer as well as the connections of the secondary cables at the padmount transformer.
- .3 The Contractor is to coordinate the installation of the Concrete Transformer Pad with Division 03. Grounding of transformer, bollards, and fencing to the Power Utility standards.
- .4 The Contractor is responsible for making secondary load connections at service entrance board.
- .5 The Contractor is to coordinate with the Power Utility for the supply, installation, and connection new utility poles with street lighting as indicated.
- .6 Coordinate with NB Power and pay associated costs.

2 Products

2.1 MATERIALS

- .1 Underground ducts in accordance with Section 26 05 45 – Underground Cable Ducts and Énergie NB Power Standard Construction Practices Underground.

- .2 Conduit in accordance with Section 26 05 34 – Conduits, Conduit Fastenings, and Conduit Fittings.
  - .3 RW90 copper conductors from padmount transformer to service entrance board as indicated.
- 3 Execution
- 3.1 INSTALLATION
- .1 Fit up service pole as shown and in accordance with NB Power Standard Construction Practices.
  - .2 Coordinate transformer pad installation as indicated.
  - .3 Supply and install secondary underground wiring as indicated.
  - .4 Allow adequate conductor length for connection to supply by power supply authority. Provide suitable bus to cable lugs so Utility can properly terminate secondary cables at padmount transformer.
  - .5 Allow adequate conductor length for connection to service equipment.
  - .6 Make grounding connections in accordance with Section 26 05 28 – Grounding - Secondary and utility service entrance standards.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results Electrical.
- .2 Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.2 COORDINATION WITH TELECOMMUNICATIONS AUTHORITY

- .1 Coordinate with telecommunications authority Aliant to ensure availability of service.
- .2 Coordinate with Telecom Service Provider Aliant and pay associated costs.

2 Products

2.1 MATERIALS

- .1 Grounding: to service provider requirements.

3 Execution

3.1 INSTALLATION

- .1 Install telephone service facilities after Utility Demarcation point.
- .2 Install grounding facilities.
- .3 Install 19mm plywood backboard complete with 2 coats grey fire retardant paint, located as indicated.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results Electrical.
- .2 Section 26 05 45 – Underground Cable Ducts.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA).

2 Products

2.1 PVC DUCTS

- .1 Rigid PVC ducts for direct burial to Section 26 05 45 – Underground Cable Duct.
- .2 Size and quantity as indicated.

3 Execution

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables in new ducts as indicated.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound (low VOC).
- .8 Provide pull cord in conduits.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.

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- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megaohms.
- .5 Tests: After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase conductor. Check insulation resistance after each splice and/or termination to ensure that cable system is no less than 50 megaohms.
- .6 Provide Departmental Representative with list of results showing location at which each test was made, circuit tested and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1 General

1.1 GENERAL

- .1 The contractor shall verify locations of all services prior to digging trenches.

1.2 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results Electrical.  
.2 Section 26 05 44 – Installation of Cables in Trenches and Ducts.

2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC ducts Type DB2 for direct burial to CSA C22.2 No. 211.1.  
.2 Rigid PVC split ducts.  
.3 Rigid PVC couplings, reducers, bell end fittings, plugs, caps, adaptors as required making the complete installation.  
.4 Rigid PVC 90° and 45° bends as required.  
.5 Rigid PVC 5° angle couplings as required.  
.6 Expansion joints where required by code.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent weld compound for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

- .1 Continuous 6 mm stranded nylon pull rope, tensile strength of 5kN, in each conduit.

2.4 MARKERS

- .1 Install continuous red polyethylene marker type, 75mm wide with black lettering "WARNING BURIED ELECTRICAL LINE" over underground electrical duct runs. Manufactured by Thomas & Betts or approved equal.

3 Execution

3.1 CONCRETE ENCASED DUCT

- .1 Install reinforced concrete encased underground duct banks, including form work.

- .2 Build duct bank on undisturbed soil or on well-compacted granular fill not less than 100 mm thick, compacted to 95% of maximum proctor dry density.
- .3 Concrete for encasement of electrical ducts shall be in accordance with CSA Standards (minimum concrete strength of 20MPa).
- .4 Open trench completely before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .6 Install base spacers at maximum intervals of 1.5m levelled to grades indicated for bottom layer of ducts.
- .7 Lay PVC ducts with configuration and reinforcing as required with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts as required. Stagger joints in adjacent layers at least 150mm and make joints watertight. Encase duct bank with 50mm thick concrete cover. Use galvanized steel conduit for sections extending above finished grade level.
- .8 Make transpositions, offsets, and changes in direction using 5 degree bends sections, do not exceed a total of 20 degrees with duct offset.
- .9 Terminate duct runs with a duct coupling set flush with the end of the concrete envelope when dead ending duct bank for future extension.
- .10 Cut, ream, and taper end of ducts infield to manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .11 Allow concrete to attain 50% of its specified strength before backfilling.
- .12 Use anchors, ties, and trench jacks as required to secure ducts and prevent moving during pouring of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .13 Clean ducts before installation. Cap ends during construction and after installation to prevent entrance of foreign materials.
- .14 Immediately after pouring of concrete, pull through each duct a mandrel followed by a stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling in cables.
- .15 Install four 3m lengths of 15m reinforcing rods, one in each corner of duct bank when connecting duct to buildings.

END OF SECTION

## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results – Electrical.
- .2 Canadian Standards Association (CSA International):
  - .1 CAN/CSA-C22.2 No.47-M90(R2001), Air-Cooled Transformers (Dry Type).
  - .2 CSA C9-M1981(R2001), Dry-Type Transformers.
- .3 National Electrical Manufacturers Association (NEMA)

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Include transformer ratings, weights and dimensions, and mounting information.

### 1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for dry type transformers for incorporation into manual in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Operation and maintenance data to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts list with catalog numbers.
  - .3 Copy of approved shop drawings.

## 2 Products

### 2.1 TRANSFORMERS

- .1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2No.47 CSA-C9.
- .2 Transformer “TX-1”:
  - .1 30 kVA, harmonic mitigating, three phase, 600/347 volt input, 208/120 volt output, 60 Hz.
  - .2 Harmonic mitigation:
    - .1 3<sup>rd</sup>, 9<sup>th</sup> & 15<sup>th</sup> harmonics and other zero sequence currents shall be treated within the secondary windings through cancellation of the zero sequence fluxes.
    - .2 5<sup>th</sup>, 7<sup>th</sup>, 17<sup>th</sup> & 19<sup>th</sup> harmonics provide the appropriate primary-secondary phase shift in order to cancel these harmonic currents with those of other loads fed from the same primary supply.
    - .3 The Harmonic Mitigation shall be by electromagnetic means only. No capacitors or electronics shall be used.
    - .4 Evidence of relevant application experience must be available upon request.

- .3 Characteristics:
  - .1 Type ANN.
  - .2 Voltage taps: Standard.
  - .3 BIL: Standard.
  - .4 Hipot: Standard.
  - .5 Average sound level: Standard.
  - .6 Impedance level at 17°C: Standard.
  - .7 Enclosure: NEMA 3R, removable front cover.
  - .8 Copper windings, losses not to exceed CSA C802.2.
  - .9 Insulation: 150°C rise.
  - .10 Finish: In accordance with Section 26 05 00 - Common Work Results – Electrical.
  
- .3 Transformer “TX-2”:
  - .1 225 kVA, harmonic mitigating, three phase, 600/347 volt input, 208/120 volt output, 60 Hz.
  - .2 Harmonic mitigation:
    - .1 3<sup>rd</sup>, 9<sup>th</sup> & 15<sup>th</sup> harmonics and other zero sequence currents shall be treated within the secondary windings through cancellation of the zero sequence fluxes.
    - .2 5<sup>th</sup>, 7<sup>th</sup>, 17<sup>th</sup> & 19<sup>th</sup> harmonics provide the appropriate primary-secondary phase shift in order to cancel these harmonic currents with those of other loads fed from the same primary supply.
    - .3 The Harmonic Mitigation shall be by electromagnetic means only. No capacitors or electronics shall be used.
    - .4 Evidence of relevant application experience must be available upon request.
  - .3 Characteristics:
    - .1 Type ANN.
    - .2 Voltage taps: Standard.
    - .3 BIL: Standard.
    - .4 Hipot: Standard.
    - .5 Average sound level: Standard.
    - .6 Impedance level at 17°C: Standard.
    - .7 Enclosure: NEMA 3R, removable front cover.
    - .8 Copper windings, losses not to exceed CSA C802.2.
    - .9 Insulation: 150°C rise.
    - .10 Finish: In accordance with Section 26 05 00 - Common Work Results – Electrical.

## 2.2 MANUFACTURERS

- .1 Standard of Acceptance Hammond HPS Centurion Series.
- .2 Acceptable manufacturer or approved equal:
  - .1 Hammond
  - .2 Rex
  - .3 Bemag
- .3 All products shall be subject to approval prior to tender close.

### 2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results – Electrical.
- .2 Label size 7.
- .3 Nameplate wording: indicate designation, capacity, primary and secondary voltages.

### 3 Execution

#### 3.1 INSTALLATION

- .1 Ensure adequate clearance around transformer for ventilation.
- .2 Install transformers in level upright position.
- .3 Remove shipping supports only after transformer is installed and just before putting into service.
- .4 Loosen isolation pad bolts until no compression is visible.
- .5 Make primary and secondary connections in accordance with wiring diagram.
- .6 Energize transformers after installation is complete.

#### 3.2 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer’s recommendations.

END OF SECTION

---

## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results – Electrical.
- .2 Section 26 32 13 – Power Generation – Diesel.

### 1.2 REFERENCES

- .1 CAN/CSA-C22.2 No.178.1-12 –Transfer Switch Equipment.

### 1.3 DESCRIPTION

- .1 Primary automatic load transfer equipment (ATS-1) to:
  - .1 Monitor voltage on all phases of normal power supply from utility.
  - .2 Initiate cranking of diesel generator on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
  - .3 Transfer load from normal supply to diesel generator when unit reaches rated frequency and voltage pre-set adjustable limits.
  - .4 Transfer load from emergency source to normal power supply when normal power restored, confirmed by sensing of voltage on all phases above adjustable pre-set limit for adjustable time period.
  - .5 Shut down diesel generator unit after running unloaded to cool down using adjustable time delay relay.
  - .6 Be equipped with open By-Pass Isolation.
  - .7 Be equipped with in-phase monitor.
  - .8 Automatic Load Transfer equipment to be of same manufacturer as genset,

### 1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Make, model and type.
  - .2 Load classification:
    - .1 100% Tungsten lamp load.
    - .2 100% Ballast lamp load.
    - .3 100% Motor load.
    - .4 Restricted use: resistance and general 100% loads, 0.8 PF or higher.
  - .3 Single line diagram showing interconnections, controls, and relays.
  - .4 Description of equipment operation including:
    - .1 Automatic starting and transfer to standby unit and back to normal power.
    - .2 Test control.
    - .3 Manual control.
    - .4 Automatic shutdown.

### 1.5 QUALITY ASSURANCE

- .1 Submit 3 copies of field test results.

## 1.6 OPERATIONS AND MAINTENANCE SUBMITTALS

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Operation and maintenance data to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts list with catalog numbers.
  - .3 Copy of approved shop drawings.
- .3 Include technical data:
  - .1 Schematic diagram of components, controls and relays.
  - .2 Illustrated parts lists with parts catalogue numbers.
  - .3 Copy of manufacturer representative field test results.

## 2 Products

### 2.1 AUTOMATIC TRANSFER SWITCH ATS-1

- .1 Mechanically held automatic transfer switch, designation ATS-1:
  - .1 Rated 600A, 600V, 3 phase, 4 wire, 60Hz, in NEMA 1 enclosure with sprinkler shield where required.
  - .2 Electrically operated and mechanically held and interlocked.
  - .3 Momentarily energized, solenoid mechanism electrical operator.
  - .4 Mechanically interlocked switch with normal, emergency, or off positions.
  - .5 The switch shall be positively locked and unaffected by momentary outages.
  - .6 Main contacts shall be silver composition.
  - .7 Inspection of contacts shall be possible from the front of the switch without disassembly of operating linkages or disconnection of power conductors.
  - .8 Solid neutral conductor bar with fully rated AL-CU pressure connectors.
- .2 Bypass Isolation Switch:
  - .1 Standard open transition - two-way bypass-isolation switch for manual bypass of the load to either source and permit isolation of the automatic transfer switch.
  - .2 Separate bypass and isolation handles permanently affixed and operable without opening the enclosure door.
  - .3 Bypass to the load-carrying source shall be accomplished without interruption of power to the load.
  - .4 Bypass operating modes: Bypass to Normal, Automatic, and Bypass to Emergency.
  - .5 Isolation handle operating modes: Closed, Test, and Open.
    - .1 Test mode shall permit testing of the entire emergency power system, with no interruption of power to the load.
    - .2 Open mode shall completely isolate the automatic transfer switch from source and load power conductors.
  - .6 Bypass switch shall function as a manual transfer switch in Open or Test modes.
- .3 Controller Display and Keypad:
  - .1 Integral LCD display and dynamic button keypad mounted on front enclosure door.

- .4 Voltage, frequency, and Phase Rotation Sensing:
  - .1 Continuous monitoring of normal and emergency phase voltages and frequency with adjustable pickup, dropout, and trip setting capabilities.
  - .2 Settings +/- 0.5% over an operating temperature range of -20°C to 70°C.
  - .3 Adjustable dropout time for transient voltage and frequency fluctuations.
  - .4 Phase rotation monitoring of both the normal and emergency sources.
  - .5 Single phasing condition monitoring of both the normal and emergency sources.
  - .6 Digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation of both the normal and emergency sources.
  
