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2123 Rte. 500 W. Embrun, ON  
Cambridge Public School  
Addition Architectural Services  
UCDSB RFQ #25-036

**ELECTRICAL SPECIFICATION**  
**ISSUED FOR TENDER**

**GWAL 2025-385**

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## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 SCOPE OF WORK**

- .1 Furnish and install a complete UL & CSA listed system of specified heater, components, and controls listed specifically for keeping roof eaves, gutters, and downspouts from being clogged by ice and snow.

## **PART 2 PRODUCTS**

### **2.1 HEATING CABLES**

- .1 The self-regulating heater shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating, to be used with wood, plastic, and asphalt building materials, and to be cut to length in the field. For energy conservation, the self-regulating heater shall have a power out-put of 10 watts per foot where it contacts ice and snow and 5 watts per foot in air. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket and protected by a tinned-copper braid and a polyolefin outer jacket.
- .2 The heater shall operate on (select: 208, 220, 240 or 277) volts without the use of transformers.
- .3 The heater shall be GM-2X ICESTOP manufactured by Raychem Corporation.
- .4 Power connection, end seal, splice, outer jacket repair, and gutter and roof insulation clip kits shall be applied in the field.
- .5 Thermostat:
  - .1 The system shall be controlled by a thermostat either directly or through an appropriate contactor.
- .6 Circuit Breaker:
  - .1 The system shall be protected by a ground fault circuit breaker with a 30 milliamp trip.
- .7 Provide fire alarm relay to indicate trouble on fire alarm system when power supply is interrupted.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Heater shall be laid in gutters and held in place with coated aluminum adhesive tape; shall be suspended in downspouts either as a loop or a single length and held in place by a hanger kit; and shall be attached to roofs using roof clip kits.
- .2 Protect the heater from damage and install according to manufacturer's instructions.

### **3.2 TESTS**

- .1 After installation, test the dielectric jacket's insulation resistance and continuity with a 2500 VDC megger. Insulation resistance from the conductors to the shield shall be between 20 & 1000 megohms.
- .2 Verify fire alarm connection.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 GENERAL**

- .1 Inspection authorities shall mean Electrical Safety Authority.
- .2 Supply authority shall mean Hydro One.
- .3 Provide shall mean supply, install, test and commission.
- .4 Refer to General Instructions, Contract Requirements, Amendments and Divisions 00 & 01 and be governed by same.

### **1.2 CODES AND STANDARDS**

- .1 Provide complete installation in accordance with the latest edition of the Ontario Electrical Safety Code and Electrical Bulletins.
- .2 Provide overhead and underground systems in accordance with CAN/CSA C22.3 No. 1-15 except where specified otherwise.
- .3 Comply with the following additional codes as a minimum:
  - .1 CSA Standards.
  - .2 ULC Standards.
  - .3 Ontario Building Code - Latest Edition.
  - .4 Fire Code.
  - .5 NFPA.
  - .6 Electrical Equipment Manufacturers Association of Canada (EEMAC)

### **1.3 CARE, OPERATION AND START UP**

- .1 Instruct operating personnel in the operation, care, and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance, and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

### **1.4 TIME OF COMPLETION**

- .1 Commence work upon notification of acceptance of offer, or as outlined in the approved construction schedule.
- .2 Verify equipment delivery times immediately and notify engineer within two (2) weeks of contract award of any deliveries which would affect schedule.

### **1.5 SHOP DRAWINGS**

- .1 Submit single electronic format (pdf) of shop drawings and product data along with transmittal. Hard copy shop drawings shall not be accepted.
- .2 The review is for the sole purpose of ascertaining conformance with the general design concept, and does not mean approval of the design details inherent in the shop drawings, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of

- responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents.
- .3 Do not commence manufacture or order materials before shop drawings are reviewed.
  - .4 Shop drawings shall clearly indicate:
    - .1 Name of Contractor.
    - .2 Name of component.
    - .3 Name of service or system.
    - .4 Contractors signed review stamp.
  - .5 Shop drawings shall include, but is not limited to, the following information:
    - .1 Arrangement of specific system.
    - .2 Electrical characteristics, volts, phase, amps, etc.
    - .3 Dimensions of equipment and required clearances.
    - .4 Performance data.
    - .5 Finish.
    - .6 Gauge of materials.
    - .7 Wiring diagrams (where applicable).
    - .8 Product data (where applicable).
  - .6 Review relevant shop drawings of other Divisions to ensure interface of systems with respect to wiring, voltages, ampacities, phases, size, controls, etc. Notify Engineer of any discrepancies immediately.
  - .7 Provide shop drawings for the equipment listed below and/or as indicated in this specification:
    - .1 Distribution equipment.
    - .2 Light fixtures.
    - .3 Emergency lighting.
    - .4 Motor control equipment.
    - .5 Emergency - power generation.
    - .6 Fire alarm.

## **1.6 FIRE & SAFETY REQUIREMENTS**

- .1 Comply with National Building Code (Part 8, Health and Safety Measures at Construction and Demolition Sites) and Provincial Regulations for Construction Projects.

## **1.7 PROTECTION**

- .1 Protect access areas through existing building (lobby, elevator, corridor stairwell, etc.) from damage. Clean area daily or more frequently if directed by Engineer.
- .2 Protect exterior areas (roof, walls, etc.) against damage during handling of new and removed materials.
- .3 Repair and make good all damaged equipment, etc. to satisfaction of the Engineer.
- .4 Protect stored materials, work in process and finished work against damage until take-over.
- .5 Protect adjacent areas against spread of dust and dirt beyond work areas.

- .6 Protect operatives and other users of site from all hazards.

## **1.8 ANCHORING METHODS**

- .1 Electrical equipment, fixtures, cable tray, conduit, and cabling is to be securely anchored or fastened to the building structure using drilled hole wedge anchors for concrete structures or steel clamps for steel structures.
- .2 Air, fuel or powder actuated devices or any other equivalent type of fastening devices is not to be used.
- .3 Where anchoring method forms part of seismic restraint requirements, anchoring methods to comply with Section 26 05 05 - Seismic Restraint Systems (SRS).

## **1.9 CUTTING, PATCHING AND MAKING GOOD**

- .1 Provide cutting & patching of existing surfaces as required to accommodate new work.
- .2 Remove all items so shown or specified.
- .3 Patch and make good surfaces cut, damaged or disturbed, to Engineer's approval. Match existing material, colour, finish, and texture or as indicated otherwise.
- .4 Provide dust tight screens or partitions to localize dust generating activities and for protection of finished areas of work, workers, and public.
- .5 Scan slabs before coring or drilling deeper than 1" (25 mm). Provide all required notification, clearance & protection for scanning process. Adjust coring & drilling locations as necessary to avoid rebar & conduits.

## **1.10 CO-ORDINATION**

- .1 Co-ordinate the work with all other Divisions, especially Divisions 21, 22 & 23, to ensure systems compatibility, and to ensure schedules and requirements are maintained.
- .2 Where perceived interferences occur, prepare detailed sketches indicating proposed solution for review and acceptance by Engineer.

## **1.11 OPERATION AND MAINTENANCE INSTRUCTION MANUALS**

- .1 Submit electronic format (pdf) copy of draft Operation and Maintenance Manual to Engineer for approval, compiled as follows:
  - .1 Enclose title sheet labelled "Operating and Maintenance Instructions", project name, date, and list of contents. Project name must appear on binder face and spine.
  - .2 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .2 Include following information plus data specified.
  - .1 Installation and maintenance instructions for equipment and materials.
  - .2 Description: Operation of the equipment and systems defining start-up, shutdown, and emergency procedures, and any fixed or adjustable set points that affects the equipment operation. Include nameplate information such as make, size, capacity, and serial number.
  - .3 Maintenance: Use clear drawings, diagrams or manufacturers' literature which specifically apply and detail the following:
    - .1 Lubrication products and schedules.

- .2 Trouble-shooting procedures.
- .3 Adjustment techniques.
- .4 Operational checks. Supplier's names, addresses and telephone numbers and components supplied by them must be included in this section. Components must be identified by a description and manufacturer's part number.
- .3 Spare Parts: List all recommended spares to be maintained on site to ensure optimum efficiency. List all special tools appropriate unique application. All parts/tools detailed must be identified as to manufacturer, manufacturer part number and supplier (including address).
- .4 Include shop drawings, operation, and maintenance instructions (bound as one) in accordance with the above for all equipment specified.
- .5 Include one complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
- .6 Within four (4) weeks of acceptance of draft manuals, submit four (4) copies.
- .7 Failure to submit manuals as specified, will incur additional 10% holdback against progress payments.
- .8 Include appropriate wiring diagrams, schematics, elevations, mounting requirements, options included, etc. as it pertains to each system and/or device.
- .9 Information in manuals is to be specific to this project. Generic information is unacceptable.

#### **1.12 AS-BUILT DRAWINGS**

- .1 Site records:
  - .1 Electrical sub-contractor shall mark all changes as work progresses and as changes occur.
  - .2 On a weekly basis, transfer information to record set of documents, revising to show all work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
  - .1 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows:  
- "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
  - .2 Engineer to submit AutoCAD 2010 disk of electrical drawings to contractor. Contractor shall modify CAD Drawings disks in accordance with Engineer CAD standards to reflect electrical systems as installed.
  - .3 Submit electronic CAD files & hard copy to Engineer for approval and make corrections as directed.
  - .4 Following approval, submit completed hard copy as-built drawings and CD with Operating and Maintenance Manuals.

#### **1.13 GUARANTEES AND WARRANTIES**

- .1 Before completion of work, collect all manufacturer's guarantees and warranties and submit to the Engineer.
- .2 Identify, bind, and index material in maintenance manuals.



- .3 Division 26's Contractor to submit a written, signed guarantee stating that all systems and components have been installed to manufacturers recommendations and that systems are operating satisfactorily and meet the design requirements, and all material and labour deficiencies will be corrected, at no cost, for a period of one year after substantial completion.

#### **1.14 FINAL INSPECTION**

- .1 Do not request final inspection until:
  - .1 Deficiencies are less than 25 items.
  - .2 All systems have been tested and are ready for operation.
  - .3 All balancing of loads has been completed.
  - .4 The Owner's operating personnel have been instructed in the operation of all systems and equipment.
  - .5 The complete operation and maintenance data books have been delivered to the Engineer.
  - .6 All inspection certificates have been furnished.
  - .7 All record drawings have been completed and approved.
  - .8 All spare parts and replacement parts have been provided and receipt of same acknowledged.
  - .9 The cleaning up is finished in all respects.
  - .10 Fire alarm verification certificates submitted.
- .2 Final inspection shall be subjected to the approval of the Engineer.

#### **1.15 CLEAN UP**

- .1 Clean up work area as work progresses.
- .2 At the end of each work period, and more often if ordered by the Engineer, remove debris from site.
- .3 Clean areas under contract to a condition at least equal to that previously existing and to approval of Engineer.
- .4 Provide cleaning of light fixture reflectors, lamps and lenses, vacuum panelboards, cabinets switchgear, etc., upon completion of contract, to Engineers satisfaction.

#### **1.16 APPROVAL OF ALTERNATIVE MATERIALS**

- .1 During the tendering period, alternative materials to those specified may be considered if full descriptive data are submitted five (5) days prior to tender closing as described in front end documents.
- .2 Approval of alternatives will be signified by issue of an Addendum to the Contract Documents.
- .3 Include cost of any and all additional work and modifications to the engineering design, and costs incurred by other Divisions as a result of using materials.

#### **1.17 CONTRACT DOCUMENTS**

- .1 Drawings and specifications are complementary, items shown or mentioned in one and not in the other are deemed to be included in the contract work.