- .5 Time Delays:
  - .1 Adjustable delay for momentary normal source outages and delay transfer and engine starting signals.
  - .2 Adjustable delay for transfer to the emergency source.
  - .3 Adjustable delay for re-transfer to normal. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
  - .4 Adjustable from 0 to 60 minutes for shut down of engine generator for cool down.
  - .5 The controller shall also include the following built-in time delays for the following operations:
    - .1 Adjustable delay on failure to acquire acceptable parameters from emergency source.
    - .2 Adjustable delay for failure to synchronize in-phase operation.
    - .3 Delay for load disconnect position for delayed transition.
  - .6 Time delays shall be adjustable in 1 second increments.
  - .7 Time delays shall be adjustable by using the display and keypad or with a remote device connected to the communications interface port.
  
- .6 Additional Features:
  - .1 Front located switches for test functions including, load, no load, auto test, and LED and display testing.
  - .2 A SPDT contact shall be provided for a low-voltage engine start signal.
  - .3 Auxiliary relay for remote function/alarm (2 NO and 2 NC contacts).
  - .4 LED indicating lights.
  - .5 Factory installed in-phase monitor capable of being enabled or disabled from the user interface.
  
- .7 Manufacturer:
  - .1 Acceptable manufacturer:
    - .1 Generac
    - .2 Kohler
    - .3 Cummins
    - .4 ASCO

## 2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results – Electrical.
  
- .2 Nameplates:
  - .1 Size 7.

3 Execution

3.1 INSTALLATION

- .1 Locate, install, and connect equipment as indicated.
- .2 Check factory made connections for mechanical security and electrical continuity.
- .3 Check relays, solid state monitors, and adjust to ensure proper working conditions.

3.2 FIELD QUALITY CONTROL

- .1 Provide factory trained field service technician to verify installation and witness start-up and commissioning of emergency power system.
- .2 Perform tests in accordance with Section 26 05 00 – Common Work Results Electrical.
- .3 Energize transfer equipment from normal power supply.
- .4 Set Generator Control Panel selector switch in Test position to ensure proper standby start, running, transfer and re-transfer. Return selector switch to Auto position to ensure standby shuts down.
- .5 Set Generator Control Panel selector switch Manual position and check to ensure proper performance.
- .6 Set Generator Control Panel selector switch in Engine Start position and check to ensure proper performance. Return switch to Auto to stop engine.
- .7 Set Generator Control Panel selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for ten (10) minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .8 Repeat, at one (1) hour intervals, three (3) times, complete test with selector switch in each position, for each test.

3.3 COMMISSIONING

- .1 Perform commissioning in accordance with 01 91 13 – General Commissioning Requirements and per manufacturer’s recommendations.

END OF SECTION

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## 1 General

### 1.1 REFERENCES

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

### 1.2 REFERENCES

- .1 CAN/CSA-C22.2 No.31-M89 (R2000), Switchgear Assemblies.

### 1.3 DESCRIPTION OF EQUIPMENT

- .1 Service entrance board incorporates service entrance wireway; main breaker, SPD, metering transformer compartment; customer metering; full distribution panelboard, factory assembled in one two-vertical section enclosure.

### 1.4 UTILITY METERING

- .1 Utility shall supply current and potential metering transformers.
- .2 All costs for factory or field installation of metering transformers to be paid by Utility. Advise Utility immediately upon order of name, address and telephone number of supplier so arrangements can be made for factory installation if required.

### 1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate:
  - .1 Floor anchoring method and foundation template.
  - .2 Dimensioned cable entry and exit locations.
  - .3 Dimensioned position and size of bus.
  - .4 Overall length, height, and depth.
  - .5 Dimensioned layout of internal and front panel mounted components.
- .3 Include:
  - .1 Time-current characteristic curves for circuit breakers and fuses.
  - .2 Factory installed customer metering equipment.
  - .3 Factory installed surge protection device.

### 1.6 QUALITY ASSURANCE

- .1 Submit 3 copies of certified test results.

### 1.7 CLOSEOUT SUBMITTALS

- .1 Provide operating and maintenance data for service entrance board for incorporation into manual specified in Section 01 10 01 – General Requirements.
- .2 Submit three copies maintenance data for complete assembly including components.

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## 2 Products

### 2.1 SERVICE ENTRANCE

- .1 Power Supply: 347/600 V, 3 phase, 4 wire, grounded neutral, 60 Hz. Short circuit interrupting current 22 kA RMS symmetrical.

### 2.2 SERVICE ENTRANCE BOARD

- .1 Service Entrance Board: to CAN/CSA-C22.2 No.29.
- .2 600/347 volt, 3 phase 4 wire, panelboard suitable for use as service entrance equipment.
- .3 Barrier metering section from adjoining sections.
- .4 Bolt on branch breakers, rating and quantities as indicated.
- .5 Factory installed surge protection device (SPD) for Type 2 service entrance applications with visual indicators.
- .6 Hinged access panels with captive knurled thumb screws.
- .7 Bus bars and main connections: 99.3% copper.
- .8 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .9 Identify phases with colour coding.

### 2.3 MAIN BREAKER

- .1 Moulded case circuit breaker CSA rated for 100% current-carrying-capacity to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase ground fault short circuit protection.

### 2.4 DISTRIBUTION CIRCUIT BREAKERS

- .1 Bolt-on moulded case circuit breaker: quick-make, quick-break for manual and automatic operation, with temperature compensation for 40 degrees C ambient.
- .2 Common trip with single handle for multi-pole operations.
- .3 Magnetic instantaneous trip elements trip settings on breakers with adjustable trips to range from 10-12 times current rating.

### 2.5 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for size 3/0 grounding cable.

- .3 Bond non-current-carrying metal parts to ground bus.

## 2.6 CUSTOMER METERING

- .1 CSA approved, factory installed, digital metering system:
  - .1 Field programmable, microprocessor based metering package measuring RMS value to the seventh harmonic.
  - .2 Displays voltage and current for each phase, kVA, KVAR, KW, PF, Hz and accumulated KWER and KW demand.
  - .3 Monitors and stores in non-volatile memory minimum values of voltage and PF, maximum values of Amps, KW, KVA, KVAR, KW demand, THD, demand KVA, demand THD, etc. All values can be called up and displayed.
  - .4 Programmable set points for load shedding or alarm, with one set of 1A, 120V dry contacts.
  - .5 Unit to include a transducer to allow for output related to varying pulse and also output related to 4-20mA signal.
  - .6 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
  - .7 Connection to BMS by Division 25.

## 2.7 UTILITY METERING

- .1 Mounting accessories and wiring the following, supplied by supply authority.
  - .1 Two (2) potential transformers.
  - .2 Three (3) current transformers.
  - .3 Demand meter with kWh register.
- .2 Separate compartment and metal raceway for exclusive use of utility company metering. Utility approval of metering compartment required prior to manufacture.
- .3 Meter cabinet connected to meter compartment with 35mm conduit.
- .4 Meter mounting height 1.5 to 1.7 m. Meter working clearances and headroom in accordance with Utility requirements.

## 2.8 FINISHES

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

## 2.9 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results – Electrical.
- .2 Nameplates:
  - .1 Size 7.
  - .2 Complete meter section labelled: “MVA - 600V”.
  - .3 Complete board labelled: “MVB - 600V”.
  - .4 Main disconnect labelled: “Main Breaker”.
  - .5 Distribution breakers labelled as per single line diagram.

## 2.10 MANUFACTURERS

- .1 Acceptable manufacturers or approved equal:
  - .1 Siemens
  - .2 Eaton
  - .3 Schneider

## 3 Execution

### 3.1 INSTALLATION

- .1 Locate service entrance board as indicated and fasten to wall.
- .2 Connect main secondary service to line terminal of main breaker.
- .3 Connect load terminals to distribution breakers to feeders as indicated.
- .4 Connect ground bus to service ground.
- .5 Check factory made connections for mechanical security and electrical continuity.
- .6 Run one grounding conductor 3/0 AWG bare copper in 27mm conduit from ground bus to building steel.
- .7 Check trip unit settings against coordination study to ensure proper working and protection of components.

### 3.2 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer’s recommendations.

END OF SECTION

## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 28 21 - Moulded Case Circuit Breakers.
- .3 Section 26 90 00 – Panel Schedules.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2No.29-M1989(R2000), Panelboards and enclosed Panelboards.

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Drawings to include electrical detail of panel, accessories, branch breaker type, quantity, ampacity, and enclosure dimensions.

### 1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for panel boards for incorporation into manual in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Operation and maintenance data for complete panel boards to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts list with catalog numbers.
  - .3 Copy of approved shop drawings.
- .3 Submit copy of typewritten as-built Panel Schedules with O&M manual.

## 2 Products

### 2.1 PANELBOARDS

- .1 Panelboards: product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipping.
- .2 250 VAC rated panelboards: bus and breakers rated for 10 kA to 14 kA (symmetrical) interrupting capacity or as indicated.
- .3 600 VAC rated panelboards: bus and breakers rated for 22 kA (symmetrical) interrupting capacity or as indicated.
- .4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

- .5 Panelboard mains, circuit quantity, and number and size of branch circuit breakers as indicated.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper or aluminum bus with neutral of same ampere rating as mains.
- .8 Install spare breakers as indicated.
- .9 Mains: suitable for bolt-on breakers.
- .10 Trim and door finish: baked grey enamel.
- .11 Size to suit actual connected load.
- .12 Drip shields where installed in sprinklered areas.

## 2.2 BREAKERS

- .1 Breakers as per Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lockable fire alarm and exit light breakers, installed as indicated.

## 2.3 SURGE PROTECTION DEVICES

- .1 Provide 3 phase 120/208 V, 4 wire and ground transient voltage surge protection, complete with indicating light with panel boards or a stand-alone system connected to each panel that provides power for computers and data. Refer to panel schedules for panels that require protection.

## 2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification as per Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Complete circuit directory with typewritten legend showing location and load of each circuit. Handwritten directories are not acceptable.

## 2.5 MANUFACTURERS

- .1 Acceptable manufacturers or approved equal:
  - .1 Siemens
  - .2 Eaton
  - .3 Schneider

3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true, and square to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.
- .4 Paint trim of recessed panelboards to match surrounding wall.
- .5 Connect loads to circuits.

3.2 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer’s recommendations.

END OF SECTION

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## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results – Electrical.
- .2 Section 26 28 14 - Fuses - Low Voltage.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
  - .1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
  - .2 CSA C22.2 No.39-M89 (R2003), Fuse holder Assemblies.

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.

### 1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for disconnect switches for incorporation into manual in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Operation and maintenance data for disconnect switches to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts list with catalog numbers.
  - .3 Copy of approved shop drawings.

## 2 Products

### 2.1 DISCONNECT SWITCHES

- .1 Fusible, non-fusible, disconnect switch in CSA Enclosure. Ratings, fusing, and enclosure as indicated.
- .2 Provision for padlocking in off switch position by multiple locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 14 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

2.3 MANUFACTURERS

- .1 Acceptable manufacturers or approved equal:
  - .1 Siemens
  - .2 Eaton
  - .3 Schneider

3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

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## 1 General

### 1.1 REFERENCES

- .1 Section 26 05 01 - Common Work Results – Electrical.
- .2 Section 26 05 32 – Outlet, Boxes, Conduit Boxes and Fittings.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA):
  - .1 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.
  - .4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

### 1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 10 01 – General Requirements.

### 1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual in accordance with Section 01 10 01 – General Requirements.

## 2 Products

### 2.1 SWITCHES GENERAL

- .1 15 A, 120 V, single pole, double pole, three-way switches as indicated.
- .2 Manually-operated ac switches with following features:
  - .1 White toggle or rocker as indicated.
  - .2 Silver alloy contacts.
  - .3 Suitable for back and side wiring.
  - .4 Terminal holes approved for No. 10 AWG wire.
  - .5 Urea or melamine molding for parts subject to carbon tracking.
- .3 Switch operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 General lighting switches to be decorative rocker style in finished areas.
- .5 General lighting switches to be toggle style for service, storage, bay areas.
- .6 Switches shall be commercial specification grade and of one manufacturer throughout project.

- .7 Acceptable manufacturers:
  - .1 Hubbell
  - .2 Leviton
  - .3 Cooper
  - .4 Arrow-Hart
  - .5 Pass & Seymour
  - .6 Bryant

## 2.2 RECEPTACLES

- .1 Duplex and quad receptacles, CSA type 5-15R, 125 V, 15 A, U ground, with following features:
  - .1 White urea molded housing.
  - .2 Break-off links for use as split receptacles.
  - .3 Suitable for No. 10 AWG for back and side wiring.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Duplex and quad receptacles, CSA type 5-20R, 125 V, 20 A, U ground, with following features:
  - .1 White urea molded housing.
  - .2 Break-off links for use as split receptacles.
  - .3 Suitable for No. 10 AWG for back and side wiring.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.
- .3 Ground Fault Circuit Interrupter Duplex receptacle, CSA Type 5-15, 125V, 15 Amp with following features:
  - .1 White flush nylon face.
  - .2 Back and side wired.
  - .3 Multiple drive screws.
  - .4 Matching wall plate.
- .4 Other receptacles with voltage, ampacity, and blade configuration as indicated.
- .5 Receptacles shall be commercial specification grade and of one manufacturer throughout project.
- .6 Acceptable manufacturers:
  - .1 Hubbell
  - .2 Leviton
  - .3 Cooper
  - .4 Arrow-Hart
  - .5 Pass & Seymour
  - .6 Bryant

## 2.3 COVER PLATES

- .1 Cover plates to be white nylon decora style for wiring devices located in finished areas.
- .2 Stainless steel cover plates for wiring devices located in service, storage, bay areas.

- .3 Weatherproof in-use covers for duplex exterior receptacles and where indicated.
  - .1 CSA Listed for wet locations.
  - .2 Heavy duty transparent polycarbonate construction, fully gasketed.
  - .3 Latching cover, bottom large cord openings, lockable.
- .4 Cover plates and covers from one manufacturer throughout project.

## 2.4 PARKING LOT RECEPTACLE PEDESTALS

- .1 CSA rated Nema 3R cast aluminum pedestal:
  - .1 Integral microprocessor controller factory programmed to regulate power output.
  - .2 CSA type 5-15R, 125 V, 15A duplex receptacle with weatherproof in-use cover.
  - .3 LED status and diagnostic indicators.
  - .4 Split neutral wiring for GFCI circuits as indicated.
- .2 Nominal size: 725 x 150 x 175 mm.
- .3 Made in Canada.
- .4 Acceptable product or approved equal: IPLC model number IP3-29-SR-C-FS.
- .5 Provide one manufacturer's handheld IR programming and data transfer device with software and cable. Standard of acceptance: IPLC-DATA-MATE.

## 3 Execution

### 3.1 INSTALLATION

- .1 Switches:
  - .1 Where switches from different manufacturers are ganged, devices must fit in single cover plate. Cutting of cover plates is not acceptable.
  - .2 Install single throw switches with handle in "UP" position when switch closed.
  - .3 Install switches in gang type outlet box when more than one switch is required in one location.
  - .4 Mount toggle switches at height as specified in Section 26 05 00 – Common Work Results – Electrical, or as indicated.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height as specified in Section 26 05 00 – Common Work Results – Electrical, or as indicated.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover Plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface mounted boxes.

- .4 Install in-use covers per manufacturer's instructions with cord openings at bottom.
  
- .4 Parking Lot Receptacle Pedestals:
  - .1 Coordinate concrete bases as indicated with General Contractor.
  - .2 Install pedestals true and plumb, complete with stainless steel mounting hardware in accordance with manufacturer's instructions.
  - .3 Install equipment in accordance with manufacturer's written instructions.
  - .4 Connect to GFCI circuits as indicated.
  - .5 Test circuits in accordance with Section 26 05 00 - Common Work Results – Electrical.
  - .6 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer's recommendations.
  - .7 The contractor shall provide, at the Departmental Representative's facility, training to familiarize the Departmental Representative's personnel with the operation, use, adjustment of the system and equipment.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 26 29 10 – Motor Starters to 600V.
- .2 Section 26 26 23 – Disconnect Switches Fused and Non-Fused.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2 No.248.12-94. Low Voltage Fuses Part 12: Class R (Bi-National Standards with, UL 248-12 (first Edition).

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.

1.4 MAINTENANCE MATERIALS

- .1 Six spare fuses of each type and size installed up to and including 600 A.

2 Products

2.1 FUSES GENERAL

- .1 Fuse type reference L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer for entire project.

2.2 FUSE TYPES

- .1 Class J Fuses (formerly HRCI-J).
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
  - .3 200kA interrupting , size and rating as indicated.

3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting device immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically match mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

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## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 24 02 - Service Entrance Board.
- .2 Section 26 24 17 – Panelboards Breaker Type.
- .3 Section 26 90 00 – Panel Schedules.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
  - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Include time-current characteristic curves for breakers with ampacity of 400A and over.

### 1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for circuit breakers for incorporation into manual in accordance with Section 01 10 01 – General Requirements.

## 2 Products

### 2.1 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C. ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Circuit breakers to have minimum 10 kA symmetrical RMS interrupting.
- .6 Ground fault interrupting capability (5 mA maximum) where indicated.
- .7 Arc fault interrupting capability where indicated.
- .8 Lockable fire alarm and exit light breakers, installed as indicated.

- .9 Complete with manufacturer's red handle and handle lock where indicated.
- .10 Shunt trip breakers: Factory installed shunt trip for remote activation of circuit breaker by emergency pushbutton.

## 2.2 THERMAL MAGNETIC BREAKER (DESIGN A)

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

## 3 Execution

### 3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

### 3.2 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer's recommendations.

END OF SECTION

## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Work Results – Electrical.
- .2 Section 26 28 23 – Disconnect Switches – Fused and Non-Fused.
- .3 Section 26 28 14 – Fuses Low Voltage.

### 1.2 REFERENCES

- .1 International Electrotechnical Commission (IEC):
  - .1 IEC 947-4-1-1990, Part 4: Contactors and motor-starters.
- .2 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches
- .3 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA 250-2008 – Enclosures for Electrical Equipment (1,000V Maximum).

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Indicate:
  - .1 Mounting method, enclosure type, and dimensions.
  - .2 Starter type and size.
  - .3 Layout of identified internal front panel components.
  - .4 Wiring diagram for each type of starter.
  - .5 Interconnection diagrams.

### 1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for starters for incorporation into manual in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Operation and maintenance data for starters to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts list with catalog numbers.
  - .3 Copy of reviewed shop drawings.

## 2 Products

### 2.1 MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.

- .2 Motor overload protective device in each phase, manually reset from outside enclosure with front door closed.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused or non-fused disconnect switch as indicated with operating lever on outside of enclosure to control disconnect as follows:
- .1 Fusible or non-fused disconnect switch in enclosure to CSA C22.2 No.4. Size, rating, and enclosure as indicated.
  - .2 Provision for padlocking in ON/OFF switch position by multiple padlocks.
  - .3 Mechanically interlocked door to prevent opening when handle in ON position.
  - .4 Quick make – quick break action.
  - .5 ON-OFF disconnect switch position indication on enclosure cover.
  - .6 Fuseholder: to CSA C22.2 No 39, suitable without adaptors, for type and size of fuse indicated.
- .3 Accessories:
- .1 Hand/Off/Auto standard, labelled as indicated.
  - .2 Indicating light.
  - .3 Overload relays manually reset from front with door closed.
  - .4 Single phase, dry type, control transformer with primary voltage as indicated and 24V secondary unless indicated otherwise, complete with secondary fuse, installed in with starter as indicated. Size control transformer for control circuit load plus 20% spare capacity.

## 2.2 MANUAL MOTOR STARTERS

- .1 Single or Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
- .1 Single pole, double pole, three-way switches as indicated, rated for load controlled.
  - .2 Switching mechanism, quick make and break.
  - .3 Overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
- .1 Toggle switch: heavy duty labelled as indicated.
  - .2 Indicating light.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

## 2.3 MANUAL MOTOR SWITCHES

- .1 Manual motor switch, with components as follows:
- .1 Single pole, double pole, three-way switches as indicated, rated for load controlled.
  - .2 Switching mechanism, quick make and break.
  - .3 Toggle switch: heavy duty labelled as indicated.
  - .4 Locking tab to permit padlocking in "ON" or "OFF" position.

## 2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results – Electrical.
- .2 Indicate name of load controlled on Size 2 nameplate.

## 2.5 MANUFACTURERS

- .1 Acceptable manufacturers or approved equal:
  - .1 Siemens
  - .2 Eaton
  - .3 Schneider

## 3 Execution

### 3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.
- .3 When a manual-automatic operation is required, use a "HAND-OFF-AUTOMATIC" (H-O-A) selector switch. Connect the selector switch so that only the normal automatic regulatory control devices will be bypassed when the switch is in the manual position. Connect all safety control devices, such as low or high-pressure cutouts, high temperature cutouts, and motor overload, in the control circuit in "both" the HAND and AUTOMATIC positions of the selector switch.

### 3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results Electrical General Requirements, and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functionality.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

### 3.3 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer's recommendations.

END OF SECTION

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## 1 General

### 1.1 RELATED SECTIONS

- .1 Section 26 24 01 – Load Transfer Equipment.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA):
  - .1 C22.2 No. 100-14 – Motors and Generators
  - .2 C282-09 – Emergency Electrical Power Supply for Buildings
  - .3 CAN/ULC-S601-07 – Standard for Shop Fabricated Steel Aboveground Tanks for Flammable and Combustible Liquids
- .2 Owner’s Atlantic Divisions Storage Tank Management - Management Plan Version 1.0 - October 2014.
- .3 Owner’s Storage Tank Installation Checklist.

### 1.3 DESCRIPTION

- .1 This section shall include the supply and installation of an exterior pad mounted standby diesel generator system of new and current equipment consisting of, but not limited to, the following:
  - .1 A 400 kW standby rating, 600/347 volt, 3 phase 4 wire, diesel engine driven generating set.
  - .2 An engine power command electronic control system mounted on the generating set with remote starting and stopping.
  - .3 A 10 amp battery charger located in the generator enclosure and hardwired to the generator battery. Size battery cable to reflect the distance from the charger to the generator.
  - .4 Weatherproof steel, residential quiet site sound attenuated housing with sound insulated hoods and enclosure complete with muffler.
  - .5 120 V, 1500 W block heater, 120 V, 200 W alternator space heater, and 120V engine coolant heater, mounted inside of generator housing. Engine to be equipped for starting in cold weather.
  - .6 Skid mounted, dual wall sub-base fuel tank.
  - .7 Remote alarm NFPA 110 monitor panel.
  - .8 600 Volt, 3 pole line circuit breaker adjustable trip as indicated.
  - .9 Installation to meet or exceed UL 2200.

### 1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Submission data to include:
  - .1 Mounting methods.
  - .2 Physical size.
  - .3 Layout and diagrams of electrical connections.
  - .4 kW rating, voltage, phase.

- .5 Fuel consumption data.
- .6 Protective housing material thickness and finish.
- .7 Layout and diagrams of battery chargers.
- .8 Layout and diagrams of block heater.
- .9 Layout and diagrams of control panel.
- .10 Layout and diagrams of remote annunciator.
- .11 Circuit breaker data sheet.
- .12 Layout and diagrams of generator.
- .13 Layout and diagrams and capacity of sub-base tank including accessories.
- .14 Concrete pad size and opening information.

### 1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for generator and all equipment for incorporation into manual specified in Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Owner's Storage Tank Installation Checklist.
  - .2 Operation and maintenance data to permit effective operation and maintenance.
  - .3 Technical data – illustrated parts list with catalog numbers.
  - .4 Copy of approved shop drawings.
- .3 Include technical data:
  - .1 Schematic diagram of components, controls, and relays.
  - .2 Illustrated parts lists with parts catalogue numbers.
  - .3 Copy of field test results.

### 1.6 MANUFACTURER

- .1 The complete system shall be built, tested and shipped by one manufacturer, so there is one source of supply. The performance of the generator set series shall be certified by an independent testing laboratory, as to the sets full power rating, stability voltage and frequency regulation.

### 1.7 GUARANTEE

- .1 The standby electric power system, furnished completely by the manufacturer, shall be warranted for a period of two years from the date of formal acceptance.

### 1.8 SOURCE QUALITY CONTROL

- .1 Factory test generator set including engine, alternator, control panels, and accessories. As an alternate this test can be performed at the site.
- .2 Factory staff to date and verify results. Submit 3 copies test results to Departmental Representative.
- .3 Test procedure:
  - .1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:
    - .1 Date.

- .2 Generator set Serial No.
  - .3 Engine, Make, Model, Serial No.
  - .4 Alternator, Make, Model, Serial No.
  - .5 Voltage regulator, Make, Model.
  - .6 Rating of generator set, kW, kVA, V, A, r/min, Hz.
  - .7 Mark check sheet and record data on forms in duplicate as test proceeds.
- .4 Tests:
- .1 With 100% rated load, operate set for 4 h, taking readings at 30 min. intervals, and record following:
    - .1 Time of reading.
    - .2 Running time.
    - .3 Ambient temp in °C.
    - .4 Lube oil pressure in kPa.
    - .5 Lube oil temp in °C.
    - .6 Engine coolant temp in °C.
    - .7 Exhaust stack temp in °C.
    - .8 Alternator voltage: phase 1.
    - .9 Alternator current: phase 1.
    - .10 Power in kW.

## 1.9 FEDERAL STORAGE TANK REGULATIONS (FSTR)

- .1 Work shall be completed by certified installer in accordance with the FSTR (2008).

## 2 Products

### 2.1 ALTERNATOR

- .1 The alternator shall be a 4-pole drip-proof, revolving field design with temperature compensated, solid state voltage regulator and brushless permanent magnet system. No brushes shall be allowed. The stator shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semi-flexible driving flange to ensure permanent alignment. The insulation system shall be Class H as defined by NEMA MG1-1.65. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to overload. The three phase, alternator shall be 600/347 volt, 3 phase, 4 wire, 400 kW.
- .2 A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system over current devices. The voltage regulator shall be equipped with digital RMS sensing on all phases.

### 2.2 ENGINE

- .1 The engine shall be diesel-fuelled, four-cycle, water-cooled with mounted radiator, fan, and water pump. It shall have 6 cylinders and a minimum displacement of 15.2 litres, with a minimum rating of 400 kW at its operating speed of 1800 rpm.

- .2 Intake and exhaust valves shall be heat resisting alloy steel, free rotating. Exhaust valve seat inserts shall be provided. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have an air cleaner, fuel and oil filters with replaceable elements, lube oil cooler, a fuel gas regulator, air/gas valve, and throttle body. Engine speed shall be governed by an electronic governor to maintain alternator steady state frequency within 1% from no-load to full-load alternator output. The engine shall have 24 volt battery charging DC, alternator. Remote, 2-wire, starting shall be by a 12 volt, solenoid shift, electrical starter from the generator mounted control panel.

### 2.3 COOLING EQUIPMENT

- .1 Engine shall be water cooled with engine mounted radiator, fan and water pump as specified above. Engine coolant shall be supplied and installed to protect the engine to -40° C. Engine coolant shall contain corrosion inhibitor as recommended by the engine manufacturer. A 120 V operated in-line circulating coolant heater shall be provided with thermostatic control to keep the coolant temperature at optimum for starting. Ductwork, louvres, dampers, and grilles shall be factory supplied and installed, as required.