- .2 The contract documents are intended to describe complete fully functional systems although not all components are indicated. Division 26 shall provide all required conduits, wiring, equipment, etc. to provide fully functional systems which meet the design intent.
- .3 Discrepancies in the design documents, or doubt as to the full intent of the design shall be brought to the Engineer's attention prior to tender close. Failure to do this means that the Contractor is fully aware and shall be responsible of design intent and requirements and shall provide fully functional and coordinated systems.

#### **1.18 PROJECT SCHEDULE**

- .1 On award of contract and upon Engineer's request, submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion.
- .2 When schedule has been reviewed by the Owner and Engineer, take necessary measures to complete work within scheduled time. Any change of schedule must be authorized by Owner and the Engineer.

#### **1.19 COST BREAKDOWN**

- .1 Within one (1) week of award of contract, submit breakdown of costs as separate amounts of labour, materials, etc. of each system. Break down electrical systems generally as follows:
  - .1 Start-up.
  - .2 Permits and inspections.
  - .3 Site work.
  - .4 Distribution.
  - .5 Coordination study.
  - .6 Branch circuit roughing.
  - .7 Wiring devices.
  - .8 Lighting:
    - .1 Exterior.
    - .2 Interior.
    - .3 Exit Lights.
  - .9 Fire alarm.
  - .10 Data system (rough-in).
  - .11 PA/intercom (rough-in).
  - .12 Security (rough-in).
  - .13 Generator & associated equipment.
  - .14 Clocks.
  - .15 Motor control.
  - .16 Testing, commissioning, and job cleanup. (Generally, 1.5 to 3% of total cost). Indicate material & labour costs separately for each item.
- .2 After acceptance by Engineer, cost breakdown will be used as the basis of progress payments.

## **1.20 PERMITS, FEES, AND INSPECTIONS**

- .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 Notify Engineer of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Engineer and include in manuals. Final payment will not be made until certificates have been submitted.

## **1.21 MATERIALS AND EQUIPMENT**

- .1 Equipment and material to be new CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .2 Factory assemble control panels and component assemblies.

## **1.22 TRADE QUALIFICATIONS**

- .1 The work shall be carried out by licensed electricians with minimum five years experience who hold Ontario Certificates of Qualifications, and current contractors license.
- .2 Installation methods and materials to be of strictest quality, and conform to Canadian General Standards Board, Canadian Standards Association, Ontario Building Code and all Local and Provincial Codes and Standards. Discrepancy in Codes to mean strictest rule applies.
- .3 The ratio of Journeymen to Apprentices shall not exceed the ratio in the Trade Qualifications and Apprenticeship Act of Ontario.
- .4 All fire alarm work shall be carried out by licensed electrician with CFAA certification.

## **1.23 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC Y1-2.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

## **1.24 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates:
    - .1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.
  - .2 Labels:
    - .1 Electronically printed, self-adhesive plastic labels with 6 mm high letters unless specified otherwise.
  - .3 Wording on nameplates to be as indicated c/w volts, phase, amps, HP, etc.
  - .4 Allow for average of twenty-five (25) letters per nameplate.

- .5 Identification to be English and French.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage, Size 7.
- .8 Terminal cabinets and pull boxes: indicate system and voltage, Size 7.
- .9 Transformers: indicate capacity, primary and secondary voltages, Size 7.
- .10 Panelboards nameplate, Size 7.
- .11 Provide typed circuit directory for each panelboard.
- .12 Identify all receptacle outlets by panel, circuit number, and voltage, with Brother P-Touch labeller.
- .13 Provide identification on service poles and prewired partitions at 300 mm A.F.F.
- .14 Provide system, circuit, voltage, phase, etc., on all ceiling space junction box covers, red for fire alarm & emergency circuits, black for others.
- .15 All circuit protective devices to be c/w a lamicaid label mounted inside door of device listing all fuse type and ratings, circuit breaker settings, and minimum interrupting ratings.
- .16 All switchboards and panelboards to have a permanent lamicaid label mounted on inside of door with minimum circuit breaker interrupting rating.

#### 1.25 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 code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

#### 1.26 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.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V yellow	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Voice/data	Green	
Security	Green	Blue
Fire Alarm	Red	
Emergency power (250V)	Red	Blue
Emergency power (600V)	Red	Yellow

### **1.27 WIRING TERMINATIONS**

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

### **1.28 MANUFACTURERS AND CSA LABELS**

- .1 Visible and legible after equipment is installed.

### **1.29 WARNING SIGNS**

- .1 As specified and to meet requirements of Electrical Inspection Department and Engineer.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

### **1.30 SINGLE LINE ELECTRICAL DIAGRAMS**

- .1 Provide single line electrical diagrams under plexiglass as follows:
  - .1 Electrical distribution system: locate in main electrical room.
  - .2 Electrical power generation and distribution systems: locate in power plant rooms.
- .2 Provide fire alarm riser diagram, plan, and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .3 Drawings: 600 x 600 mm minimum size.

### **1.31 LOCATION OF OUTLETS**

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

### **1.32 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1100 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 Above top of continuous baseboard heater: minimum 200 mm.
    - .3 Above top of counters or counter back splashes: 175 mm.
    - .4 In mechanical rooms: 1200 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 400 mm.

- .5 'F' indicates floor mounting.
- .6 'C' indicates ceiling mounted.
- .7 Wall mounted telephone and interphone outlets: 1100 mm.
- .8 Fire alarm pull stations: 1200 mm.
- .9 Fire alarm bells: 2300 mm.
- .10 Wall mounted speakers: 2300 mm.
- .11 Clocks: 2100 mm.
- .12 Doorbell pushbuttons: 1100 mm.
- .13 Thermostats: 1200 mm.

### 1.33 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads operating. Do tests after space is fully occupied and operational. 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, after space is fully occupied and operational.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers, and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

### 1.34 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits, and fittings; to be embedded or plastered over, neatly, and close to building structure so furring can be kept to minimum.
- .4 Provide all required accessories, inserts, hangers, toggle bolts, support channels, anchors etc. as required to complete systems.

### 1.35 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
  - .1 Power generation and distribution system including phasing, voltage, grounding, and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: fire alarm system, P.A., intercom, C.C.T.V., security, etc.
- .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 Carry out tests in presence of Engineer.
- .5 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for Engineer's review.
- .7 Hot spot testing:
  - .1 After 24 hours of operation under full load, perform infrared tests on all cable terminations and connections and all transformer, panel, and breaker connections, to ensure the integrity of the system.
  - .2 Tests to be carried out by using an infrared camera.
  - .3 Terminations and/or connections failing tests shall be replaced immediately as part of the contract.

#### **1.36 CO-ORDINATION OF PROTECTIVE DEVICES**

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

#### **1.37 FIRE AND SMOKE STOPPING**

- .1 Provide fire and smoke stopping where conduits, cables, trays, etc., penetrate floor slabs or fire rated walls with an approved ULC listed putty, equal to 3M caulk CP25 and putty 303.
- .2 Installation of fire stops by trained manufacturers representative.

#### **1.38 SPRINKLER-PROOF EQUIPMENT**

- .1 Provide sprinklerproof equipment in all sprinklered areas to the local authority's requirements.

#### **1.39 ACCESS DOORS**

- .1 Provide access doors as required by inspection authorities and Engineer to ensure access to concealed electrical work.
- .2 Access doors shall be as specified in Division 09 with fire resistance rating equal to wall or ceiling in which door to be installed. Minimize access door requirements and obtain approval of locations prior to electrical systems installation. Prepare a sketch drawing indicating locations for review by Owner/Architect/Engineer.
- .3 Submit access door shop drawings.

#### **1.40 RELATED WORK**

- .1 Temporary power - Division 01.
- .2 Excavation & Backfill - Division 02.
- .3 Concrete & Reinforcement - Division 03.
- .4 Flashing - Division 07.
- .5 Painting - Division 09.

#### 1.41 PROGRESS BILLING – ELECTRICAL

.1

Item		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Job Set-up (Mobilization)							
Permits & Inspections							
Site Work							
Distribution	Material						
	Labour						
Branch Circ. Roughing	Material						
	Labour						
Wiring Devices	Material						
	Labour						
Lighting (Interior & Exterior)	Material						
	Labour						
Emergency & Exit Lighting	Material						
	Labour						
Fire Alarm	Material						
	Labour						
Data/Communications (Rough-in)	Material						
	Labour						
Generator & Transfer Switches	Material						
	Labour						
	Start-up						
PA Intercom (Rough-in)	Material						
	Labour						
	Start-up						



Item		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Security (Rough-in)	Material						
	Labour						
Testing & Job Clean-up (Demobilization)							
Commissioning							
As-builts and O&M Manuals							
TOTAL ORIGINAL CONTRACT AMOUNT							

**PART 2 PRODUCTS – NOT USED**

**PART 3 EXECUTION – NOT USED**

**END OF SECTION**

February 2026

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 CODES AND STANDARDS**

- .1 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE 242, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
  - .2 IEEE 1584b, IEEE Guide for Performing Arc-Flash Hazard Calculations - Amendment 2.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA (Fire) 70E, Standard for Electrical Safety in the Workplace, 2018 Edition.

### **1.3 SUBMITTALS**

- .1 The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- .2 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Two (2) bound copies of the complete final report shall be submitted, along with electronic pdf version.
- .3 The report shall include the following sections:
  - .1 Executive Summary.
  - .2 Descriptions, purpose, basis, and scope of the study.
  - .3 Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short circuit duties.
  - .4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
  - .5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
  - .6 Details of the incident energy and flash protection boundary calculations.
  - .7 Recommendations for system improvements, where needed.
  - .8 One-line diagram.

### **1.4 QUALIFICATIONS**

- .1 The short-circuit/device evaluation, protective device coordination and arc flash hazard analysis studies shall be performed or reviewed and sealed by a licensed Professional Electrical Engineer registered to practice in the Province of Ontario skilled in performing and interpreting the power system studies.

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- .2 The licensed Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
- .3 The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- .4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

## 1.5 GENERAL

- .1 Include in the tender all costs for preparation of a complete System Coordination/Short Circuit/Device Evaluation Study and Arch Flash Hazard Analysis in accordance with IEEE 242, 'Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems', and IEEE 1584, 'Guide for Performing Arc-Flash Hazard Calculations'.
- .2 The scope of the studies shall include:
  - .1 The Study shall include all relevant distribution and protective devices within the following scope:
    - .1 Upstream from the local Utility feeder protection devices.
    - .2 Downstream to the affected branch circuit panels.

## 1.6 COORDINATION STUDY

- .1 The work of the Coordination Study shall include:
  - .1 Liaison with the local Utility for information on relays and other protective devices, and system and substation capacities which affect the coordination of this system for both primary and any standby feeders.
  - .2 Liaison with distribution equipment and switchgear manufacturers to obtain actual trip curves of existing and proposed protective devices for new & existing equipment.
  - .3 Sending a trained and qualified representative on site to gather data on existing equipment within the scope of the study, such as transformers, cables, and lengths, breakers, fuses, and all adjustable protective device settings. The information gathered will include the method of installation where such installation impacts upon the Study (e.g. method of cable installation reflecting upon the allowable ampacity of the cable).
  - .4 Recommendations shall be included, listing all deficiencies within the scope of the study and proposing methods of correction for each deficiency.
- .2 The Coordination Study report shall include the following:
  - .1 Each Time-Current graph shall be printed in colour. The selected colours will allow the end-user to easily discriminate between different device curves, especially on complicated graphs where devices overlap.
  - .2 The Time-Current curves shall be drawn on special log-log graphs with time coordinate range of 0.01 to 1,000 seconds and current coordinate ranges of 4 orders. Separate graphs are to be provided for phase and ground protection for each portion of the system. The entire distribution system shall be subdivided into portions so that the curve for each device clearly shows its relationship to associated upstream and downstream devices.

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The coordination study should separate the emergency power from the normal power distributions. Each graph for a portion of the system shall include/show the following:

- .1 The portion of the distribution system represented by the devices on the graph shall be represented by a single line diagram drawn in the corner of the Time-Current coordination graph.
- .2 Each device curve shall end at the 3 phase symmetrical fault level calculated for that bus.
- .3 Cable, Bus, or Conductor damage curves shall be shown where appropriate. All Transformer inrush, damage and overload curves shall be shown.
- .4 Motor starting curves and protective devices shall be shown for all motors larger than 75 HP.
- .5 On the graphs, or on the same page as the graph, all protective device curves within the scope of the graph shall be shown with the following information:
  - .1 Relay curves with text indicating; Manufacturer, Type, Current Transformer size, Tap or Pickup setting, Time Dial settings, and curve type.
  - .2 Fuse curves with average melting curve for low voltage fuses and minimum melt and total clearing for high voltage fuses with text indicating; Manufacturer, Type, Ampacity, Voltage, and Speed.
  - .3 Static-Trip Breaker curves with text indicating; Breaker and Trip Unit Manufacturer and type, Current Transformer and Sensor Type, and all trip unit settings.
  - .4 Thermal-Magnetic Breaker curves with text indicating; Breaker type, Trip rating, and instantaneous trip settings.
- .3 Include tables within the Study that clearly list all protective devices within the scope of the study and all associated information. These tables are to be based on settings established and noted in the coordination curves. The tables shall be logically arranged and grouped to effectively present the following information. The tables shall include:
  - .1 Relays; including manufacturer, type, curve, CT, and all protective settings.
  - .2 Transformers; including size, type, manufacturer, configuration, voltage, and impedance.
  - .3 Fuses; including manufacturer, type, ampacity, voltage, speed.
  - .4 Static Trip Units; including manufacturer, type, CT, sensor or plug, all protective settings.
  - .5 Thermal-Magnetic Trip Units; including manufacturer, rating, and instantaneous setting.
  - .6 Motor Protectors (Overloads); include manufacturer, type, rating, all protective settings.
  - .7 All protective devices shall be listed with clear descriptive text to identify their place within the distribution system.
  - .8 All protective devices shall have a reference to the Time-Current graph where they are shown.

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- .4 The tables shall list all existing and recommended settings of all protective devices within the scope of the study. This will allow the end-user to identify and plan for required changes to protective device settings, and to determine which settings have been implemented and modified.

## 1.7 SHORT CIRCUIT/DEVICE EVALUATION STUDY

- .1 The work of the Short Circuit study shall include:
  - .1 Evaluation and documentation of three phase single phase & ground fault short circuit fault levels at all distribution buses, motor control centres and main panel board locations within the scope listed above.
  - .2 The output of the short circuit study shall be a printed tabulation of asymmetrical and symmetrical RMS short circuit current values for both interrupting duty and momentary duty, including X/R ratios.
  - .3 All significant sources and impedances shall be evaluated, including but not limited to, Utility and Emergency Sources, motors, cables and their lengths, transformers, reactors, and any other devices impacting upon the available short circuit.
- .2 The work of the device evaluation study shall include:
  - .1 All pertinent interrupting devices within the scope of the job shall be listed with its interrupting rating or its series interrupting rating as applicable.
  - .2 A cross reference in table form shall be provided whether the protective devices at each bus are appropriate for the available fault current at each bus.

## 1.8 ARC FLASH HAZARD ANALYSIS

- .1 Arc Flash Hazard Analysis:
  - .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA (Fire) 70E, Annex D.
  - .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centres, panelboards, busway, and splitters) where work could be performed on energized parts.
  - .3 The Arc-Flash Hazard Analysis shall include all locations in the systems.
  - .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of  $1.2 \text{ cal/cm}^2$ .
  - .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
  - .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

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- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
  - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
  - .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific situation.
- .2 The electrical contractor shall ensure that the recommendations of the study are implemented as part of the contract.

## **PART 2 PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **PART 3 EXECUTION**

### **3.1 FIELD ADJUSTMENT**

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Notify Owner in writing of any required major equipment modifications.

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### **3.2 ARC FLASH WARNING LABELS**

- .1 The contractor of the Arc Flash Hazard Analysis shall provide an 89 mm x 127 mm (3.5 in.) thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- .3 The label shall include the following information, at a minimum:
  - .1 Location designation
  - .2 Nominal voltage
  - .3 Flash protection boundary
  - .4 Hazard risk category, PPE
  - .5 Incident energy
  - .6 Working distance
  - .7 Engineering report number, revision number, and issue date.
  - .8 Labels shall be machine printed, with no field markings.
- .4 Arc flash labels shall be provided in the following manner, and all labels shall be based on recommended overcurrent device settings.
  - .1 For each 600, and applicable 208 volt panelboard, one arc flash label shall be provided.
  - .2 For each motor control centre, one arc flash label shall be provided.
  - .3 For each low voltage switchboard, one arc flash label shall be provided.
  - .4 For each switchgear, one arc flash label shall be provided.
  - .5 For medium voltage switches one arc flash label shall be provided.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 DEFINITIONS**

- .1 SRS: acronym for Seismic Restraint System.

### **1.3 GENERAL DESCRIPTION**

- .1 This section covers design, supply, and installation of complete SRS for all systems, equipment specified for installation on this project by Division 26. This includes, but is not limited to, electrical light fixtures, transformers, MCC's, UPS, diesel generators, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.
- .2 Cable restraint systems, rod stiffener clamps, and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site-specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.

### **1.4 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA S832, Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.
- .2 Ontario Regulation
  - .1 ONTARIO OBC, Ontario Building Code.

### **1.5 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Submit seismic restraint shop drawings, c/w seal of Professional Engineer registered in Province of Ontario, clearly identifying equipment/systems reviewed and the equipment/systems requiring restraint. Shop drawings must clearly show all forces transferred to structure.
- .3 Seismic Design Engineer shall provide a spreadsheet identifying all equipment and systems requiring or not requiring seismic restraints and include all circulations.
- .4 Submit additional copy of shop drawings and product data to project Structural Engineer for review of connection points to building structure.

### **1.6 MAINTENANCE DATA**

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 26 05 00 - Electrical General Requirements.



## **1.7 SEISMIC FORCE**

- .1 The Importance Factor for this project is:
  - .1  $I = 1.3$  - Schools.

## **PART 2 PRODUCTS**

### **2.1 SRS MANUFACTURER**

- .1 SRS to be from one manufacturer regularly engaged in production of same, 5 years experience.
- .2 Acceptable materials: Korfund-Sampson, Mason Industries, Tecoustics, Vibra-Sonic Control, Vibron.

### **2.2 GENERAL**

- .1 Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Division 26 to include all costs associated with this work as it relates to Division 26 installations.
- .2 SRS to be fully integrated into, compatible with:
  - .1 Noise and vibration controls specified elsewhere in this project specification, telecommunications.
  - .2 Structural, mechanical, electrical design of project.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury, interfering with other systems, and from moving from normal position.
- .4 Design and installation in accordance with OBC & CSA S832.
- .5 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .6 SRS to restrain seismic forces in all directions.
- .7 Fasteners and attachment points to resist same load as seismic restraints.
- .8 SRS of conduit systems to be compatible with:
  - .1 Expansion, anchoring, and guiding requirements.
  - .2 Equipment vibration isolation and equipment SRS.
- .9 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .10 Attachments to RC structure:
  - .1 Use high strength mechanical expansion anchors.
  - .2 Drilled or power-driven anchors not permitted.
- .11 Seismic control measures not to interfere with integrity of firestopping.

### **2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS**

- .1 Floor-mounted equipment, systems:
  - .1 Anchor equipment to equipment supports.
  - .2 Anchor equipment supports to structure.
  - .3 Use size of bolts scheduled in approved shop drawings.

- .2 Suspended equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Install tight to structure.
    - .2 Cross-brace in all directions.
    - .3 Brace back to structure.
    - .4 Slack cable restraint system.
  - .2 SRS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
  - .3 Hanger rods to withstand compressive loading and buckling.

## **2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT**

- .1 Floor mounted equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Vibration isolators with built-in snubbers.
    - .2 Vibration isolators and separate snubbers.
    - .3 Built-up snubber system approved by Engineer, consisting of structural elements and elastomeric layer.
  - .2 SRS to resist complete isolator unloading.
  - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
  - .4 Cushioning action to be gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Slack cable restraint system.
    - .2 Brace back to structure via vibration isolators and snubbers.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.
- .2 Install SRS at least 25 mm from all other equipment, systems, services.
- .3 Co-ordinate connections with all disciplines.

### **3.2 INSPECTION AND CERTIFICATION**

- .1 SRS to be inspected and certified by Manufacturer upon completion of installation.
- .2 Seismic Design Engineer shall provide written report to Engineer certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

### **3.3 COMMISSIONING DOCUMENTATION**

- .1 Upon completion and acceptance of certification, hand over to Engineer complete set of construction documents, revised to show "as-built" conditions.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA)

### **1.3 SHOP DRAWINGS**

- .1 Submit shop drawings for precast equipment in accordance with Section 26 05 00 - Electrical General Requirements.

### **1.4 REQUIREMENTS**

- .1 Coordinate the installation of underground services with the supply authority, telephone, and cable T.V. companies and meet their requirements as a minimum.
- .2 Coordinate buried services with all existing services (water, sewer, gas, telephone, cable, hydro, etc.).
- .3 The supply authority will provide the following:
  - .1 Termination of primary cables.

### **1.5 APPROVED CONTRACTORS**

- .1 All work on Embrun Hydro primary services to be performed by pre-approved contractors.
- .2 Electrical contractor shall provide primary transformer, switchgear/transformer base, and pad. Provide primary and secondary duct banks and primary and secondary cabling and grounding as per drawings and specifications.

## **PART 2 PRODUCTS**

### **2.1 PVC DUCTS**

- .1 PVC ducts, type EB1, encased in reinforced concrete, type DB2 for direct burial. Corrugated not permitted.

### **2.2 PVC DUCT FITTINGS**

- .1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5° angle couplings.

### **2.3 MARKERS AND PROTECTION**

- .1 Yellow marker tape along entire duct run buried 300 mm below grade.

### **2.4 GROUND STATION**

- .1 Provide 3 m x 20 mm diameter ground rods (minimum four) c/w 4/0 copper ground conductor interconnecting rods, transformer, switchgear and extended into building.

- .2 Confirm quantity of rods with supply authority and conform to their requirements.
- .3 Ground all metal objects such as protective posts, transformer case and neutral, switchgear, fences, etc.
- .4 Connections to be thermite weld or Burndy 'Hyground'.

## **PART 3 EXECUTION**

### **3.1 DUCTBANK INSTALLATION GENERAL**

- .1 Install underground ductbanks and manholes including formwork.
- .2 Build ductbank and manholes on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.
- .3 Obtain approval of forming, reinforcement, placement, and route with supply authority.
- .4 Open trench completely between manholes to be connected before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .5 Prior to laying ducts, construct "mud slab" not less than 75 mm thick.
- .6 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .7 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.
- .8 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 75 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. Encase ductbank with 75 mm thick concrete cover. Use galvanized steel conduit for sections extending above finished grade level.
- .9 Make transpositions, offsets and changes in direction using 5° bend sections, do not exceed a total of 20° with duct offset.
- .10 Use bell ends at duct terminations in manholes or buildings.
- .11 Use conduit to duct adapters when connecting to conduits.
- .12 Terminate duct runs with duct coupling set flush with the end of concrete envelope when dead ending ductbank for future extension.
- .13 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .14 Allow concrete to attain 50% of its specified strength before backfilling.
- .15 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing 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.
- .16 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .17 Immediately after placing of concrete, pull through each duct a wooden mandrel not less than 300 mm long and of a diameter 6 mm less than internal diameter of duct, followed by 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.