### 2.4 EXHAUST EQUIPMENT

- .1 This section shall include the supply and installation of a muffler and exhaust connections. Supply and installations of exhaust piping, elbows, rain caps, insulation, etc., shall be as required.

### 2.5 STARTING SYSTEM

- .1 This section shall include the supply and installation of an engine mounted 24 volt battery charging D.C. alternator with a transistorized voltage regulator. Remote, 2-wire starting shall be by a 24 volt, solenoid shift electric starter. Fully automatic battery charger shall be solid state, constant voltage, current limiting type, to provide float charging and equalize charge. The charger shall be located in the enclosure and complete hardwired as indicated. Charger size shall be minimum 5% of battery ampere hour capacity.
- .2 The generating set shall contain a complete engine start-stop control which starts engine on closing contact and stops engine on opening contact. A cranking limiter shall be provided to open the starting circuit in approximately 45 to 90 seconds if the engine is not started within that time. The engine controls shall also include an E-stop pushbutton and 3-position selector switch with the following positions: AUTO-OFF-MANUAL.

### 2.6 ALARMS AND INSTRUMENTATION

- .1 The control panel shall be a programmable, digital display capable of displaying the following: System status, power output, PF, kWh, total and last run times, phase voltage and current, oil pressure, coolant temperature and level, engine speed, battery voltage, history log, customizable events, service reminders, etc.
- .2 Alarms shall be visual and audible including: low oil pressure, coolant temperature, coolant level low, low fuel pressure, engine over speed, battery voltage warning. Alarms and warnings shall be spelled out (no alarm codes), time and date stamped, snap shots of key operating parameters during alarm and warnings.

## 2.7 PROTECTIVE HOUSING

- .1 The outdoor weather protective sound attenuated (Level 2 - 75 dBA at 7m) housing shall be factory assembled to generator set base and radiator cooling. Housing shall include self-enclosed exhaust system, and provide ample air flow for generator operation. The housing shall have stainless steel hinges, latches, and handles, hinged side access doors and rear control door. All doors shall be lockable and keyed alike.
- .2 The panels shall be minimum 14 gauge steel with cell foam insulation and mylar layer.
- .3 All sheet metal shall be primed for corrosion protection and factory finished electrostatically painted.
- .4 Generator shall be provided with heavy duty isolator pads and spring vibration isolators.

## 2.8 SUB-BASE FUEL TANK

- .1 The generator set shall have a dual wall sub-base fuel tank mounted directly underneath generator on skid. The fuel tank shall be CSA and ULC S601 certified.
- .2 The fuel tank shall be sized for minimum 24 hour full load operation.
- .3 The fuel tank shall have the following:
  - .1 Overfill protection: Lockable fuel transfer spill fill containment box
  - .2 Minimum 50mm vent c/w vent whistle
  - .3 Vacuum gauge
  - .4 Inner and outer tank emergency pressure relief vents
  - .5 Leak alarm
  - .6 Low fuel level alarm
  - .7 Provide necessary devices and accessories to execute alarms and functionality per CAN/CSA-C282-09 and as specified in part 2.10.5.
- .4 The fuel tank shall be constructed of 8 gauge aluminized steel top with 12 gauge aluminized steel sides and bottom.
- .5 The fuel tank shall have a baked enamel finish the same color as the generator skid.

## 2.9 ACCESSORIES

- .1 All accessories required for proper operation shall be supplied and installed by the Electrical Contractor. These accessories shall include, but not be limited to, the following:
  - .1 Factory standard frame battery mounting.
  - .2 Fuel lines and flexible fuel line connections.
  - .3 Muffler (critical) and flexible exhaust connections.
  - .4 Starting batteries, and battery charger.
  - .5 Engine coolant.
  - .6 Engine oil.
  - .7 Circulating coolant heater.

- .2 The final mounting details shall be as per the generator supplier's details and instructions and shall be coordinated with manufacturer.

## 2.10 REMOTE ALARM ANNUNCIATOR PANEL

- .1 Remote alarm annunciator panel to provide visual and audible indicators.
- .2 Lockable, flush mount enclosure.
- .3 LED indicating lights for status, warnings, and shutdowns.
- .4 12/24 VDC power supply with circuit protection. Feed from generator batteries.
- .5 CAN/CSA-C282-09 compliant minimum functionality:
  - .1 Overcrank
  - .2 Low engine temperature
  - .3 High engine temperature pre-alarm
  - .4 High engine temperature
  - .5 Low lube oil pressure
  - .6 Low fuel (2 hour remaining)
  - .7 Control switch out of auto position
  - .8 Low battery voltage
  - .9 Lamp test
  - .10 Contacts for local and remote alarm
  - .11 Low start air pressure (if applicable)
  - .12 Low Start hydraulic pressure (if applicable)
  - .13 Air shutdown damper (if applicable)
  - .14 Low coolant level
  - .15 Tank leak detection
  - .16 ATS in bypass mode
  - .17 Main disconnect open

## 2.11 SPECIFIED UNIT

- .1 Acceptable manufacturer:
  - .1 Generac
  - .2 Kohler
  - .3 Cummins
  - .4 MTU

## 3 Execution

### 3.1 INSTALLATION

- .1 Install, connect, and commission the standby generator unit as indicated on the drawings and in complete accordance with the manufacturer's standard recommendations; to provide complete working system.
- .2 Work shall be completed by certified installer in accordance with the FSTR (2008).

### 3.2 UNIT PERFORMANCE

- .1 Frequency regulation shall not exceed 3-hertz from no load to rated load. Voltage regulation shall be within plus or minus 1% of rated voltage, from no load to full rated load. The instantaneous voltage dip shall be less than 13% of rated voltage when full, 1-phase, load and rated power factor is applied to the alternator. Recovery to stable operation shall occur within 2 seconds. Stable or steady state operation is defined as operation with terminal voltage remaining constant within plus or minus 1% of rated voltage. Provide a minimum of plus or minus 5% voltage adjustment from rated value. Temperature rise shall be within NEMA MG1-22.40 definition.

### 3.3 START-UP AND CHECK OUT

- .1 The Supplier of the above generating set shall supervise and check out the installation and be present at the start-up of the unit. The Supplier shall also provide one full day's instruction to Departmental Representative's Maintenance Personnel, on the operation and maintenance of the unit. He shall then issue a letter to the Departmental Representative stating whether or not the installation is in accordance with the Manufacturer's recommendations.
- .2 As part of the start-up and check-out, the supplier shall provide complete commissioning of the emergency power system. All safety functions shall be fully tested. Part of this work shall include an eight (8) hour load test at variations of load up to 100%, as directed by the Departmental Representative. Load banks, auxiliary equipment, wiring, etc., required for this testing shall be provided by this Electrical Contractor.
- .3 Provide full fuel tank prior to hand-over. The Contractor shall provide in his price the requirement to return to the site every 3 months during the one year warranty period to check and exercise unit and correct any defects in the work. The unit is to be supplied with a 7-day exerciser that will take full load.

### 3.4 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer's recommendations.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 26 51 01 – Lighting Controls.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
  - .1 C22.2 No. 9.0-96 (R2011), General Requirements for Luminaires.
  - .2 C866-12, Performance of LED luminaires.
  - .3 C22.2 No. 206-13 – Lighting Poles.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and complete product data in accordance with Section 01 10 01 – General Requirements.
- .2 Shop drawings to include electrical characteristics and system wattages.
- .3 Submit complete photometric data prepared by independent testing laboratory for luminaires.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Operation and maintenance data for luminaires to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts list with catalog numbers.
  - .3 Copy of approved shop drawings.

2 Products

2.1 GENERAL

- .1 Contractor is responsible for providing controls which are compatible with switching functions and luminaires as indicated.

2.2 LUMINAIRES

- .1 Type “A2” – 2’x4’ LED Troffer:
  - .1 4,300 nominal lumens, 3000k, 80 CRI, 53 watt, 120 V.
  - .2 0-10V dimming.
  - .3 Rated LED life 50,000 hours L70.
  - .4 Nominal size: 1219 x 610 x 90 mm.
  - .5 Acrylic enamel steel body, flush steel, full size lens frame. Pattern 12 prismatic lens, 3 mm thick virgin acrylic. Field replaceable LED boards and driver.
  - .6 Five year LED and driver warranty.

- .7 Standard of Acceptance Philips CFI 2TG43L830-4-FS-02F-UNV-DIM.
- .8 Acceptable manufacturer:
  - .1 Philips
  - .2 Metalux
  - .3 Lithonia
  - .4 Peerless
  
- .2 Type "AD" – 2'x4' LED Troffer:
  - .1 Characteristics to match Type A2 c/w manufacturer's drywall flange.
  
- .3 Type "B" – 2" LED Recessed Linear:
  - .1 560 nominal lumens per foot, 3000k, 80 CRI, 9 watt per foot, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 Nominal size: 50 x 100 mm.
  - .4 Powder coat finish aluminum body, diffuse lens.
  - .5 Complete with mounting to suit installation location.
  - .6 Continuous run lengths as indicated.
  - .7 Five year LED and driver warranty.
  - .8 Standard of Acceptance Cooper NEO-RAY S22DR-2L30-TG-XX-1DD-SI-S92W.
  - .9 Acceptable manufacturer:
    - .1 Philips Ledalite
    - .2 Cooper Neo-ray
    - .3 Lumenwerx Via
  
- .4 Type "B1" – 2" LED Suspended Linear:
  - .1 560 nominal lumens per foot, 3000k, 80 CRI, 9 watt per foot, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 Nominal size: 50 x 100 mm.
  - .4 Powder coat finish aluminum body, diffuse lens.
  - .5 Complete with mounting to suit installation location.
  - .6 Continuous run lengths as indicated.
  - .7 Five year LED and driver warranty.
  - .8 Standard of Acceptance Cooper NEO-RAY S22DP-2L30-SC-XX-1DD-SI-S92W.
  - .9 Acceptable manufacturer:
    - .1 Philips Ledalite
    - .2 Cooper Neo-ray
    - .3 Lumenwerx Via
  
- .5 Type "C" – 4' LED Decorative Surface Mount Vandal-Proof:
  - .1 3,500 nominal lumens, 3000k, 80 CRI, 53 watt, 120 V.
  - .2 0-10V dimming.
  - .3 Rated LED life 50,000 hours L80.
  - .4 Nominal size: 276 x 1219 x 70 mm.
  - .5 Low profile, white acrylic enamel aluminum body with stainless steel TORX hardware, high impact lens with acrylic opal diffuser. Field replaceable LED boards and driver.
  - .6 cUL listed for damp locations.
  - .7 5 year LED and driver warranty.
  - .8 Standard of acceptance Philips LPL LED Series LPLR4L53-30-UNV-F2.
  - .9 Acceptable manufacturer:
    - .1 Philips

- .2 Metalux
- .3 Lithonia
- .4 Peerless
  
- .6 Type "D" - 5" LED Recessed Downlight:
  - .1 1,000 nominal lumens, 3000k, 80 CRI, 13 watt, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 White flange with diffuse finish reflector. Wide beam spread. Complete with galvanized steel frame-in and brackets.
  - .4 0-10V dimming.
  - .5 CSA listed for wet locations.
  - .6 5 year LED and driver warranty.
  - .7 Standard of acceptance Philips LyteCaster L5RAZ101-L5R1030-L5RDC.
  - .8 Acceptable manufacturer:
    - .1 Philips
    - .2 Halo
    - .3 Lithonia
    - .4 Juno
  
- .7 Type "D1" - 6" LED Recessed Downlight:
  - .1 2,500 nominal lumens, 3000k, 80 CRI, 28 watt, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 White flange with comfort clear diffuse finish reflector. Wide beam spread. Complete with galvanized steel frame-in and brackets.
  - .4 0-10V dimming.
  - .5 CSA listed for wet locations.
  - .6 5 year LED and driver warranty.
  - .7 Standard of acceptance Philips LyteCaster P6RD25NZ101VB-P6RD830VB-P6RDCC.
  - .8 Acceptable manufacturer:
    - .1 Philips
    - .2 Halo
    - .3 Lithonia
    - .4 Juno
  
- .8 Type "E" - 4" LED Recessed Downlight:
  - .1 2,500 nominal lumens, 3000k, 80 CRI, 28 watt, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 White flange with comfort clear diffuse finish reflector. Wide beam spread. Complete with galvanized steel frame-in and brackets.
  - .4 0-10V dimming.
  - .5 CSA listed for wet locations.
  - .6 5 year LED and driver warranty.
  - .7 Standard of acceptance Philips LyteCaster P6RD25NZ101VB-P6RD830VB-P6RDCC.
  - .8 Acceptable manufacturer:
    - .1 Philips
    - .2 Halo
    - .3 Lithonia
    - .4 Juno

- .9 Type "F" – 4' LED Strip:
  - .1 4,000 nominal lumens, 3000k, 80 CRI, 94 LPW, 43 watt, 120 V.
  - .2 Rated LED life 60,000 hours L70.
  - .3 Nominal size: 1220 x 77 x 95 mm.
  - .4 White acrylic enamel steel body with heavy duty frosted acrylic lens.
  - .5 cUL listed for damp locations.
  - .6 Five year LED and driver warranty.
  - .7 Standard of acceptance Metalux 4SNLED-LD4-37SL-LW-UNV-L830-CD1-U.
  - .8 Acceptable manufacturer:
    - .1 Philips
    - .2 Metalux
    - .3 Lithonia
    - .4 Peerless
  
- .10 Type "G" – 4' LED Wrap:
  - .1 4,000 nominal lumens, 3000k, 80 CRI, 94 LPW, 43 watt, 120 V.
  - .2 Rated LED life 60,000 hours L70.
  - .3 Nominal size: 1220 x 70 x 220 mm.
  - .4 White acrylic enamel steel body with heavy duty pattern 12 acrylic diffuser.
  - .5 cUL listed for damp locations, cold location suitable.
  - .6 Five year LED and driver warranty.
  - .7 Standard of acceptance Philips OWL440L830-UNV.
  - .8 Acceptable manufacturer:
    - .1 Philips
    - .2 Metalux
    - .3 Lithonia
    - .4 Peerless
  
- .11 Type "H" – Decorative LED Sconce:
  - .1 1,000 nominal lumens, 3000k, 80 CRI, 26 watt, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 Nominal size: 120 diameter x 325 mm.
  - .4 Direct / indirect.
  - .5 Luminaire housing constructed of metal with painted white gloss finish.
  - .6 Reflectors made of pure anodized aluminum.
  - .7 Crystal glass partially frosted with screw neck.
  - .8 Five year LED and driver warranty.
  - .9 Acceptable manufacturer:
    - .1 Bega Limburg L6874
  
- .12 Type "I" – Decorative LED Pendant:
  - .1 2,400 nominal lumens, 3000k, 80 CRI, 34 watt, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 Nominal size: 100 diameter x 325 mm.
  - .4 Housing, canopy, and rod suspension constructed of aluminum with a brilliant white finish.
  - .5 Hand blown crystal glass, partially frosted, with thread.
  - .6 Crystal glass partially frosted with screw neck.
  - .7 Five year LED and driver warranty.
  - .8 Acceptable manufacturer:
    - .1 Bega Limburg L5445.