- .18 Install four 3 m lengths of 10M reinforcing rods, one in each corner of ductbank when connecting duct to manholes or buildings. Wire rods to 10M dowels at manhole or building and support from duct spacers. Protect existing cables and equipment when breaking into existing manholes. Place concrete down sides of ductbank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.
- .19 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

### **3.2 MANHOLES**

- .1 Install precast manholes.
- .2 Install manhole frames and covers for each manhole. Set frames in concrete grout onto the manhole neck.
- .3 Drain floor towards sump with 1 to 48 slope minimum and install drainage fittings as indicated.
- .4 Install cable racks, anchor bolts and pulling irons as indicated.
- .5 Ensure filling of voids in joint being sealed. Plaster with cement grout, walls, ceiling, and neck.
- .6 Spray paint an "X" on ceiling of manhole above floor drain or sump pit.

### **3.3 MARKERS**

- .1 Mark ducts every 30 m along straight runs and changes in direction.
- .2 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .3 Lay concrete markers flat and centred over duct with top 25 mm above earth surface.
- .4 Provide drawings showing locations of markers.
- .5 Install marker tape.
- .6 Install protective planks.

### **3.4 INSPECTIONS**

- .1 Advise Engineer and inspection authority so that they may inspect ducts prior to placing and be present during placement of concrete and clean-out.

### **3.5 CABLE INSTALLATION IN DUCTS**

- .1 Install cables as indicated in ducts.
- .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 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.
- .6 After installation of cables, seal duct ends with duct sealing compound.
- .7 Check phase rotation and identify each conductor.
- .8 Perform megger tests and Hi-Pot tests to manufacturers recommendations.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 REFERENCES**

- .1 CSA International
  - .1 CSA C22.2 No. 18.4, Hardware for the Support of Conduit, Tubing and Cable.
  - .2 CSA C22.2 No. 65, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Pressure type wire connectors to: CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No. 65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded round copper conductors.
  - .2 Clamp for stranded round copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.
  - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CSA C22.2 No. 18.4.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and cables and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
  - .3 Install fixture type connectors and tighten to CSA C22.2 No. 65. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**



## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 SHOP DRAWINGS**

- .1 Submit cabletrough and busway shop drawings. Indicate mounting details, capacities, connections, etc.

### **1.3 LOCATION OF CONDUIT**

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.
- .2 Conduit to be concealed.

### **1.4 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.1HB, Canadian Electrical Code Handbook - An Explanation of Rules of the Canadian Electrical Code, Part 1.
  - .2 CSA C22.2 No. 65, Wire Connectors.
  - .3 CSA C22.2 No. 126.1, Metal Cable Tray Systems.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
  - .2 EEMAC F5-1, Standard for Cabletrough Systems and Accessories.

## **PART 2 PRODUCTS**

### **2.1 CONDUITS**

- .1 Rigid galvanized steel threaded conduit.
- .2 Epoxy coated conduit: with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing EMT, with steel set screw couplings and connectors.
- .4 Rigid PVC conduit.
- .5 Flexible steel conduit and liquid-tight flexible metal conduit.

### **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Six mm dia. threaded rods to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

## **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

## **2.5 FISH CORD**

- .1 Polypropylene.

## **2.6 CABLETROUGH**

- .1 Cabletroughs and fittings: to EEMAC F5-1.
- .2 Ladder ventilated type, Class C1 to CSA C22.2 No. 126.1.
- .3 Galvanized steel tray 300 mm wide with depth of 100 mm.
- .4 Horizontal elbows, end plates, dropouts, vertical risers and drops, tees, wyes, expansion joints, and reducers where required. Fittings: manufactured accessories for cabletrough supplied. Radii on fittings: 600 mm minimum.
- .5 Solid covers for complete cabletrough system including fittings, in 150 mm sections maximum.
- .6 Barriers where different voltage systems are in the same cabletrough.
- .7 Provide supports at intervals recommended by manufacturer.

## **2.7 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG (including ground wires).
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90. RWU-90 for buried services.

## **2.8 ARMoured CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 XLPE insulation, 600 V rated.
- .3 Armour: interlocking type fabricated from aluminum.

## **2.9 FIXTURE WIRE**

- .1 Use type GTF for installation in lighting fixtures.

## **2.10 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.2.1HB.
- .2 100 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.

## **2.11 SHEET STEEL OUTLET BOXES**

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

## **2.12 MASONRY BOXES**

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

## **2.13 CONCRETE BOXES**

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

## **2.14 FLOOR BOXES**

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.

## **2.15 CONDUIT BOXES**

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of all devices.

## **2.16 BOX FITTINGS- GENERAL**

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

## **2.17 VAPOUR BARRIER BOXES**

- .1 Equal to Commander #1004-VB.

## **2.18 SERVICE FITTINGS**

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for two duplex receptacles. Bottom plate with two knockouts for centred or offset installation. 12 x 102 mm extension piece as required.

## **2.19 WIRE AND BOX CONNECTORS**

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required. Equal to T&B-PT Series.
- .2 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded copper conductors.
- .3 Clamps or connectors for armoured cable as required.

## **2.20 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended. Equal to Unistrut, Burndy or Cantruss.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Conduit Systems:
  - .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
  - .2 Conceal conduits except in mechanical and electrical service rooms.
  - .3 Use rigid galvanized steel threaded conduit in hazardous classified areas and where indicated.
  - .4 Use electrical metallic tubing EMT except in were indicated or specified elsewhere.
  - .5 Use rigid PVC conduit underground.
  - .6 Use liquid tight flexible metal conduit for connection to motors which may vibrate or must be moved for servicing.
  - .7 Use liquid tight flexible metal conduit for connection to equipment in damp, wet, or corrosive locations.
  - .8 Use explosion proof flexible connection for connection to explosion proof motors.
  - .9 Install conduit sealing fittings in hazardous areas. Fill with compound.
  - .10 Minimum conduit size 21 mm.
  - .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
  - .12 Mechanically bend steel conduit over 21 mm dia.
  - .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
  - .14 Install fish cord in empty conduits.
  - .15 Run 2-27 mm spare conduits up to ceiling space and 2-27 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
  - .16 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
  - .17 Dry conduits out before installing wire.
  - .18 Run parallel or perpendicular to building lines.
  - .19 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
  - .20 Run conduits in flanged portion of structural steel.
  - .21 Group conduits wherever possible on channels.
  - .22 Do not pass conduits through structural members except as indicated.
  - .23 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

- .24 Do not install horizontal conduits runs in masonry walls.
- .25 Do not install conduits in terrazzo or concrete toppings.
- .26 Locate conduits in concrete to suit reinforcing steel. Install in centre one third of slab.
- .27 Protect conduits from damage where they stub out of concrete.
- .28 Install sleeves where conduits pass through slab or wall.
- .29 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .30 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .31 Organize conduits in slab to minimize crossovers.
- .32 Slope conduits to provide drainage.
- .33 Install rigid galvanized steel conduit at roof areas, if exposed.
- .34 Ream raceways to remove burrs.
- .35 Provide nylon pull cord in all empty raceways.
- .2 Wiring:
  - .1 Install RW-90 conductors in raceways except as otherwise indicated.
  - .2 Install MI cables and single conductor cables only as indicated. Provide aluminum at supply end of all single conductor runs, and code size ground conductors.
  - .3 Installation of type AC-90 will be permitted from:
    - .1 Conduit system junction boxes to recessed lighting fixtures in suspended ceilings, maximum length 2.5 m each run.
    - .2 Conduit system junction boxes to hollow gypsum partitions, maximum length 2.5 m each run.
    - .3 AC-90 is permitted in hollow gypsum partitions.
    - .4 AC-90 is not permitted in insulated masonry walls or concrete walls.
  - .4 Leave minimum 200 mm length of conductor at junction and outlet boxes.
  - .5 Splices shall not be pulled into conduits.
  - .6 Install type RWU-90 conductors in all underground conduit systems.
  - .7 Group AC-90 cables where possible. Do not bundle.
  - .8 Provide approved wire pulling lubricants for cable installations in conduits.
- .3 Outlet boxes:
  - .1 Support boxes independently of connecting conduits.
  - .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
  - .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
  - .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
  - .5 Provide circuit number identification on all junction boxes with black marker.

- .4 Wire and Box Connections:
  - .1 Remove insulation carefully from ends of conductors and:
    - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
    - .2 Install fixture type connectors and tighten. Replace insulating cap.
    - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.
- .5 Fastenings and Supports:
  - .1 Secure equipment to hollow masonry, tile and plaster surfaces with lead anchors or nylon shields.
  - .2 Secure equipment to poured concrete with expandable inserts.
  - .3 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. Provide additional supports to T-bar ceiling as required.
  - .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
  - .5 Fasten exposed conduit or cables to building construction or support system using straps.
    - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
    - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
    - .3 Beam clamps to secure conduit to exposed steel work.
  - .6 Suspended support systems:
    - .1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.
    - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.
  - .7 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.
  - .8 Provide metal brackets, frames, hangers, clamps, and related types of support structures were indicated or as required to support conduit and cable runs.
  - .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
  - .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
  - .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
  - .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .6 Cabletrough:
  - .1 Install complete cabletrough system.
  - .2 Support cabletrough on both sides.
  - .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

- .4 Confirm support requirements with manufacturer.
- .5 Use angle iron supports under tray over 18" (450 mm) in width.
- .7 Coordinate with manufacturer and install M.I. cabling under direction of manufacturer's representative.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 REFERENCES/CODES**

- .1 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.

## **PART 2 PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as indicated as required to electrically conductive underground water pipe.
- .2 Rod electrodes: galvanized steel 19 mm dia. by 3 m long.
- .3 Grounding conductors: bare stranded copper, tinned, soft annealed.
- .4 Insulated grounding conductors: green, type RW90.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Compression wire connectors.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding and bonding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect all exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to IEEE 837.
- .5 Use compression connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.



- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards. Type RWU-90.
- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end with conductive plate and provide non-metallic entry plate at load end.
- .13 Ground secondary service pedestals.
- .14 Provide continuous ground conductor for raceways, outlets, and junction boxes for all systems.
- .15 Ground all transformer secondary neutrals and enclosures back to primary feeder distribution panel.
- .16 Provide a ground conductor in all EMT conduits.
- .17 Provide ground conductor for all nonconductive raceways.
- .18 Ground all systems raceways, provide ground bushings.
- .19 Ground all gas piping within Building #6 AWG.
- .20 Provide #6 AWG copper ground conductor to all telephone/communications/data terminal cabinets or backboards.
- .21 Provide #6 AWG green insulated ground in all cabletroughs bonded at 3 m intervals.
- .22 Provide a complete bonding system to all raised floor pedestals, using #6 AWG bare copper conductor's c/w mechanical connections (Burndy). Specifically designed for use, on pedestals and interconnected with new 'ground windows'. All grounding to code requirements.
- .23 Provide new 'ground bars' where indicated, each a length of copper busbar, 450 mm W, 100 mm H, 6 mm D, mounted on insulating offset adaptors (phenolic plastic). Each ground window to be interconnected as indicated and grounded to the building service ground. Provide compression type cable connectors, 2 hole type at each end. Provide 750 MCM conductor interconnecting ground windows to building ground.
- .24 Provide #6 AWG insulated copper bonding conductors from 'ground bars' up to individual pieces of equipment located on raised floor. Confirm connections on site with the owner's representative. Provide all required connectors, cable clips, 2 hole connectors, cadmium plated bolt-washer-nut assembly and all necessary drilling for installation of connectors.
- .25 Provide connection of static dissipative floor tiles (indicated on architectural drawings) to ground windows.

### 3.2 MANHOLES

- .1 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

### 3.3 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter, and by providing min. 4-20 mm x 3 m rods, 3 m spacing & in accordance with Hydro One Code.

- .2 Install water meter shunt.
- .3 Install rod, electrodes and make grounding connections.
- .4 Bond separate, multiple electrodes together.
- .5 Use size 4/0 AWG copper conductors for connections to electrodes.
- .6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails.

### **3.4 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, communications systems and conduits, raised floors, etc.

### **3.5 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG, unless otherwise noted.

### **3.6 FIELD QUALITY CONTROL**

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

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International) / National Standard of Canada
  - .1 CAN/CSA C233.1, Gapless Metal Oxide Surge Arresters for Alternating Current Systems.
  - .2 CAN/CSA C61869-1, Instrument Transformers - Part 1: General Requirements.
- .2 The Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
- .3 Underwriters Laboratories
  - .1 UL 1, Flexible Metal Conduit.
  - .2 UL 248, Low-Voltage Fuses - Part 12: Class R Fuses.
  - .3 UL 1449, Surge Protective Devices.

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Coordination study, refer to Section 26 05 01 - System Coordination/Short Circuit/Device Evaluation Study & Arc Flash Hazard Analysis.

### **1.4 ACCEPTABLE MANUFACTURERS**

- .1 Schneider/Square D.
- .2 Equipment supplied shall be of a single manufacturer.

### **1.5 SPARE PARTS**

- .1 Provide three spare fuses of each size and type installed in this project.

### **1.6 RATINGS**

- .1 Equipment supplied shall have interrupting capacities in excess of currents calculated in the short circuit study.

### **1.7 OVERCURRENT PROTECTION**

- .1 Confirm overcurrent protection requirements of equipment supplied by Divisions 20, 21, 22 & 23, Architectural Divisions and equipment supplied by Owner prior to installation.

## **PART 2 PRODUCTS**

### **2.1 SERVICE ENTRANCE BOARD**

- .1 Rating: 208/120 V, 3 phase, 4 W, 1600 A, 50 KAIC, short circuit current kA (rms symmetrical).

- .2 Cubicles: free standing, against wall, dead front, metal enclosed, front access only.
- .3 Barrier metering section from adjoining sections.
- .4 Provision for installation of supply authority metering in barriered section.
- .5 Owner's metering.
- .6 Distribution section c/w moulded case circuit breakers.
- .7 Hinged access panels with captive knurled thumb screws.
- .8 Bus bars and main connections: 99.3% copper, self cooled.
- .9 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .10 Identify phases with colour coding.
- .11 Copper ground bus extending full width of cubicles and located at bottom. 6 mm x 50 mm.
- .12 Separate compartment and metal raceway for exclusive use of power supply authority metering. Coordinate with supply authority.
- .13 Digital Metering System
  - .1 Instrument transformers to CAN/ CSA C61869-1, and government approved for revenue metering, 3 current transformers and 3 potential transformers.
  - .2 Digital meter to be fully CSA approved.
  - .3 Instrument transformers to be installed in service entrance board by service entrance board manufacturer.
  - .4 Digital metering system shall be installed by service entrance board manufacturer at factory, flush mounted. Field installation is not permitted.
  - .5 Provide current transformer and potential transformers for both power and metering purposes.
  - .6 Digital metering system is to be an integrated micro-processor-based package capable of the following functions:
    - .1 Display voltage and current on each phase.
    - .2 Display kVA, KVAR, kW, PF, Hz and accumulated MWH, and kW demand.
    - .3 System to continuously monitor and store minimum values of volts and power factor and maximum values of amps, kW, kVA, KVAR, KWD.
    - .4 Items listed in .3 above to be stored in non-volatile memory.
    - .5 Provide a microprocessor-based, internal 16-bit CPU, digital 3-phase power meter/monitor capable of measuring and recording true RMS voltages, line currents, neutral current, harmonics and other parameters such as frequency, phase and total Real Power (kW), Reactive Power (kVAR), Apparent Power (kVA), and power factors.
    - .6 Meter to be capable of measuring individual and Total Harmonic Distortion (THD) up to 15 nth harmonic of all voltages and currents including neutral.
    - .7 Meter to be manufacturer's standard capable of withstanding surge and transient tests.
- .14 Shop Drawings:
  - .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.

- .2 Indicate on shop drawings.
  - .1 Floor anchoring method and foundation template.
  - .2 Dimensioned cable entry and exit locations.
  - .3 Dimensioned position and size of bus.
  - .4 Overall length, height, and depth.
  - .5 Dimensioned layout of internal and front panel mounted components.

## 2.2 SURGE PROTECTIVE DEVICES (SPDS)

- .1 Designed, manufactured, and tested in accordance with UL 1449.
- .2 Integrated into electrical distribution equipment wherever possible.
- .3 The SPD shall be compliant with the Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).
- .4 Unit Operating Voltage (UOV): As indicated on drawings.
- .5 Maximum Continuous Operating Voltage (MCOV): not less than 125% of nominal system voltage.
- .6 The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs).
- .7 Protective Modes - The SPD must protect all modes of the electrical system being utilized as indicated in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	Yes	Yes	Yes	Yes
Delta	N/A	N/A	N/A	N/A
Single Split Phase	Yes	Yes	Yes	Yes
High Leg Delta	Yes	Yes	Yes	Yes

- .8 Nominal Discharge Current (In): minimum 20 kA.
- .9 Voltage Protection Rating (VPR): minimum VPR as follows:
 

Modes	208/120	480/277	600/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000
- .10 Shall be maintenance free and without replaceable modules, fuses, etc.
- .11 The surge current shall be equally distributed to all MOV components. The surge suppression platform must provide equal impedance paths to each matched MOV.
- .12 Shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation shall be up to 50 dB from 10 kHz to 100 MHz.
- .13 Monitoring Diagnostics:
  - .1 Protection Status Indicators:
    - .1 For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode.
    - .2 For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

- .3 The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes.
- .2 Remote Status Monitor - The SPD shall include Form C dry contacts (one N.O. and one N.C.) for remote annunciation of its status. Both the N.O. and N.C. contacts shall change state under any fault condition.
- .3 Audible Alarm and Silence Button - The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
- .4 Surge Counter - The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of  $50 \pm 20A$  occurs. A reset pushbutton shall allow the surge counter to be zeroed. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- .14 All SPDs shall be tested and demonstrate suitability for application within IEEE C62.41 Category C, B, and A environments.
- .15 Surge Current Capacity - The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:  
Minimum surge current capacity based on IEEE C62.41 location category:

Category	Application	Per Phase	Per Mode
C	Service Entrance Location (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs Busway)	120 kA	60 kA

- .16 SPD Type - all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

## 2.3 SECONDARY LIGHTNING ARRESTORS

- .1 Arrestor component parts: to CAN/CSA C233.1.
- .2 Arrestor characteristics:
  - .1 System voltage: 600/347.
  - .2 Rated voltage of arrester: 650V.
  - .3 Indoor type.
- .3 Install arresters and connect to secondary bus and ground bus.

## 2.4 METER SOCKET

- .1 Weatherproof meter sockets to suit supply authority meter c/w automatic current transformer shorting devices when meter removed 7 jaw, king size type.

## **2.5 METER CABINET**

- .1 Sheet steel CSA enclosure to suit supply authority C.T.'s & P.T.'s. Confirm size with supply authority.

## **2.6 DISCONNECT SWITCHES**

- .1 Heavy duty fusible and non-fusible, disconnect switch in CSA Enclosure I, size as indicated. CSA 3 Enclosure in outdoor or damp locations. Arc quencher and visible blade copper terminals.
- .2 Provision for padlocking in on-off switch position.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated.
- .5 Quick make, quick break type.

## **2.7 PANELBOARDS**

- .1 Install circuit breakers in panelboards before shipment.
- .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .3 250 and 600 V panelboards: bus and breakers rated for interrupting capacity as indicated in coordination study.
- .4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated. Copper bus.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Mains: suitable for bolt-on breakers, copper. Neutral and ground: copper.
- .8 Panel must be capable of accepting 3 pole breakers anywhere in panel.
- .9 Trim with concealed front bolts and hinges. 14 gauge up to 24 circuit, 12 gauge for larger panels.
- .10 Distribution panels shall be minimum 12 gauge construction.

## **2.8 MOULDED CASE CIRCUIT BREAKERS**

- .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 Circuit breakers with interchangeable trips as indicated.
- .4 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.
- .5 Provide Kirk-key locks on main breaker and breaker for the future generator in main switchboard.

## **2.9 SOLID STATE TRIP BREAKERS**

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

- .2 Optional features include:
  - .1 Shunt trip.
  - .2 Motor-operated mechanism c/w time delay unit.
  - .3 On-off locking device.
  - .4 Handle mechanism.
  - .5 Provide remote off control on main breaker.

## 2.10 FUSES

- .1 Fuse type references L1, L2, J1, R1 etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.
- .3 HRC-L fuses (formerly Class L).
  - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type L2, fast acting.
- .4 HRCI-J fuses (formerly Class J).
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
- .5 HRCI-R fuses (formerly Class R). For UL 1 fuses, peak let-through current and  $I^2t$  values not to exceed limits of UL 248, table 10.2.
  - .1 Type R1, (UL 1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL 1 maximum let-through limits.
  - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .3 Type R3, (UL 1), fast acting Class R, to meet UL 1 maximum let-through limits.

## 2.11 CONTACTORS

- .1 Contactors: to EEMAC No. 1CS.
- .2 Mechanically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Breaker combination contactor as indicated.
- .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in CSA Enclosure 2 (sprinklerproof) unless otherwise indicated.
- .6 Include following options in cover:
  - .1 Red indicating lamp for 'OFF', green for 'ON'.
  - .2 Hand-Off-Auto selector switch.
- .7 Control transformer: 600-120V, 50 VA minimum, in contactor enclosure.



## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Confirm equipment locations and sizes in electrical and mechanical rooms to ensure equipment will fit.
- .2 Secure floor and wall mounted equipment plumb and square.
- .3 Connect supply and load feeders from all equipment.
- .4 Check trip unit and fuse ratings to match those recommended in coordination study.
- .5 Check factory made connections for secureness and electrical continuity.
- .6 Provide isolation pads for floor mounted transformers.
- .7 Install fuses as required.
- .8 Ensure adequate clearances around equipment for ventilation requirements and code.
- .9 Ground secondary neutral of dry type transformers to primary source ground system.
- .10 Install panelboards plumb and true and make connections.
- .11 Provide auxiliary equipment and connections as required.
- .12 Install surge suppression equipment integral to electrical equipment. Where SPD must be installed external to assembly, lead length between the breaker and suppressor shall be kept as short as possible. Any excess conductor length shall be trimmed in order to minimize let-through voltage.
- .13 Test surge suppression equipment in accordance with UL 1449 & provide test results.
- .14 Provide typed, dated panel directory for each affected panelboard on this project.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.

### **1.3 EQUIPMENT**

- .1 Receptacle and switch devices shall be of a single manufacturer.
- .2 Acceptable manufacturers: Hubbell, Arrow Hart, Pass and Seymour, Leviton, Bryant.

### **1.4 REFERENCES**

- .1 Canadian Standards Association (CSA).

## **PART 2 PRODUCTS**

### **2.1 SWITCHES**

- .1 15 or 20 A, 120 V, or 347 V single pole, double pole, three-way, four-way switches as required. Low voltage switches 0-10V as indicated on drawings.
- .2 Manually-operated general purpose ac switches with following features:
  - .1 Silver alloy contacts.
  - .2 Urea or melamine molding for parts subject to carbon tracking.
  - .3 Suitable for back and side wiring.
  - .4 White toggle.
  - .5 Specification Grade.
- .3 Switches equal to the following:
  - .1 120 V, 15 A - Cristal.
  - .2 120 V, 15 A, 3-way - Cristal.
  - .3 120 V, 15 A, 4-way - Cristal.
  - .4 347 V, 15 A - Cristal.
  - .5 347 V, 20 A - Cristal.
  - .6 347 V, 20 A, 3-way - Cristal.
  - .7 Wall mounted occupancy switches, white, 1500 W rated equal to Philips c/w relay pack.
  - .8 Ceiling mounted occupancy sensors:
    - .1 Hallway (narrow).
    - .2 Area (wide).
  - .9 Low voltage switches and occupancy sensors shall be Philips - dynalite.