- .13 Type "J" – Corner Mount Maximum Security:
- .1 2 lamp F32 T8 28W, 120 V with fluorescent night light separately switched.
  - .2 Nominal size: 1269 x 205 x 205 mm.
  - .3 White, 14 gauge steel housing with ¼" clear polycarbonate lens, prismatic acrylic diffuser.
  - .4 Complete with lamps and ballast.
  - .5 Acceptable manufacturer:
    - .1 Cooper Fail-Safe FMC-X-228-120-80/86-EB82-FNL9W. Alternates will not be accepted.
- .14 Type "K" - LED Wall Pack:
- .1 2,500 nominal lumens, 4000k, 40 watt, 120 V.
  - .2 Rated 60,000 hours L70.
  - .3 Die-cast aluminum housing with integrated heat management and electrostatic powder coat finish. Acrylic lens sealed with full gasketing. Field replaceable LED boards and driver.
  - .4 Nominal size 300 x 115 x 142 mm.
  - .5 CSA / cUL listed for wet locations.
  - .6 5 year LED and driver warranty.
  - .7 Standard of acceptance Keene LP16P. Colour to be confirmed with shop drawing review.
  - .8 Acceptable manufacturer:
    - .1 Keene
    - .2 Lumark
    - .3 Lithonia
    - .4 Cree
- .15 Type "K1" – LED Wall Pack:
- .1 Characteristics to match Type K c/w 120V button photocell.
- .16 Type "M" – LED Undercabinet:
- .1 500 nominal lumens, 3000k, 6 watt, 120 V.
  - .2 Rated 50,000 hours L70.
  - .3 Low profile housing with wire way cover, integral driver, connections for hardwire, mounting, rocker switch.
  - .4 Nominal size 500 x 100 x 25 mm.
  - .5 CSA / cUL listed for wet locations.
  - .6 5 year LED and driver warranty.
  - .7 Acceptable manufacturer:
    - .1 Halo
    - .2 Nora
    - .3 Lithonia
- .17 Type "N" – LED Vanity:
- .1 2,000 nominal lumens, 2700k, 80 CRI, 18 watt, 120 V.
  - .2 Rated LED life 50,000 hours L80.
  - .3 Nominal size: 910 x 100 x 100 mm.
  - .4 Aluminum body, end caps, frosted acrylic lens.
  - .5 cUL listed for damp locations.
  - .6 5 year LED and driver warranty.

- .7 Standard of acceptance WAC catalogue number WS-7334. Finish to be confirmed with shop drawing review.
- .8 Acceptable manufacturer:
  - .1 Philips
  - .2 Cooper
  - .3 WAC
  
- .18 Type "Q" – LED Surfacemount:
  - .1 1000 nominal lumens, 3500k, 80 CRI, 10 watt, 120 V.
  - .2 Rated LED life 50,000 hours L80.
  - .3 Nominal size: 175 mm diameter x 16 mm.
  - .4 Heavy duty white plastic body, end caps, frosted lens.
  - .5 cUL listed for damp locations.
  - .6 5 year LED and driver warranty.
  - .7 Standard of acceptance Philips S7R835K10.
  - .8 Acceptable manufacturer:
    - .1 Philips
    - .2 Cooper
    - .3 Lithonia
    - .4 Peerless
  
- .19 Type "R" – 4' LED Cove:
  - .1 4,000 nominal lumens, 3500k, 80 CRI, 94 LPW, 43 watt, 120 V.
  - .2 Rated LED life 60,000 hours L70.
  - .3 Nominal size: 1220 x 77 x 95 mm.
  - .4 White acrylic enamel steel body with heavy duty semi-frosted acrylic lens.
  - .5 cUL listed for damp locations.
  - .6 Five year LED and driver warranty.
  - .7 Standard of acceptance Metalux 4SNLED-LD4-37SL-LN-UNV-L835-CD1-U.
  - .8 Acceptable manufacturer:
    - .1 Philips
    - .2 Metalux
    - .3 Lithonia
    - .4 Peerless
  
- .20 Type "S" - 5" LED Recessed Shower Light:
  - .1 900 nominal lumens, 2700k, 80 CRI, 13 watt, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 White flange with white baffle reflector. Wide beam spread. Complete with galvanized steel frame-in and brackets.
  - .4 CSA listed for wet locations.
  - .5 5 year LED and driver warranty.
  - .6 Standard of acceptance Philips Lightolier 1050LRN09D1-1050LRN0927-1050LRNDLWB.
  - .7 Acceptable manufacturer:
    - .1 Philips
    - .2 Halo
    - .3 Lithonia
    - .4 Juno

- .21 Type "S1" – Vandal Surface Shower Light:
  - .1 Complete with ballast and 1 lamp 18W quad CFL, 120 V.
  - .2 Nominal size: 279 mm diameter x 98 mm.
  - .3 Vandal resistant die cast aluminum, white finish. Tamperproof Torx hardware. 0.156" high strength polycarbonate lens.
  - .4 CSA listed for wet locations.
  - .5 Acceptable manufacturer:
    - .1 CD Lighting ARA-11-1-18Q-120-EB-THWHT. Alternates will not be accepted.
  
- .22 Type "V" - 4" LED Recessed Downlight:
  - .1 650 nominal lumens, 3000k, 80 CRI, 9 watt, 120 V.
  - .2 Rated LED life 50,000 hours L70.
  - .3 White flange with diffuse finish reflector. Wide beam spread. Complete with galvanized steel frame-in and brackets.
  - .4 CSA listed for wet locations.
  - .5 5 year LED and driver warranty.
  - .6 Standard of acceptance Philips LyteCaster L4RAU-L4R068030-L4RDD.
  - .7 Acceptable manufacturer:
    - .1 Philips
    - .2 Halo
    - .3 Lithonia
    - .4 Juno
  
- .23 Type "W" – LED Surface Light:
  - .1 6,400 nominal lumens, 3000k, 80 CRI, 73 watt, 120 V.
  - .2 Rated LED life 60,000 hours L70. Type 5 distribution.
  - .3 -40 to 40C operating temperature.
  - .4 Nominal size: 340 x 400 x 40 mm.
  - .5 Corrosion resistant, natural aluminum powdercoat finish, die cast aluminum housing, tempered glass fully gasketed lens. Field replaceable LED board and driver.
  - .6 CSA listed for wet locations.
  - .7 5 year LED and driver warranty.
  - .8 Standard of acceptance CFI G3-MR-5-273LA-6470-NW-UNV-NP
  - .9 Acceptable manufacturer:
    - .1 Philips
    - .2 Cooper
    - .3 Lithonia
    - .4 Juno
  
- .24 Type "Z" – LED Parking Lighting and Pole:
  - .1 LED full cut off parking lot luminaire complete with pole, mounting hardware and fusing.
  - .2 8,000 nominal lumens, 4000k, 80 CRI, 75 watt, 120 V. Type IV distribution.
  - .3 Slim profile, round luminaire housing. Die cast aluminum, powder coat housing. Built in heat sink located on top of luminaire. Tempered glass lens, fully gasketed.
  - .4 Electronic LED driver, minimum startup temperature -30 deg C.
  - .5 Complete with arm and pole adaptor.
  - .6 cUL approved for wet locations.
  - .7 Colour to be determined upon receipt of shop drawings.

- .8 Complete with manufacturer's back light control.
- .9 Standard of acceptance Luminis Maya Series MA10-R4-L2W30R1-120-TBD-BLC.
- .10 Acceptable manufacturer:
  - .1 Luminis Maya
  - .2 Philips SlenderForm Round
  - .3 Lumenpulse Pure
- .11 Round steel pole:
  - .1 125mm diameter, 7500 mm height.
  - .2 10 EPA at 80 mph.
  - .3 Powdercoat finish, corrosion resistant, to match luminaire.
  - .4 Complete with handhole, mounting and brackets, ground lugs.
  - .5 Complete with fusing installed in handhole.
  - .6 Standard of acceptance: Dynapole SRSR-25.
  
- .25 Type "Z2" – LED Parking Lighting and Pole:
  - .1 LED full cut off parking lot luminaire complete with pole, mounting hardware and fusing.
  - .2 8,000 nominal lumens, 4000k, 80 CRI, 75 watt, 120 V. Type V distribution.
  - .3 Slim profile, round luminaire housing. Die cast aluminum, powder coat housing. Built in heat sink located on top of luminaire. Tempered glass lens, fully gasketed.
  - .4 Electronic LED driver, minimum startup temperature -30 deg C.
  - .5 Complete with arm and pole adaptor.
  - .6 cUL approved for wet locations.
  - .7 Colour to be determined upon receipt of shop drawings.
  - .8 Standard of acceptance Luminis Maya Series MA10-R4-L2W30R1-120-TBD.
  - .9 Acceptable manufacturer:
    - .1 Luminis Maya
    - .2 Philips SlenderForm Round
    - .3 Lumenpulse Pure
  - .10 Round steel pole:
    - .1 125mm diameter, 7500 mm height.
    - .2 10 EPA at 80 mph.
    - .3 Powdercoat finish, corrosion resistant, to match luminaire.
    - .4 Complete with handhole, mounting and brackets, ground lugs.
    - .5 Complete with fusing installed in handhole.
    - .6 Standard of acceptance: Dynapole SRSR-25.
  
- 3 Execution
- 3.1 INSTALLATION
  - .1 Locate and install luminaires complete with accessories as indicated.
- 3.2 WIRING
  - .1 Connect luminaires to lighting circuits as indicated.

### 3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires from ceiling grid in accordance with local inspection requirements.

### 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.

### 3.5 PARKING LUMINAIRES AND POLES

- .1 Coordinate concrete bases as indicated with General Contractor.
- .2 Install poles true and plumb, complete with mounting hardware in accordance with manufacturer's instructions.
- .3 Install luminaires on pole.
- .4 Check luminaire orientation, level, and tilt.
- .5 Install fusing and holders in handhole.
- .6 Connect luminaire wiring to underground lighting circuit in handhole.
- .7 Install type Z complete with manufacturer's back light control shielding.
- .8 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical.

### 3.6 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – Commissioning and Testing and per manufacturer's recommendations.

END OF SECTION

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- 1 General
- 1.1 RELATED SECTIONS
  - .1 Section 26 50 00 – Lighting.
- 1.2 DESCRIPTION
  - .1 Contractor is responsible for providing and installing a complete lighting control system for the building as shown in the Contract Drawings and Specifications.
- 1.3 SHOP DRAWINGS AND PRODUCT DATA
  - .1 Submit shop drawings and complete product data in accordance with Section 01 10 01 – General Requirements.
  - .2 Shop drawing to include wiring diagrams and installation instructions.
- 1.4 OPERATION AND MAINTENANCE DATA
  - .1 Provide operation and maintenance data for lighting controls for incorporation into manual in accordance with Section 01 10 01 – General Requirements.
  - .2 Include:
    - .1 Operation and maintenance data for lighting controls to permit effective adjustments, operation, and maintenance.
    - .2 Technical data – illustrated parts list with catalog numbers.
    - .3 Copy of reviewed shop drawings.
- 2 Products
- 2.1 SENSORS
  - .1 Wall Switch Vacancy Sensors:
    - .1 single or 2-pole as indicated, wall switch occupancy sensor, cUL Listed.
    - .2 Passive infrared (PIR) sensor, coverage of 180°, coverage up to 1000 square feet.
    - .3 Push button manual ON/OFF.
    - .4 0-10V dimming slider where indicated.
    - .5 Digital time delay adjustable from 5 to 30 minutes, adjustable unit sensitivity, compatible with lighting loads as indicated.
    - .6 Colour: white, complete with matching wall plate.
    - .7 Field set delay for 10 minutes.
  - .2 Ceiling Mount Vacancy / Occupancy Sensors:
    - .1 Ceiling mount vacancy sensor, cUL Listed.
    - .2 Dual technology (PIR / ultrasonic) sensor, coverage of 360°, coverage up to 1,000 square feet.
    - .3 360° one sided Fresnel lens.
    - .4 Colour: White.
    - .5 Digital time delay adjustable from 30 seconds up to 30 minutes, self-adjusting unit sensitivity, compatible with lighting loads as indicated.