## **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA type, voltage, ampacity, phase as indicated, with following features:
  - .1 White urea molded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.
  - .6 Ground fault interrupter 5 mA, Class 'A' type all areas of Grade 8 and below grades.
  - .7 Surge suppressor type where indicated.
  - .8 Child safety receptacles where indicated.
  - .9 Provide receptacles equal to the following:
    - .1 15 A, 120 V, - Hubbell #5262.
    - .2 20 A, 120 V, - Hubbell #6331.
    - .3 20 A, 250 V, - Hubbell #6391.
    - .4 30 A, 125/250 V (Dryer) - Hubbell #9430-P.
    - .5 50 A, 125/250 V (Range) - Hubbell #9450-P.
    - .6 Isolated ground - Hubbell #IG-5262.
    - .7 Ground fault - Hubbell #GF5252-W.
    - .8 Safety receptacles - Hubbell #SG-62-HI.
    - .9 Surge suppressor - Hubbell #5252-S.
  - .10 Specification grade.

## **2.3 CLOCK OUTLETS**

- .1 Special wiring devices:
  - .1 Clock hanger outlets, 15 A, 125 V, 3 wire, grounding type, suitable for No. 10 AWG for installation in flush outlet box.

## **2.4 DIMMER SWITCHES**

- .1 Low voltage 0-10V unless otherwise specified.

## **2.5 COVER PLATES**

- .1 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .2 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .3 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .5 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

## **2.6 TELEPHONE, DATA & CABLE TV OUTLET**

- .1 Provide 100 x 100 mm outlet box c/w plaster ring and 21 mm EMT to accessible ceiling space at indicated locations.
- .2 Coverplates to be provided by respective companies or as specified in other sections.
- .3 Provide plastic over plate on all unused outlets.

## **2.7 TIME CLOCK**

- .1 Microprocessor based-equal to Paragon #EC72D/120 V.

## **2.8 HAND DRYERS AUTOMATIC**

- .1 Surface mounted, w/ push button and adjustable shutoff, 120 V, 1Ø, 1800 Watts, tamper resistant, colour as per Architect, equal to Nova 5. Stainless steel. Cast aluminum Provide stainless steel backplate.

# **PART 3 EXECUTION**

## **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
  - .4 Install low voltage switches c/w low voltage cabling and zone labels.
- .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 specified in Section 26 05 00 - Electrical General Requirements or as indicated.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Coverplates:
  - .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 coverplates meant for flush outlet boxes on surface-mounted boxes.
- .4 Provide weatherproof devices as indicated.
- .5 Install service poles to manufacturers recommendations and secure to ceiling and floor. Make electrical connections and test.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA).
- .2 International Electrotechnical Commission (IEC)
  - .1 IEC 60947-4-1, Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.
  - .7 Name of load to be controlled.
  - .8 M.C.C. - mounting, anchoring, layout, incoming and outgoing cables, capacity, volts, phase, wiring diagrams.

### **1.4 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 26 05 00 - Electrical General Requirements.
- .2 Include operation and maintenance data for each type and style of starter.

### **1.5 MAINTENANCE MATERIALS**

- .1 Provide listed spare parts for each different size and type of starter:
  - .1 3 contacts, stationary.
  - .2 3 contacts, movable.
  - .3 1 contact, auxiliary.
  - .4 1 control transformer.
  - .5 1 operating coil.
  - .6 2 fuses.
  - .7 10% indicating lamp bulbs used.

## **1.6 RELATED WORK**

- .1 Refer to shop drawings of other divisions, especially Div. 20, 21, 22, 23 & 25 for exact characteristics of loads to be controlled. Notify Engineer of any changes prior to installation. Ensure starters are suitable for load to be controlled.
- .2 Coordinate with Div. 20, 21, 22, 23 & 25 for control function requirements of the building automation system, and/or monitoring functions. Notify engineer of any discrepancies in requirements.

## **1.7 ACCEPTABLE MANUFACTURERS**

- .1 Motor starters, controls, and centres to be of a single manufacturer.
- .2 Acceptable manufacturers: Allen Bradley, Siemens, Westinghouse, Klockner-Moeller, Square D, Cutler-Hammer, G.E.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category. Half sized starters not acceptable.

### **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 Switching mechanism, quick make, and break.
  - .2 Overload heaters, manual reset, trip indicating handle.
  - .3 CSA certified as a disconnecting means.
- .2 Accessories:
  - .1 Toggle or H.O.A. switch heavy duty oil tight labelled as indicated.
  - .2 Indicating light: heavy duty oil tight type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
  - .4 Keyed where indicated.
- .3 All starters in common areas to be flush mounted. Surface mount in services 1200 MS.

### **2.3 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Magnetic and combination magnetic starters of size, type, rating, and CSA 1 enclosure type with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number i marking identical to diagram.
- .2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:
  - .1 Locking in "OFF" position with up to 2 padlocks.
  - .2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 H.O.A. selector switches: heavy duty oil tight labelled as indicated.

.2 Indicating lights: heavy duty oil tight type and colour as indicated.

.3 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

.4 3 Phase starters to include loss of phase protection relay. Relay shall reset automatically once phases have returned to normal.

.5 Auxiliary control devices as required.

## 2.4 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

## 2.5 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Electrical General Requirements.

## 2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements.

## 2.7 REMOTE CONTROL STATIONS

.1 Heavy duty type c/w pilot lights and labels, in flush box c/w coverplate.

## 2.8 EMERGENCY PUSHBUTTON STATION

.1 Heavy duty, key reset, pilot lights. 100 m x 100 m box.

# PART 3 EXECUTION

## 3.1 INSTALLATION

.1 Install starters, connect power, and control wiring as required.

.2 Ensure correct fuses and overload devices elements installed.

## 3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

.5 Submit the following information for each motor controlled, with manuals:

.1 Motor nameplate date and manufacturer.

- .2 Actual measured full load current.
- .3 Overload device, rating, and setting.
- .6 Verify motor rotation prior to acceptance.
- .7 Secure motor control centre rigid and plumb on channel bases, make power and control connections and test individual starters as above.

**END OF SECTION**



## **PART 1 GENERAL**

### **1.1 GENERAL**

- .1 The following shall be the full responsibility of the Solar PV Contractor (Contractor):
  - .1 Solar PV system design, design approval, supply, installation and connection to School Electrical Service and Hydro One Electrical Grid;
  - .2 Coordination of system design, metering, and connections with Hydro One and Electrical Safety Authority;
  - .3 Coordination of system design, load and attachment with General Contractor and Structural Supplier.
  - .4 Submission of drawings and documents, and all costs associated with these submissions, to the following for review and approval:
    - .1 Hydro One;
    - .2 ESA Plans Examination;
    - .3 Ontario Power Authority;
    - .4 All other regulating agencies for Solar PV systems.

### **1.2 APPLICABLE CODES AND STANDARDS:**

- .1 Ontario Electrical Safety Code
- .2 Solar Photovoltaic (PV) Systems Certified (SPVC) Certification (NOC 7241)
- .3 Underwriters Laboratories (UL)
  - .1 UL 1703 – “Flat-Plate Photovoltaic Modules and Panels”
  - .2 UL 1741 – “Standard for Static Inverters and Charge Controllers for use in Photovoltaic Systems”
- .4 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE 929-2000 – “Recommended Practice for Utility Interface of Photovoltaic Systems”
  - .2 IEEE 1262 “Recommended Practice for Qualifications of Photovoltaic Modules”
- .5 All applicable State Building Codes and requirements
- .6 Cal OSHA § 2588 (Title 8, Subchapter 5, Group 1, Article 88) Solar Photovoltaic Systems

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with General Requirements and Submittals.
- .2 Provide design, layout, drawings, and calculations for complete Solar PV System, sealed by Professional Engineer in the Province of Ontario, for the following:
  - .1 Roof Layout;
  - .2 Electrical Single Line Diagram;
  - .3 Structural support and attachment;
- .3 Support, connections and seismic restraint of all Solar PV fixtures, equipment, and conduit, including, but not limited to:
  - .1 Solar Panels;

- .2 Support Structure
- .3 Service and distribution equipment;
- .4 Typical conduit and cable supporting system.
- .4 Following project completion, signing Engineer shall provide a letter of final site review.
- .5 Contractor shall carry the cost of all Engineering, including site reviews, design and drawing preparation.
- .6 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for solar equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .2 Submit:
    - .1 Functional description of equipment.
    - .2 Technical data sheets of all devices.
    - .3 Device location plans and cable lists.
- .7 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Submit 1 sample of each solar PV panel complete with housing, brackets, and mounting hardware.
- .8 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Submit Product Safety Certificates.
- .9 Test and Evaluation Reports:
  - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .10 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .11 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data:
  - .1 Submit maintenance data for incorporation into manuals. Include the following:
    - .1 System configuration and equipment physical layout.
    - .2 Functional description of equipment.
    - .3 Manufacturer's Instructions for operation, adjustment, and cleaning.
    - .4 Illustrations and diagrams to supplement procedures.

#### **1.5 WARRANTY**

- .1 Project Warranty: 2 year from Substantial Completion.

- .2 Extended warranty period must include warranty against meeting specified performance requirements, for specified time period.
- .3 Manufacturer's Warranty: Submit, for Departmental Representative's and Consultant's acceptance, manufacturer's standard warranty document executed by authorized company official.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 It is the responsibility of the Solar PV Contractor to ensure that the system has all equipment, required to furnish and install a fully operational system. Minimum 36 kW (AC). Array size 45kW (DC).

### **2.2 ELECTRICAL**

- .1 Power provided must be compatible with the onsite distribution system.
- .2 Power capacity should be measured at the inverter AC output using the PVUSA Test Conditions (PTC), i.e. 1,000 Watts/m at 220° C ambient temperature and wind speed of 1 m/s.
- .3 The system must include all the hardware and software needed for the solar PV.
- .4 All systems must be installed in accordance with all applicable requirements of local electrical codes and the National Electrical Code (NEC), including but not limited to Article 690, "Solar Photovoltaic Systems" and Article 705 – "Interconnected Electrical Power Production Sources".
- .5 Systems must be designed and installed using UL or ETL listed components, including mounting systems.
- .6 All Balance of Systems (wiring, component, wiring, conduits, and connections) must be suited for conditions for which they are to be installed.
- .7 Interconnection must be acceptable to the distribution utility. Supplier will assist the UCDSB in preparing and submitting appropriate interconnection agreements with the local utility company. This shall be done at no cost or liability to the UCDSB.
- .8 System shall be supplied with lockable DC and AC disconnect switches.
- .9 The AC panel connected to the PV system, as well as the main switchboard and all branch circuits feed from the same circuit breaker as the PV system shall be clearly labeled with NEC compliant labels indicating the possible danger from alternate power sources.
- .10 Modules, inverters, balance of system equipment, and metering and measurement equipment all must comply with Hydro One, Electrical Safety Authority.

### **2.3 PV MODULES**

- .1 System must comply with IEEE 1262 "Recommended Practice for Qualifications of Photovoltaic Modules".
- .2 Modules must be certified to UL 1703 – "Flat-Plate Photovoltaic Modules and Panels".

### **2.4 INVERTERS**

- .1 Inverters must comply with the following requirements:
  - .1 IEEE 929-2000 – "Recommended Practice for Utility Interface of Photovoltaic Systems"
  - .2 UL 1741 – "Standard for Static Inverters and Charge Controllers for use in Photovoltaic Systems"

- .3 Listed on the CEC list of eligible inverters
- .2 Inverters shall be non-islanding type designed to shut down on loss of utility power.
- .3 Inverters shall be installed in all-weather enclosures (NEMA 4 or 3R) suitable for exterior location.
- .4 Inverters shall be located in an easily accessible, weather-protected area, and not be subject to direct rain or sun, preferably located in-doors.
- .5 As far as practical, the AC output of all inverters located in one building shall be connected to the same distribution panel.

## **2.5 METERS**

- .1 Each branch feeder dedicated to an inverter, or groups of inverters shall have revenue class metering per FDG 33 71 73.33.
- .2 Meters shall be Schneider Electric ION 7330 or Hydro One approved equal.
- .3 A conduit for circuits shall be installed from the PV Meter to the building main switchboard, near the main utility meter.

## **2.6 STRUCTURAL REQUIREMENTS**

- .1 All structures, including array structures, shall be designed to resist dead load, live load, plus wind and seismic loads to the geographic area.
- .2 PV systems must be able to withstand the following:
  - .1 Wind speeds of at least 95 mph.
  - .2 Seismic Hazard Level for area of work.
- .3 Thermal loads caused by fluctuations of component and ambient temperatures must be combined with all the above load combinations.
- .4 All structural components, including array structures, shall be designed in a manner commensurate with attaining a minimum 30 year design life. Particular attention shall be given to the prevention of corrosion at the connections between dissimilar metals.
- .5 The structural design should provide for easy and cost-effective repair or replacement of the roof.
- .6 Refer to structural specifications and drawings for detailed structural scope of work.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Prior to installation, all design drawings and specifications shall be submitted to and approved by the Engineer.
- .2 Installer shall coordinate work with UCDSB Project Manager and General Contractor to minimize effect on building construction or operations.
- .3 All shutdowns and clearances of building electrical system shall follow UCDSB policies.
- .4 Installer is responsible for properly sealing all roof and wall penetrations associated with PV system.
- .5 Installer is responsible for removing all unused material and restoring the location to acceptable condition.

### **3.2 ACCEPTANCE TESTING**

- .1 A performance test shall be used to verify system operation. Supplier shall submit an acceptance test procedure for UCDSB approval prior to test performance.
- .2 Acceptance testing shall be done near mid-day in sunny conditions.
- .3 Acceptance testing shall verify that all components are functioning correctly, and the system will produce at least 90% of the expected output for solar conditions at the time of the test.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 26 05 00 - Electrical General Requirements.

### **1.3 REFERENCES**

- .1 Canadian Standards Association (CSA).
  - .1 CSA C22.2 No. 141, Emergency Lighting Equipment.
  - .2 CSA C860, Performance of Internally Lighted Exit Signs, Includes Update No. 1 (2011).
- .2 Electrical Safety Authority (ESA)
- .3 International Organization for Standardization (ISO)
  - .1 ISO 3864-1, Graphical symbols - Safety Colours and Safety Signs - Part 1: Design Principles for Safety Signs and Safety Markings.
  - .2 ISO 7010, Graphical Symbols - Safety Colours and Safety Signs - Registered Safety Signs.

## **PART 2 PRODUCTS**

### **2.1 LUMINAIRES**

- .1 Provide light fixtures as per fixture schedule, c/w drivers, lamps, and mounting accessories.

### **2.2 EXIT LIGHTS**

- .1 Exit lights: to CSA C22.2 No. 141 and CSA C860.
- .2 Housing: extruded aluminum, brushed aluminum finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: LED with 25-year rated life.
- .5 Pictogram: aluminum frame, opal diffuser panel, pictogram panel with multiple films for direction selection, and clear protective panel. Pictogram panel shall consist of green pictogram and white graphic symbol meeting the visibility specifications referred to in ISO 3864-1 and conform to the dimensions indicated in ISO 7010.
- .6 Suitable for 120V normal supply and 12VDC emergency supply.
- .7 Die cast mounting bracket for wall, ceiling, or end mounting as indicated.
- .8 Provide circuit labels at all exit signs.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.

- .2 Provide sufficient cable length and access panels, to provide access to wiring connections in hard ceiling areas, to the inspection authorities requirements.
- .3 Install light fixtures to manufacturers recommendations.
- .4 Connect fixtures to indicated circuits and connect exit lights to emergency battery units.
- .5 Verify and coordinate location of light fixtures on site with other trades to verify clearances at indicated locations prior to installation.

### **3.2 LUMINAIRE SUPPORTS**

- .1 For recessed or surface mounted lighting in suspended ceiling installations, support luminaires independently from ceiling, by means of a minimum of two chain hangers bolted to diagonal corners of the fixture body and secured to building structure in accordance with ESA, Section 26 05 00 - Electrical General Requirements and Section 26 05 05 - Seismic Restraint Systems (SRS).
- .2 For gymnasium or other type of high-bay light fixtures, provide a safety cable between fixture housing and lens or refractor.

### **3.3 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.

### **3.4 POLE MOUNTED FIXTURES**

- .1 Division 26 is responsible for providing anchor bolts and templates to those Divisions who are providing concrete bases.

### **3.5 TESTING**

- .1 Verify operation of lighting systems, and controls.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

### **1.3 WARRANTY**

- .1 For batteries, the 12 months warranty period is extended to 120 months, with a no-charge replacement during the first 5 years and a pro-rate charge on the second 5 years.

## **PART 2 PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Supply voltage: 347V or 120V, ac.
- .2 Output voltage: 12 V dc.
- .3 Operating time: 30 minutes at rated load c/w 10% spare capacity.
- .4 Battery: sealed, maintenance free, long life.
- .5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .6 Solid state transfer circuit.
- .7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .8 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .9 Lamp heads:
  - .1 Integral on unit or remote: 345° horizontal and 180° vertical adjustment, lamp type: LED, 12V MR16, 100 hr. die cast head, glare free, sealed beam.
  - .2 Recessed ceiling mounted: fully recessed housing, par 36 lamp, 12V, 50W.
- .10 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .11 Finish: White.
- .12 Auxiliary equipment:
  - .1 Test switch.
  - .2 AC input and dc output terminal blocks inside cabinet.
  - .3 Bracket.
  - .4 Cord and single twist-lock plug connection for AC.



- .5 Ammeter, voltmeter, low-volts disconnect, time delay relay, DC terminal blocks inside enclosure.
- .6 RFI suppressors.
- .7 Self diagnosis circuitry.

## **2.2 WIRING OF REMOTE HEADS**

- .1 Conduit: type EMT.
- .2 Conductors: RW-90 type to Section 26 05 21 - Conduit and Wire - sized in accordance with manufacturer's recommendations, minimum #10 AWG. Larger wire sizes to account for voltage drop.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.
- .4 Measure voltage at most remote light heads and verify voltage drop is not greater than 3%.
- .5 Wire exit lights on normal and 12V dc wiring.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 SHOP DRAWINGS**

- .1 Submit detailed product literature.
- .2 Submit detailed block diagram of individual components and location of complete integrated system complete with wiring diagram.

### **1.3 OPERATIONS MANUALS**

- .1 Submit on hard copy and one CD version of the operations manual describing specific operating functions of entire system and components.

### **1.4 STANDARD OF ACCEPTANCE**

- .1 This specification has been compiled around the TORCHTECH system with appropriate part numbers identified.
- .2 PA system contractor shall have minimum 10 years of experience in similar facilities. General contractor shall carry PA system quote in tender. General contractor shall manage PA system contractor on site.

### **1.5 SYSTEM OPERATIONAL CHARACTERISTICS**

- .1 Integrated Intercom/Public Address and telephone system to be complete with telephone interface. A minimum of four (4) links to be available to allow for transferring of an exterior call to a classroom handset. Operation shall allow for someone entering a specific code from a classroom handset to be able to access an outside line.
- .2 The various components are to form an integrated communications system which provides for the following minimum basic functions:
  - .1 Intercom and Public Address System:
    - .1 Direct dialling, two-way communications between all locations equipped with Administrative Control Consoles, Staff Station, or classroom station.
    - .2 Automatic gain control on intercom speech to assure constant speech level.
    - .3 Facilities for automatically sounding a warning tone over any loudspeaker selected for two-way communication to alert the classroom teacher to the call and to prevent unauthorized monitoring.
    - .4 Facilities for the distribution of emergency announcements from the administrative control console to all locations.
    - .5 Facilities for the distribution of paging announcements from administrative control console, or administrative telephone, on an all-call basis, or a preselected zone basis or multiple zone basis to any of the 8 paging zones. Speaker assignment to any of the 8 zones shall be user programmable from the administrative control console. The paging zones shall be independent of the time tone and audio program distribution zones. Systems sharing zones for both paging and time tone shall not be acceptable.

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- .6 Capability of distributing audio program sources from the control console. Inputs shall be provided for low impedance microphones, AM/FM tuner, tape player, and CD Player. Program distribution shall be accomplished on an ALL ROOMS basis, SELECTED ROOMS basis or an INDIVIDUAL ROOM as programmed from the console. The program source shall be capable of being located remotely from the central electronics so that the customer does not have to go to the communications closet to set up the program.
- .7 Facilities for the automatic distribution of user programmable, class change time signals to all areas activated by a self contained, 512 event programmable clock. Time signals shall be user programmable to any of the 8 available time zones. All time signal programming shall be accomplished from the control console. Eight-time schedules shall be provided. The time zones shall be independent of the paging and audio program zones. Systems sharing the same zone assignment for both paging and time zones shall not be acceptable.
- .8 Capabilities for user programming of alphanumeric architectural room numbers from the control console.
- .9 System shall support alphanumeric readout of incoming calls by room number, priority at control console.
- .10 Facilities for up to 6 calls in priority levels. Each classroom shall be capable of being assigned to any one or more priority levels from the control console, allowing for emergency call ins from classrooms.
- .11 Facilities for displaying incoming calls to a priority basis. Incoming calls will be sequentially displayed in order of priority. It shall be possible to review all calls stored in memory in the order received.
- .12 Facilities to place an incoming call on hold.
- .13 Capabilities of interfacing with Gym Sound System, providing automatic bridging of the local system, whenever it is accessed from the console. The system shall automatically track the local system, controlling the audio program as programmed from the control console.
- .14 The system shall provide for interface to the building PABX telephone system. The System shall be capable of being accessed by the telephone system to;
  - .1 Initiate paging announcements from any telephone on the customer's system to all or 8 selective areas of the building.
  - .2 Establish 2 way hands-free open voice intercom communications between any intercom speaker.
- .15 The system will integrate to a school supplied VOIP phone system. The contractor shall coordinate with the VOIP supplier (ShoreTel) to ensure that the equipment required to meet these integration functions is supplied. Any gateways or analog CO converters that are not proprietary to the VOIP system are to be supplied by the intercom contractor and must integrate to the following SIP specifications are supported by ShoreTel:
  - .1 RFC 3261 Session Initiation Protocol (SIP)
  - .2 RFC 2833 In-band DTMF/Out-of-band DTMF
  - .3 RFC 3515 SIP Refer
  - .4 RFC 3550 1889 Transport protocol for real-time (RTP/ RTCP) applications