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- .6 Field set delay for 10 minutes.
  - .3 Power Pack Modules:
    - .1 Self-contained, universal 120 VAC powerpack for use with sensors as required.
    - .2 cUL listed plenum rated.
  - .6 Sensors to be of one manufacturer. Acceptable products:
    - .1 WattStopper
    - .2 Lutron
    - .3 Sensor Switch
    - .4 Leviton
- 2.2 DIMMABLE SWITCHES
- .1 cUL listed, compatible with LED lighting loads as indicated.
  - .2 Switch: ON/OFF with preset slider, colour white.
  - .3 Complete with matching faceplate.
  - .4 Acceptable manufacturers:
    - .1 WattStopper
    - .2 Lutron
    - .3 Sensor Switch
    - .4 Leviton
- 2.3 RELAY PANELS
- .1 Programmable Controller:
    - .1 Control boxes are to be fitted with dividers and metal cable grommets to allow connecting line voltage feeder-line from the bottom and/or sides of the enclosure, similarly, low voltage feeder lines are to be connected from the top and/or sides of the enclosure.
    - .2 Minimum 16 gauge cold rolled steel construction. Surface mounted. Removable hinged door with key lock. Sprinkler shield where required.
    - .3 Mounting of relays, components, and interface cards will be done on removable steel mounting plates.
    - .4 Programmable via integral keypad and LCD display and USB interface. Controllers which are set-up or adjusted via remote control only are not acceptable.
    - .5 Separate power and data line surge and spike suppression.
    - .6 Internal memory backup and restore.
    - .7 Complete with LV transformer and terminal strips.
  - .3 Relays:
    - .1 24 VDC low voltage control.
    - .2 Momentary duty rating.
    - .3 Number of poles and rating for load controlled as indicated.
    - .4 Quantity as indicated plus two 15A single pole spares.
  - .4 Panels will be factory assembled and wired to meet CSA and cUL specifications.

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- .5 Acceptable manufacturer:
  - .1 ILC
  - .2 WattStopper
  - .3 Lutron
  - .4 Leviton

### 3 Execution

#### 3.1 OCCUPANCY SENSOR INSTALLATION

- .1 Install sensors as per manufacturer's instructions.
- .2 Supply and install power pack modules in ceiling space as per manufacturer's instructions.
- .3 The Contractor shall commission and make adjustments to all lighting controls to the satisfaction of the Departmental Representative. This shall include, but not be limited to, adjustments to the sensitivity and the time delay of sensors, scheduling, etc.
- .4 The Contractor shall be responsible for locating and aiming sensors as required for complete and proper volumetric coverage as per the manufacturer's recommendations. Rooms shall have 90 to 100 percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the specified areas.
- .5 Proper judgment must be exercised so as to ensure the optimal installation in the available space and to overcome local and environmental difficulties including, space limitations, light fixtures, air supply ducts, and interference of structural components.
- .6 The contractor shall provide, at the Departmental Representative's facility, training to familiarize the Departmental Representative's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

#### 3.2 RELAY PANEL INSTALLATION

- .1 Locate relay panels as indicated.
- .2 Locate low voltage switches as indicated and wire to panel.
- .3 Wire relay groups as indicated on the drawings.
- .4 The contractor shall provide, at the Departmental Representative's facility, training to familiarize the Departmental Representative's personnel with the operation, use, adjustment of the relay panel system and equipment.
- .5 This contractor shall be responsible to commission the relay panel, including but not limited to system start up, verification of proper functionality, and adjustments in sequences and schedules, time delays, etc. to the satisfaction of the Departmental Representative, as well as, providing materials and devices to allow Departmental Representative to make adjustments as necessary.

- .6 Coordinate digital input from BMS with Division 25.

### 3.3 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – Commissioning and Testing and per manufacturer’s recommendations.

END OF SECTION

---

## 1 General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.2 No.141-M1985(R1999), Unit Equipment for Emergency Lighting.

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.

### 1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for emergency lighting equipment for incorporation into manual in accordance with Section 01 10 01 – General Requirements.

## 2 Products

### 2.1 EMERGENCY LIGHTING UNITS

- .1 Emergency lighting equipment to CSA C22.2 No 141.
  - .1 Supply voltage: 120 VAC.
  - .2 Battery: sealed, maintenance free, operating time: 60 min.
  - .3 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output.
  - .4 Solid state transfer circuit.
  - .5 Low voltage disconnect: solid state, modular, operates at 75% battery output voltage.
  - .6 Diagnostic LED indicator lights, integrated test switch.
  - .7 Lamp heads: Two head, LED MR16 lamps, integral on unit, horizontal and vertical adjustment.
  - .9 Cabinet: steel, suitable for direct mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
  - .10 Acceptable manufacturer:
    - .1 Lumacell
    - .2 Aimlite
    - .3 Ready-Lite

## 3 Execution

### 3.1 INSTALLATION

- .1 Connect fixtures to lighting circuits as indicated.
- .2 Direct heads as required.

3.2 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer’s recommendations.

END OF SECTION

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## 1 General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.2 No.141-02, Unit Equipment for Emergency Lighting.
  - .2 CSA C860-01(December 2002), Performance of Internally-Lighted Exit Signs.

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.

### 1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for exit signage for incorporation into manual in accordance with Section 01 10 01 – General Requirements.

## 2 Products

### 2.1 PICTOGRAM EXIT SIGNS

- .1 Type “X1” – for installation in typical areas:
  - .1 Edge-lit LED Pictogram “Running Man” exit signs to CSA C22.2 No 141.
  - .2 Universal mounting, complete with recessed mounting kit as required.
  - .3 120 volt, LED light source, 2.2 watt. 90 minute self-powered, with sealed Ni-Cad battery, solid state transfer and charger.
  - .4 White powdercoat finish.
  - .5 Standard of Acceptance: Aimlite catalogue number RPELUWHTBAT.
- .2 Type “X2” – for installation in rooms 164 and 163:
  - .1 Vandal resistant pictogram “Running Man” exit signs to CSA C22.2 No 141.
  - .2 Wall mounted.
  - .3 120 volt, LED light source, 2.2 watt. 90 minute self-powered, with sealed Ni-Cad battery, solid state transfer and charger.
  - .4 Vandal resistant steel housing with lexan shield, stainless steel vandal proof hardware.
  - .5 Standard of Acceptance: Aimlite catalogue number RPVR1WWHT-BAT.

## 3 Execution

### 3.1 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Ensure that exit light circuit breaker is locked in ON position.
- .4 Verify self-powered operation.

3.2 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – General Commissioning Requirements and per manufacturer’s recommendations.

END OF SECTION

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## 1 General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.46-M1988 (R2006), Electric Air-Heaters.

### 1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 10 01 – General Requirements.  
Data to include:
  - .1 General:
    - .1 CSA approvals.
    - .2 Product characteristics.
    - .3 Performance criteria.
    - .4 Manufacturer's installation instructions.
    - .5 Physical size and weight.
    - .6 kW rating, voltage, phase, full load amperage.
    - .7 Cabinet material thicknesses.
    - .8 Limitations.
    - .9 Colour and finish.
    - .10 Controls.
    - .11 Manufacturer's recommended testing instructions and procedures.
  - .2 Floor warming system including:
    - .1 Installation layouts, materials list, and system schematic specific to rooms where installed.
    - .2 Cable routing, spacing, installation methods.
    - .3 Power connections, terminations, ties, control devices.
  - .3 Proposed layout of in-floor heating system cables including:
    - .1 Installation layouts, materials list, and system schematic specific to rooms where installed.
    - .2 Cable routing, spacing, installation methods.
    - .3 Power connections, terminations, ties, control devices.

### 1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for in-floor heating systems, unit heaters, baseboard heaters, and controls for incorporation into manual in accordance with Section 01 10 01 – General Requirements.
- .2 Include:
  - .1 Operation and maintenance data for complete systems to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts list with catalog numbers.
  - .3 As-built drawings showing in-floor cable and equipment routing and locations.
  - .4 Copy of approved shop drawings.
  - .5 Copy test results.

---

## 2 Products

### 2.1 UNIT HEATERS

#### .1 UH-1:

- .1 CSA certified, 240/208 volt, 5000 watt.
- .2 Heavy duty, white epoxy-polyester powdercoat steel housing. Stainless steel element with aluminum fins.
- .3 Adjustable louvres; complete with universal swivel mounting brackets.
- .4 High limit temperature cut out with automatic reset; fan thermal overload protection.
- .5 Nominal size 425 mm x 425 mm x 300 mm.
- .6 Complete with factory installed relay and disconnect switch.

#### .2 UH-2:

- .1 CSA certified, 240/208 volt, 3000 watt.
- .2 Heavy duty, white epoxy-polyester powdercoat steel housing. Stainless steel element with aluminum fins.
- .3 Adjustable louvres; complete with universal swivel mounting brackets.
- .4 High limit temperature cut out with automatic reset; fan thermal overload protection.
- .5 Nominal size 425 mm x 425 mm x 300 mm.
- .6 Complete with factory installed thermostat and disconnect switch.

#### .3 UH-3:

- .1 CSA certified, 240/208 volt, 3000 watt.
- .2 Heavy duty, white epoxy-polyester powdercoat steel housing. Stainless steel element with aluminum fins.
- .3 Adjustable louvres; complete with universal swivel mounting brackets.
- .4 High limit temperature cut out with automatic reset; fan thermal overload protection.
- .5 Nominal size 425 mm x 425 mm x 300 mm.
- .6 Complete with factory installed thermostat and disconnect switch.

#### .4 Standard of Acceptance: Stelpro SHU Series.

#### .5 Acceptable manufacturers:

- .1 Stelpro
- .2 Ouellet
- .3 Dimplex

### 2.2 FORCE FLOW HEATERS

#### .1 FF-1:

- .1 CSA certified, 347 volt, 3000 watt.
- .2 Architectural, heavy duty, epoxy-polyester powdercoat aluminum housing. Stainless steel element with aluminum fins.
- .3 Recessed mounting.
- .4 High limit temperature cut out with automatic reset; fan thermal overload protection.
- .5 Nominal size 416 mm x 591 mm x 125 mm.

- .6 Finish colour to be determined with shop drawing review.
- .2 FF-2:
  - .1 CSA certified, 347 volt, 1500 watt.
  - .2 Architectural, heavy duty, epoxy-polyester powdercoat aluminum housing. Stainless steel element with aluminum fins.
  - .3 Recessed mounting.
  - .4 High limit temperature cut out with automatic reset; fan thermal overload protection.
  - .5 Nominal size 416 mm x 591 mm x 125 mm.
  - .6 Finish colour to be determined with shop drawing review.
- .3 Standard of Acceptance: Stelpro WFA Series.
- .4 Acceptable manufacturers:
  - .1 Ouellette
  - .2 Stelpro
  - .3 Dimplex

## 2.3 RADIANT CEILING PANELS

- .1 RP-1:
  - .1 CSA C22.2 No.46 certified, 347 volt, 750 watt.
  - .2 White epoxy-polyester powdercoat 22 gauge steel housing with 50mm mineral wool insulation. Alloy heating element with Tefzel insulation rated 200 C and high efficiency reflective foil.
  - .3 Complete with mounting frame and hardware for flush installation in ceiling type as indicated.
  - .4 Factor installed junction box.
  - .5 Nominal size 1219 mm x 610 mm x 50 mm.
  - .6 10 year warranty.
- .2 Acceptable manufacturer or approved equal:
  - .1 Therma-Ray AS2448-75-347 Series.

## 2.4 IN-SLAB ELECTRIC HEAT

- .1 CSA certified system of self-regulating, direct bury in concrete, self-regulating heating cable.
- .2 10 year warranty.
- .3 Heating cable shall consist of:
  - .1 Continuous core of conductive polymer that is radiation crosslinked, extruded between two (2) 14 AWG nickel-plated copper bus wires that varies its power output in response to temperature changes.
  - .2 Modified polyolefin inner jacket and a tinned-copper braid ground.
  - .3 70-mil modified polyolefin outer jacket.
  - .4 Self-regulating factor minimum 75 percent.
  - .5 30 watts per foot, 347 volts.

- .4 System shall be of a single manufacturer and form a complete UL Listed and CSA Certified system.
- .5 System shall be complete all components required to make a complete installation including but not limited to tie downs, splices, tees, connections, end seals, expansion joint cables and sleeves.
- .6 Acceptable manufacturer or approved equal:
  - .1 Pentair Raychem Electromelt.

## 2.5 FLOOR WARMING SYSTEM

- .1 CSA certified system of radiant floor warming cable system, installed under tile of type as indicated.
- .2 10 year warranty.
- .3 Heating cable shall consist of:
  - .1 Factory fabricated electrical heating cables.
  - .2 Utilize alloy resistance wire element, electrically insulated, and rated to 250 degrees C.
  - .3 Factory-made waterproof splice connections for each non-heating lead to resistance wire.
  - .4 Complete heating element covered with stainless steel braid over entire length.
  - .5 Wattage / voltage as indicated.
- .4 Controller:
  - .1 Flush mount single room controller, 240/120 volts, with sensors and built-in GFCI.
- .5 System shall be of a single manufacturer and form a complete UL Listed and CSA Certified system.
- .6 System shall be complete all components required to make a complete installation including but not limited to manufacturer's standard spacing strips, tie downs, splices, tees, connections, end seals, sensor probes, controllers.
- .7 Acceptable manufacturer or approved equal:
  - .1 Therma-Ray FW Series / SmartRooms SR-240/120-Floor controller.
  - .2 Pentair Nuheat.

## 2.6 HEAT TRACE CABLE SYSTEM

- .1 Heat Trace Cable:
  - .1 CSA certified, self-regulating, low temperature, freeze protection heat trace cable.
  - .2 120 volt, 12 watt per foot.
  - .3 Complete with manufacturer's end terminations, splice and tee connections, power connections, and corrosion resistant aluminum hold down ties.
  - .4 Pentair GM-1X or approved equal.

- .2 Controller:
  - .1 Wallmount, polycarbonate enclosure with lockable cover.
  - .2 120V, 30A max load.
  - .3 Adjustable hold time.
  - .4 cUL listed.
  - .5 LED indicating lights: Power, Heat, Snow.
  - .6 Auxiliary output for status output to BMS.
  - .7 Complete with outdoor air temperature sensor.
  - .8 Pentair PD PRO or approved equal.
  
- 3 Execution
  
- 3.1 INSTALLATION
  - .1 Unit and Force Flow Heaters:
    - .1 Install heaters at locations as indicated on drawings. Verify final mounting heights and tilt with Departmental Representative prior to installation.
    - .2 Install in accordance with manufacturer's instructions.
    - .3 Maintain minimum clearances as per manufacturer's instructions and requirements of local body having jurisdiction.
    - .4 Make power and controls connections.
  
  - .2 Radiant Ceiling Panels:
    - .1 Install in ceiling types as indicated in accordance with manufacturer's instructions and requirements of local body having jurisdiction.
    - .2 Refer to Architectural ceiling plans to coordinate panel frame with ceiling type.
    - .3 Make power and controls connections.
  
  - .3 In-slab Electric Heat:
    - .1 Install complete system in accordance with manufacturer's instructions and requirements of local body having jurisdiction.
    - .2 Coordinate layout of heating cable with all other trades prior to and during installation.
    - .3 Make power and controls connections.
    - .4 Connect to GFCI breakers as indicated.
    - .5 Manufacturer's representative to review system before concrete pour and is to be present during pour.
    - .6 The heating system should not be put into operation until the poured concrete thermal mass has cured a minimum of 28 days, unless otherwise specified and approved by thermal mass supplier.
  
  - .4 Floor Warming System:
    - .1 Install complete system in accordance with manufacturer's instructions and requirements of local body having jurisdiction.
    - .2 Coordinate layout of heating cable with all other trades prior to and during installation.
    - .3 Make power and controls connections in accordance with manufacturer's instructions.
    - .4 Manufacturer's representative to review system before flooring installation and is to be present during installation.

- .5 Heat Trace Cable:
  - .1 Install complete system in accordance with manufacturer's instructions and requirements of local body having jurisdiction.
  - .2 Install cable in continuous length. Do not splice.
  - .3 Install on drains as indicated. Coordinate installation with Mechanical.
  - .4 Make power and controls connections in accordance with manufacturer's instructions.
  - .5 Connect to GFCI breakers as indicated.

### 3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Manufacturer's recommendation and Section 26 05 00 - Common Work Results Electrical.
- .2 Unit and Force Flow Heaters:
  - .1 Test cut-out protection when air movement is obstructed.
  - .2 Test fan delay switch to assure dissipation of heat after element shut down.
  - .3 Test unit cut-off when fan motor overload protection has operated.
  - .4 Ensure heaters and controls operate correctly.
  - .5 Field adjust swivel mount and louver for optimal coverage.
- .3 Radiant Ceiling Panels:
  - .1 Physically check panels for heat output.
  - .2 Perform branch circuit load tests and insulation resistance tests per Manufacturer's recommendations.
  - .3 Test installed panels at rated voltage using ammeter. Ensure that ammeter values are same as calculated for heating load.
  - .4 Record and submit results.
- .4 In-slab Electric Heat:
  - .1 Perform Megger tests in accordance with Manufacturer's recommendations prior to and during concrete slab pour.
  - .2 Perform branch circuit load tests per Manufacturer's recommendations.
  - .3 Other tests in accordance with Manufacturer's recommendations.
  - .4 Record and submit results.
- .5 Floor Warming System:
  - .1 Perform Megger tests in accordance with Manufacturer's recommendations prior to and during concrete slab pour.
  - .2 Perform branch circuit load tests per Manufacturer's recommendations.
  - .3 Other tests in accordance with Manufacturer's recommendations.
  - .4 Test operations of controllers.
  - .5 Record and submit results.

### 3.3 COMMISSIONING

- .1 Perform commissioning in accordance with Section 01 91 13 – Commissioning and Testing and per manufacturer's recommendations.

END OF SECTION

**DPA**

VOLTS - 208/120  
 PHASE - 3  
 WIRE - 4

LOCATION: RM 124

FED FROM: TX-1

MAINS - 800A / 800A MAIN BREAKER  
 MOUNTING - SURFACE

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
PA	7.2			1	80		100	2	7.9			PB
		7.2		3				4		7.9		
			7.2	5				6			7.9	
PS	4.7			7	50		50	8	3.7			PC
		4.7		9				10		3.7		
			4.7	11				12			3.7	
PD	13.1			13	150		50	14	2.7			PE
		13.1		15				16		2.7		
			13.1	17				18			2.7	
PF	10.8			19	150		30	20				SPARE
		10.8		21				22				
			10.8	23				24				
CU-1	4.5			25	60		60	26	4.5			CU-2
		4.5		27				28		4.5		
			4.5	29				30			4.5	
			31					32				
			33					34				
			35					36				
			37					38				
			39					40				
			41					42				
			43					44				
			45					46				
			47					48				
			49					50				
			51					52				
			53					54				
			55					56				
			57					58				
			59					60				

PHASE A - 59.1  
 PHASE B - 59.1  
 PHASE C - 59.1  
 TOTAL LOAD - KW 177

NOTES:  
 L = Lockable  
 G = Ground Fault Breaker  
 A = Arc Fault Breaker  
 R = Red Handle for Fire Alarm Breaker

**PANEL PA**

VOLTS - 208/120  
 PHASE - 3  
 WIRE - 4

LOCATION: RM 124

FED FROM: DPA

INTERRUPTING - 10KA  
 MAINS - 225 A  
 MOUNTING - SURFACE

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
SITE LTG	0.8			1	15		15	2	0.9			SITE LTG
SITE LTG		1.3		3	15		15	4		1.0		SITE LTG
SITE LTG			0.8	5	15		15	6			0.2	EXTERIOR LTG
				7			15	8	0.2			EXTERIOR LTG
SPARE				9	15		15	10				SPARE
SPARE				11	15		15	12				SPARE
SPARE				13	15		15	14				SPARE
BLOCK HEATER		0.7		15	15[G]		15[G]	16		0.7		BLOCK HEATER
			0.7	17		18		0.7				
BLOCK HEATER	0.7			19	15[G]		15[G]	20	0.7			BLOCK HEATER
		0.7		21		22		0.7				
BLOCK HEATER			0.7	23	15[G]		15[G]	24			0.7	BLOCK HEATER
	0.7			25		26	0.7					
BLOCK HEATER		0.7		27	15[G]		15[G]	28		0.7		BLOCK HEATER
			0.7	29		30		0.7				
BLOCK HEATER	0.7			31	15[G]			32				
		0.7		33		34						
				35				36				
				37				38				
GENSET BLOCK HTR		1.5		39	20		15	40		1.0		GAS DETECTORS
GENSET ALT HTR			0.2	41	15		15	42			0.2	ACCESS CONTROLLERS
GENSET 120V	1.0			43	15		15	44	0.3			ACCESS CONTROLLERS
BATTERY CHARGER		0.1		45	15		15	46		0.5		SECURITY PANEL
				47				48				
				49				50				
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

3.7 5.5 2.9

2.8 4.5 2.3

NOTES:

- L = Lockable
- G = Ground Fault Breaker
- A = Arc Fault Breaker
- R = Red Handle for Fire Alarm Breaker

PHASE A - 6.5 30%  
 PHASE B - 10.0 46%  
 PHASE C - 5.3 24%  
 TOTAL LOAD - KW 21.7

**PANEL PB**

VOLTS - 208/120  
 PHASE - 3  
 WIRE - 4

LOCATION: RM 124

FED FROM: DPA

INTERRUPTING - 10KA  
 MAINS - 225 A  
 MOUNTING - SURFACE

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
UH-163	1.3			1	20		20	2	1.3			UH-163
		1.3		3				4		1.3		
O/H DOOR			0.4	5	15		15	6			0.1	TPS-125
AC-1	0.1			7	15		15	8	0.1			AC-2
		0.1		9				10		0.1		
AC-4			0.1	11	15		15	12			0.1	AC-5
	0.1			13				14	0.1			
AC-6		0.2		15	15		15	16		0.1		AC-7
			0.2	17				18			0.1	
AC-8	0.1			19	15		15	20	0.1			AC-9
		0.1		21				22		0.1		
AC-10			0.2	23	15		15	24			0.3	AC-11
	0.2			25				26	0.3			
TPS-173		0.1		27	15		15	28		0.9		FLOOR WARMING 128B
TPS-138			0.1	29	15		15	30			0.9	
FLOOR WARMING 128A	0.6			31	15		15	32	0.5			FLOOR WARMING 130B
		0.6		33				34		0.5		
C-DHWR			0.1	35	15		15	36			0.8	C-1
EF-2	0.5			37	15		15	38	1.0			RELEASING PANEL
		0.5		39				40		1.2		
UH-125			1.0	41	15		30	42			1.2	CU-4
	1.0			43				44	1.2			
SPARE				45	15		15	46		1.2		CU-3
SPARE				47	15		15	48			1.0	UH-124
SPARE				49	15		15	50	1.0			SPARE
SPARE				51	15		15	52				
				53				54				
				55				56				
				57				58				
				59				60				

3.7 2.8 2.0

5.5 5.3 4.4

NOTES:

- L = Lockable
- G = Ground Fault Breaker
- A = Arc Fault Breaker
- R = Red Handle for Fire Alarm Breaker

PHASE A - 9.2  
 PHASE B - 8.1  
 PHASE C - 6.4  
 TOTAL LOAD - KW 23.7

**PANEL PC**

VOLTS - 208/120  
PHASE - 3  
WIRE - 4

LOCATION: RM 112

FED FROM: DPA

INTERRUPTING - 10KA  
MAINS - 225A / 50A MAIN BREAKER  
MOUNTING - RECESSED

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
EXIT LIGHTS	0.5			1	15[L]		15	2	1.1			LTG 104,105,114,115
LTG 116,121		0.4		3	15		15	4		0.6		LTG 100,101,103
LTG 122,123			0.6	5	15		15	6			0.5	LTG 101,106
LTG 113,119,120,135	1.0			7	15		15	8	1.1			LTG 102,108,109,110,113
LTG 132,133		0.8		9	15		15	10		1.0		LTG 112,117
LTG 124,125,126			0.6	11	15		15	12			0.4	LTG 136,137,138
LTG 107,111,118	0.4			13	15		15	14				SPARE
				15			15	16				SPARE
				17				18				
SECURITY PANEL	0.5			19	15		15	20	0.5			ACCESS CONTROL
DOOR OPERATOR		0.6		21	15		15	22		0.6		DOOR OPERATOR
EMERG. CALL PANEL			0.1	23	15		15	24			0.1	DOOR BELL
				25				26				
				27				28				
				29				30				
				31				32				
				33				34				
				35				36				
				37				38				
				39				40				
				41				42				
				43				44				
				45				46				
				47				48				
				49				50				
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

2.4 1.8 1.4

2.7 2.1 0.9

PHASE A - 5.1  
PHASE B - 3.9  
PHASE C - 2.2  
TOTAL LOAD - KW 11.2

NOTES:  
L = Lockable  
G = Ground Fault Breaker  
A = Arc Fault Breaker  
R = Red Handle for Fire Alarm Breaker

<b>PANEL PD</b>												
VOLTS - 208/120						INTERRUPTING - 10KA						
PHASE - 3						MAINS - 225A / 150A MAIN BREAKER / TVSS						
WIRE - 4			LOCATION: RM 112			FED FROM: DPA			MOUNTING - RECESSED			
LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
FACP	1.0			1	15[L]		15	2	1.2			REC FRIDGE 114
AUTO-DIALER		0.0		3	15[L]		15	4		1.2		REC FRIDGE 104
REC MICROWAVE 114			1.1	5	20		20	6			0.6	REC SPLIT FED 104
SPARE				7	15			8	0.6			
REC SPLIT FED 114		0.6		9	20		15	10		0.5		REC 104
			0.6	11		15	12			0.5		REC 104
REC 116,121	0.5			13	15		20	14	1.0			FLOOR BOX 104
ELEC FLUSH		0.8		15	15		15	16		0.5		REC 114,115
REC TV 103,108			1.0	17	15		15	18			0.5	REC 123
REC 107	0.5			19	15		15	20	0.5			REC 100,101,103
REC 102, 109		0.6		21	15		15	22		0.5		REC 105,106
REC TV 123			1.0	23	15		15	24			0.5	REC 118,133
REC 137,138	0.6			25	15		20	26	1.0			REC 112
REC 136		0.5		27	15		20	28		1.0		REC 113
REC 113			1.0	29	15		15	30			1.0	REC 113
REC 113	1.0			31	15		15	32	1.0			REC 113
REC 113		1.0		33	15		15	34		1.0		REC 113
REC 113			1.0	35	15		15	36			0.5	REC TV 114
REC 111	1.0			37	15		15	38	0.5			REC 132
REC 122		1.0		39	15		15	40		1.0		REC 122
REC 124, 125			0.2	41	15		15	42			1.0	REC 109,110
REC 120	0.5			43	20		20	44	1.0			REC 119
REC 119 RACK		1.0		45	20		15	46		1.0		REC 119
REC 119 RACK			1.0	47	20		20	48			1.0	REC 119
SPARE (FUTURE 119 RACK)				49	20		15	50	1.2			QUAD REC 107
SPARE (FUTURE 119 RACK)				51	20			52				
REC PROJECTOR			1.0	53	15			54				
REC 105	1.0			55	15			56				
				57				58				
				59				60				

6.0 5.4 7.8

7.9 6.6 5.5

NOTES:

- L = Lockable
- G = Ground Fault Breaker
- A = Arc Fault Breaker
- R = Red Handle for Fire Alarm Breaker

PHASE A - 13.9  
 PHASE B - 12.0  
 PHASE C - 13.3  
 TOTAL LOAD - KW 39.2

2016-Jan-29

**PANEL PE**

VOLTS - 208/120  
 PHASE - 3  
 WIRE - 4

LOCATION: RM 131

FED FROM: DPA

INTERRUPTING - 10KA  
 MAINS - 225A / 50A MAIN BREAKER  
 MOUNTING - RECESSED

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
EXIT LIGHTS	0.5			1	15[L]		15	2	0.6			LTG 127,128,129,130
LTG 159,163,164,171,173-176		1.1		3	15		15	4		1.0		LTG 139,141,143,144,145,151
LTG 165,166,167,168,169,170			0.3	5	15		15	6			1.2	LTG 131,140
LTG 147,148,149,150,152,154,155	1.3			7	15		15	8	0.9			LTG 153,156,157,157A
LTG 157,158		0.6		9	15		15	10		0.6		LTG 160,161,162,172
SPARE				11	15		15	12				SPARE
SPARE				13	15		15	14				SPARE
SPARE				15	15		15	16				SPARE
				17				18				
				19				20				
				21				22				
				23				24				
				25				26				
				27				28				
				29				30				
				31				32				
				33				34				
				35				36				
				37				38				
				39				40				
				41				42				
				43				44				
				45				46				
				47				48				
				49				50				
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

1.8 1.7 0.3

1.5 1.6 1.2

NOTES:

- L = Lockable
- G = Ground Fault Breaker
- A = Arc Fault Breaker
- R = Red Handle for Fire Alarm Breaker

PHASE A - 3.3  
 PHASE B - 3.3  
 PHASE C - 1.5  
 TOTAL LOAD - KW 8.1

**PANEL PF**

VOLTS - 208/120  
PHASE - 3  
WIRE - 4

LOCATION: RM 131

FED FROM: DPA

INTERRUPTING - 10KA  
MAINS - 225A / 150A MAIN BREAKER / TVSS  
MOUNTING - RECESSED

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
REC 147	0.6			1	15		15	2	0.5			REC 152
REC 150		0.6		3	15		15	4		1.0		REC 154,155
REC 156			0.5	5	15		20	6			0.5	REC 148,153,157
REC 158	0.6			7	15		20	8	0.5			REC 131
REC 149		1.0		9	15		15	10		1.0		REC 149
REC 157			1.0	11	15		15	12			1.0	REC 157
REC 157	1.0			13	15		15	14	1.0			REC 157
REC 157		1.0		15	15		15	16		1.0		REC 157
REC 126			1.0	17	15		15	18			0.2	REC 144
REC 157A	0.5			19	15		15	20	0.5			REC 144
REC 126		0.5		21	15		15	22		0.5		REC 144
REC 128A,128B,130A,130B			0.5	23	15		15	24			0.6	ELEC FLUSH
QUAD REC 152	0.5			25	20		15	26	0.5			REC 143,145,151
QUAD REC 152		0.5		27	20		20	28		0.3		REC 140,142
REC EXT			0.5	29	15		15	30			0.5	REC 163
REC 160	0.2			31	15		15	32	0.4			REC 161
REC 162		0.4		33	15		15	34		0.4		REC 172,173,175
REC 171			0.5	35	15			36			1.0	REC SPLIT FED 171
REC FRIDGE 171	1.2			37	15		20	38	1.0			
REC 166,169		0.2		39	15		15	40				SPARE
REC TV 156,157,157A			1.2	41	15		15	42				SPARE
SPARE				43	15		20	44	1.2			REC WASHER 173
REC DRYER 173		2.5		45	30		15	46				SPARE
			2.5	47		15	48					
REC 139,141	0.4			49	15		15	50				SPARE
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

4.9 6.6 7.6

5.4 4.0 3.8

NOTES:

- L = Lockable
- G = Ground Fault Breaker
- A = Arc Fault Breaker
- R = Red Handle for Fire Alarm Breaker

PHASE A - 10.4  
PHASE B - 10.6  
PHASE C - 11.3  
TOTAL LOAD - KW 32.3

**PANEL PP**

VOLTS - 208/120  
PHASE - 3  
WIRE - 4

LOCATION: RM 200

FED FROM: TX-2

INTERRUPTING - 10KA  
MAINS - 225A / 60A MAIN BREAKER  
MOUNTING - SURFACE

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
REC 200	1.9			1	20		15 [L]	2	0.1			EXIT LIGHTS
LTG ROOF		0.1		3	15		15	4		1.0		LTG 200
REC ROOF			1.2	5	15		15	6			1.2	REC ROOF
HEAT TRACE	0.6			7	15[G]		15	8	0.5			BMS
SPARE				9	15		15	10				SPARE
SPARE				11	15		15	12				SPARE
				13				14				
				15				16				
				17				18				
AC-12	0.1			19	15		15	20	0.3			AC-13
HRV-1		1.5		21	30		30	22		1.5		HRV-2
HRV-3			0.8	23	20		25	24			0.5	HRV-4
	0.8			25		20	26	0.8				HRV-5
		0.8		27		30	28		1.5			HRV-6
EF-1			0.1	29	15		15	30			0.1	EF-3
	0.1			31			32					
TPS		0.1		33	15		15	34		0.1		DAMPER MOTORS
AC-3			0.4	35	15			36				
				37				38				
				39				40				
				41				42				
				43				44				
				45				46				
				47				48				
				49				50				
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

3.5 2.5 2.5

1.6 4.1 1.8

NOTES:

- L = Lockable
- G = Ground Fault Breaker
- A = Arc Fault Breaker
- R = Red Handle for Fire Alarm Breaker

PHASE A - 5.1  
PHASE B - 6.6  
PHASE C - 4.2  
TOTAL LOAD - KW 15.9

<b>PANEL PS</b>														
VOLTS - 208/120			LOCATION: RM 304				FED FROM: DPA		INTERRUPTING - 10KA					
PHASE - 3									MAINS - 100A / 50A MAIN BREAKER					
WIRE - 4									MOUNTING - SURFACE					
LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION		
	A	B	C						A	B	C			
LTG INT	0.9			1	15		15	2	1.0			LTG EXT		
REC		0.6		3	15		15	4		0.5		SECURITY PANEL		
REC			0.6	5	15		15	6			0.4	O/H DOOR		
UH-1	2.0			7	30		20	8	1.9			REC EXT		
		2.5		9		15	10						SPARE	
UH-2			1.5	11	20		15	12				SPARE		
	1.5			13		15	14						SPARE	
EF-4		0.1		15	15		15	16		0.5		ACCESS CONTROL		
			0.1	17			18							
DAMPER MOTORS	0.1			19	15			20						
				21				22						
				23				24						
				25				26						
				27				28						
				29				30						
			4.5	3.2	2.2							2.9	1.0	0.4

  

PHASE A - 7.5 PHASE B - 4.2 PHASE C - 2.6 TOTAL LOAD - KW 14.2	NOTES: L = Lockable G = Ground Fault Breaker A = Arc Fault Breaker R = Red Handle for Fire Alarm Breaker
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**PANEL VA**

VOLTS - 347/600  
 PHASE - 3  
 WIRE - 4

LOCATION: RM 124

FED FROM: MVB

INTERRUPTING - 14KA  
 MAINS - 225 A  
 MOUNTING - SURFACE

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
RHC-8,9	3.0			1	20			2				
DHW-1		12.0		3	50		50	4		12.0		DHW-2
			12.0	5		6				12.0		
	12.0			7		8		12.0				
RHC-25		0.5		9	15		15	10		0.9		INFLOOR 126
SPARE				11	15		15	12				SPARE
SPARE				13	15		15	14				SPARE
SPARE				15	15		15	16				SPARE
				17				18				
				19				20				
				21				22				
				23				24				
				25				26				
				27				28				
				29				30				
				31				32				
				33				34				
				35				36				
				37				38				
				39				40				
				41				42				
				43				44				
				45				46				
				47				48				
				49				50				
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

15.0 12.5 12.0

12.0 12.9 12.0

PHASE A - 27.0  
 PHASE B - 25.4  
 PHASE C - 24.0  
 TOTAL LOAD - KW 76.4

NOTES:  
 L = Lockable  
 G = Ground Fault Breaker  
 A = Arc Fault Breaker  
 R = Red Handle for Fire Alarm Breaker

**PANEL VB**

VOLTS - 347/600  
 PHASE - 3  
 WIRE - 4

LOCATION: RM 112

FED FROM: MVB

INTERRUPTING - 14KA  
 MAINS - 225A / 100A MAIN BREAKER  
 MOUNTING - RECESSED

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
HTR 104	4.5			1	20		20	2	3.0			HTR 104
HTR 104		3.0		3	20		20	4		4.5		HTR 114,115
HTR 116,121			3.0	5	20		20	6			4.5	HTR 122
HTR 102,103,105	3.8			7	20		20	8	3.8			HTR 109
HTR 110,113		4.5		9	20		20	10		4.5		HTR 113
HTR 113			4.5	11	20		20	12			0.8	HTR 107
HTR 123	1.5			13	20		20	14	5.0			RHC-13,14,15,16
RHC-10,11,12		2.8		15	20		15	16		3.0		FF-100
INFLOOR 104			3.2	17	15[G]		15[G]	18			3.6	INFLOOR 114,115,122,123
INFLOOR 102,109,110	2.9			19	15[G]		15[G]	20	3.6			INFLOOR 113
				21				22				
				23				24				
				25				26				
				27				28				
				29				30				
				31				32				
				33				34				
				35				36				
				37				38				
				39				40				
				41				42				
				43				44				
				45				46				
				47				48				
				49				50				
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

12.7 10.3 10.7

15.3 12.0 8.9

PHASE A - 28.0  
 PHASE B - 22.3  
 PHASE C - 19.6  
 TOTAL LOAD - KW 69.8

NOTES:  
 L = Lockable  
 G = Ground Fault Breaker  
 A = Arc Fault Breaker  
 R = Red Handle for Fire Alarm Breaker

2016-Jan-29

**PANEL VC**

VOLTS - 347/600  
 PHASE - 3  
 WIRE - 4

LOCATION: RM 131

FED FROM: MVB

INTERRUPTING - 14KA  
 MAINS - 225A / 100A MAIN BREAKER  
 MOUNTING - RECESSED

LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION
	A	B	C						A	B	C	
HTR 156,157A	3.8			1	20		20	2	4.5			HTR 157
HTR 157		4.5		3	20		20	4		4.5		HTR 157
HTR 157			3.0	5	20		20	6			4.5	HTR 149
HTR 141,145	3.8			7	20		20	8	3.8			HTR 144
HTR 126		3.8		9	20		20	10		3.0		HTR 126
RHC-19,20,21			3.3	11	20		20	12			2.3	RHC-1,2,3,4
FF-140	1.5			13	15		20	14	5.0			RHC-5,6,7
INFLOOR 149,156,157A		2.6		15	15[G]		20	16		2.8		RHC-17,18,22,23,24
INFLOOR 157			5.2	17	20[G]		20[G]	18			3.6	INFLOOR 165
INFLOOR 167	3.6			19	20[G]		20[G]	20	3.6			INFLOOR 168
INFLOOR 170		3.6		21	20[G]			22				
				23				24				
				25				26				
				27				28				
				29				30				
				31				32				
				33				34				
				35				36				
				37				38				
				39				40				
				41				42				
				43				44				
				45				46				
				47				48				
				49				50				
				51				52				
				53				54				
				55				56				
				57				58				
				59				60				

12.6 14.5 11.5

16.9 10.3 10.4

PHASE A - 29.5  
 PHASE B - 24.7  
 PHASE C - 21.8  
 TOTAL LOAD - KW 76.0

NOTES:  
 L = Lockable  
 G = Ground Fault Breaker  
 A = Arc Fault Breaker  
 R = Red Handle for Fire Alarm Breaker

<b>PANEL VP</b>													
VOLTS - 347/600			CCT NO.			BREAKER SIZE			LOAD DESCRIPTION				
PHASE - 3			A B C			A B C			LOAD DESCRIPTION				
WIRE - 4			LOCATION: 200			FED FROM: MVB			INTERRUPTING - 14KA				
									MAINS - 400A / 250A MAIN BREAKER				
									MOUNTING - SURFACE				
LOAD DESCRIPTION	KW			CCT NO.	BREAKER SIZE	A B C	BREAKER SIZE	CCT NO.	KW			LOAD DESCRIPTION	
	A	B	C						A	B	C		
TX-2	6.6			1	40		30	2	7.0			HC-1	
		6.6		3				4		7.0			
			6.6	5				6			7.0		
HC-2	4.2			7	20		15	8	1.7			HC-3	
		4.2		9				10		1.7			
			4.2	11				12			1.7		
HC-4	2.0			13	15		40	14	8.7			HC-5	
		2.0		15				16		8.7			
			2.0	17				18			8.7		
HC-6	5.7			19	25		15	20	1.2			HC-7	
		5.7		21				22		1.2			
			5.7	23				24			1.2		
HC-8	0.8			25	15		15	26	2.8			HC-9	
		0.8		27				28		2.8			
			0.8	29				30			2.8		
HC-10	1.8			31	15		20	32	4.8			HC-11	
		1.8		33				34		4.8			
			1.8	35				36			4.8		
HC-12	2.3			37	15		15	38	3.6			H-1	
		2.3		39				40		3.6			
			2.3	41				42			3.6		
H-2	2.6			43	15		15	44	3.6			H-3	
		2.6		45				46		3.6			
			2.6	47				48			3.6		
			49				50						
			51				52						
			53				54						
			55				56						
			57				58						
			59				60						
			26.0	26.0	26.0				33.3	33.3	33.3		

PHASE A - 59.3  
 PHASE B - 59.3  
 PHASE C - 59.3  
 TOTAL LOAD - KW 178.0

NOTES:  
 L = Lockable  
 G = Ground Fault Breaker  
 A = Arc Fault Breaker  
 R = Red Handle for Fire Alarm Breaker