- .5 RFC 3551 RTP Profile for Audio and Video Conferences with Minimal Control
- .6 RFC 2327 Session Description Protocol (SDP)
- .7 RFC 2396 Uniform Resource Identifiers (URIs)
- .8 RFC 2806 URLs for Telephone Calls
- .9 RFC 3966 URIs for Telephone Calls
- .10 RFC 2976 SIP Info Method
- .11 RFC 3264 Offer/answer
- .12 RFC 3842 Message waiting indication reception
- .13 RFC 3265 Subscription for MWI events
- .14 RFC 3891 The Session Initiation Protocol (SIP) "Replaces" Header
- .15 RFC 4208 Session Timers in the Session Initiation Protocol
- .2 Distribution Channels:
  - .1 The System shall provide true dual, simultaneous open voice global speech paths MULTIPLE SPEECH or dual program distribution channels between Administrative Control Console and Classroom stations.
  - .2 The speech paths shall be true dual, simultaneous open voice, unrestricted.
  - .3 A minimum of two Audio Channels shall be provided for intercom communications and/or audio program distribution.
  - .4 Any two, Administrative Control Consoles, Administrative Telephones, or staff phones shall be capable of independent, simultaneous communications with any two classrooms via the classroom loudspeaker. There shall be no restrictions as to a single path per group of classrooms.
- .3 Telephone Communications:
  - .1 The System shall provide for full duplex, private telephone communications between staff telephones, classroom stations, or Administrative Control Console.
  - .2 Provide at least 4 simultaneous, full duplex private telephone links per group of 25 staff or classroom telephones. The system shall be capable of modular expansion of 4 links per 25 staff telephones. The system shall also be equipped with 4 global links in addition to the 4 links per group of 25 telephones.
  - .3 The system shall be capable of being expanded to accommodate 125 staff and classroom telephones and provide 24 duplex private telephone links, plus 100% trunking for all administrative telephones.
  - .4 Staff and classroom telephones shall be carbon type with built in networks.
  - .5 The system shall provide for direct dialling, private, 2 way, duplex, telephone communications from all locations equipped with a DTMF telephone, to locations equipped with a non dial telephone, and associated speaker or an Administrative Control Console. Any control console or DTMF telephone in the system shall be capable of direct dialling any other control console, DTMF telephone or non dial phone in the system.

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- .6 Classroom stations equipped with DTMF phones as described above shall be capable of:
  - .1 Selectively calling intercom speakers and establishing open voice communications.
  - .2 Selectively initiating Zone and All Call paging announcements.
  - .3 Make and receive outside calls.
  - .4 Ability to group hunt for available interface lines.
  - .5 These phones capable of being restricted from any of above features.
- .4 Time Control System:
  - .1 Provide a Time Control System as an integral part of the System. The time control system shall be capable of controlling class change signals to all speakers.
  - .2 Battery back up shall be provided by the System, ensuring correct timekeeping of the internal master clock during failure.
  - .3 The integrated Master Clock/Controller shall incorporate a built-in calendar and incorporate the capability to program in all holidays.
  - .4 The integrated Master Clock/Controller shall provide a 10 year battery back-up real time clock.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Communications Conductors:
  - .1 22 gauge stranded twisted pair, shielded, copper drain wire, PVC insulation, and FT-6 rated jacket.
  - .2 #18 AWG copper, FT-6 rated for speakers.
  - .3 All P.A. system cabling to be shielded, FT-6 rated.

### **2.2 CENTRAL CONTROL UNIT (CCU)**

- .1 Each Central Control Unit shall be a Bogen Multcom2000 or approved alternate, specifically designed for use with the Administrative Control Console and shall have provisions for expanding the system to a total of 240 stations, which allows any combination and quantity of Administrative Consoles, classroom intercom, and call stations. Shall be located in Main PA Equipment Cabinets, see item 2.3.
- .2 The CCU shall be complete with the circuitry to accomplish all functions for full duplex private telephone communications for staff telephones, CO telephone links.
- .3 The CCU shall provide a 0 dBm signal for connections to an external amplifier for distribution of program audio, time signals, and paging announcements.

### **2.3 MAIN PA EQUIPMENT CABINET**

- .1 The cabinet shall be a metal upright type with louvres and locking rear door. The unit shall contain up to 77" of mounting space for accommodating all equipment specified. The cabinet shall have internal mounting rails and power strip. Proper size shall be determined by the manufacture to accommodate all of their equipment with 20% expansion capability.

- .2 Install main equipment cabinets and associated components in the following locations:

- .1 PA1 - This system is to be located in IT room 103.

## **2.4 AUXILIARY INPUT COMPONENTS**

- .1 The AM/FM Tuner shall be a Yamaha model TX-492 or approved equal. The unit shall be equipped with an LED tuning display, front panel indicators, internal clock, base, treble, and volume controls. The AM section shall be tunable over a range of 525 to 1620 kHz. The FM section shall be tunable over a range of 88 to 108 MHz.
- .2 Provide USB connectivity and Bluetooth feature. Ipod audio interface: Provide one (1) 3.5mm stereo headphone patch cord to allow easy connection to any Ipod model. One (1) 1-2U rack mounted shelf with non-slip, non-conductive, pad type surface, installed for easy access approx. 1200mm AFF. Identify patch cord as "Ipod". Provide surge protection devices for all powered components. All units shall be capable of installation into the specified cabinet or remotely if desired.
- .3 Ipod audio interface: Provide one (1) 3.5mm stereo headphone patch cord to allow easy connection to any Ipod model. One (1) 1-2U rack mounted shelf with non-slip, non-conductive, pad type surface, installed for easy access approx. 1200 mm AFF. Identify patch cord as "Ipod"
- .4 The auxiliary input components shall be installed in closed wall mounted metal rack cabinets with louvres and locking front doors. The cabinet shall have internal mounting rails and surge protected power strip. Proper size shall be determined by the manufacture to accommodate all of their equipment with 20% expansion capability.
- .5 Install auxiliary equipment cabinets and associated components in the following locations:
  - .1 AUX1 - This system is to be located in IT room 103.

## **2.5 POWER AMPLIFIERS**

- .1 Power amplifiers shall be capable of producing an audio output of 60, 125 or 250 watts RMS at less than 1% distortion and shall have a peak power output of over full wattage. They shall be designed to operate on a line voltage of 115 AC. Shall be located in Main PA Equipment Cabinets, see item 2.3.
- .2 Provide in sufficient quantity and power rating to provide two (4) distinct school paging zones, each controlled by the two (2) Central Control units (see item 1.1)
- .3 Each Central Control unit shall be equipped with one internal paging amplifier and one external paging amplifier.

## **2.6 ADMINISTRATIVE MASTER CONTROL CONSOLE**

- .1 High impact molded plastic enclosure, moisture proof faceplate, colour coded keys complete with appropriate labelling.
- .2 Telephone handset complete with retractable cord, built-in microphone, and speaker.
- .3 Display of calls by priority level, via 3 line x 16 character L.C.D. display.
- .4 Programmable functions including:
  - .1 Selection and distribution of program signals.
  - .2 Station assignment numbers.
  - .3 Call priority levels.
  - .4 Clock events and zones.
  - .5 Speaker zone assignments.

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- .6 Tone characteristics.
- .7 Access codes.
- .5 Paging by emergency all call, all call or individual and grouped zones.
- .6 Shall have the following features: Call forwarding, call on hold and DTMF dialling.
- .7 Shall be capable of three (3) distinct ring signals related to priority.
- .8 Install Administrative Master Consoles in the following locations:
  - .1 M1 - This master console is to be located in IT room 103.

## **2.7 CLASSROOM STATIONS**

- .1 Wall mounted 12 button DTMF handset with 4 function buttons and 3 priority dial buttons.
- .2 Ceiling mounted speaker in backbox.
- .3 Speakers to be talk-back type while handset still in holder.
- .4 Hook switch for handset to disconnect speaker for private conversation.

## **2.8 SPEAKERS**

- .1 Type 1:
  - .1 Ceiling or wall mounted as indicated.
  - .2 Diameter: 200 mm.
  - .3 Power: 10 Watts.
  - .4 Sensitivity: 95 dB with 1 Watt, 1 kHz at 1.2 m.
  - .5 Impedance: 8 Ohm.
  - .6 300 mm square, 100 mm deep backbox complete with baffle line matching transformer, no visible screws on cover.
- .2 Type 2 (Exterior Horn):
  - .1 Impedance: 8 Ohm.
  - .2 Line match transformer.
  - .3 100 degree dispersion.
  - .4 125 db at 1.2 m, 30 Watt input.
  - .5 High impact plastic.
  - .6 Stainless steel wire guard.

## **2.9 DOOR BUZZERS**

- .1 Door buzzer pushbutton, heavy duty type, illuminated, flush mounted under stainless steel cover.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 A single communications sub-contractor shall provide the wiring, equipment and connections of equipment outlined in this section.
- .2 Install system components to manufacturer's recommendations.

- .3 Make terminations on barrier terminals or push blocks.
- .4 Speakers in daycare area, community centre and auditorium shall be wired to school main P.A. system for emergency lockdown transmission only.
- .5 Install the hearing assistive system in gym sub pa rack in room 103.
- .6 Ensure that both Intercom systems are interconnected with each other, restrictively allowing any system to access all paging & Intercom functions of the other system.

### **3.2 TESTING**

- .1 Test complete system including intelligibility to the satisfaction of the Consultant.
- .2 Adjust equalization to permit maximum sound levels in Gymnasium and school systems without feedback or distortion.

### **3.3 PROGRAMMING**

- .1 Confirm room numbers with school board officials prior to programming.
- .2 Program and provide zones as per school board direction.

### **3.4 COMMISSIONING**

- .1 Carry out programming to Board's requirements with respect to dialling access.
- .2 Provide a minimum of 3 on site system operation, programming, troubleshooting and overview seminars to the school board's representatives and school operators.

**END OF SECTION**



## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Common Work Results for Electrical, all electrical sections, and all other disciplines related to the project.

### **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 26 05 00 - Common Work Results for Electrical.

### **1.3 MAINTENANCE MATERIALS**

- .1 Provide 12 spare batteries.

## **PART 2 PRODUCTS**

### **2.1 BATTERY POWERED CLOCKS**

- .1 1.5 volt D.C. "C" size battery to be included.
- .2 Arabic numerals, 12 hour faceplate.
- .3 Black trim, white faceplate, black numbers.
- .4 Hour, minute and second hands.
- .5 Quartz crystal movement.
- .6 12" diameter for all classrooms, corridors, and offices.
- .7 15" diameter complete with heavy duty protective plastic dome for Gymnasium and Lunch Room.
- .8 Equal to Edwards 2940 series.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install clocks were indicated and set time on all clocks at time of acceptance.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.
- .2 Provide sleeving as required.

### **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.

### **1.3 SCOPE**

- .1 Security system:
  - .1 It is intended that all security devices, wiring, terminations, and system programming provided by Protectron and shall be arranged by the General Contractor and/or prime electrical contractor.
- .2 Security wiring:
  - .1 All wiring shall be provided and installed by security contractor.
  - .2 All power to equipment power supplies by electrical trades. All power wiring to be in EMT conduit.
- .3 Provide relay c/w wiring and interface with night light circuit on Delta control system.

### **1.4 ACCEPTABLE SUPPLIER AND INSTALLER**

- .1 It is the responsibility of the General Contractor to obtain Tender quote from the preferred security contractor and submit one (1) combined Tender to include all services. It is also the responsibility of the General Contractor and/or prime electrical contractor to manage the sub-trade for performance on site and contractual management.

## **PART 2 PRODUCTS**

### **2.1 SECURITY EQUIPMENT**

- .1 Alarm panel - DSC Maxsys PC4020.
- .2 Alarm keypad - DSC PC4501.
- .3 Alarm expander - DSC PC4116.
- .4 Motion detector - Sentrol RCR50.
- .5 Door contact - Sentrol 1078.
- .6 Card access controller - Amag M21508DBC.
- .7 Card access 1 door panel - Amag EN1DBC.
- .8 Proximity card reader - Amag 690-CG (AWG #22, 6 conductors, shielded, stranded cable).
- .9 Keypad/prox reader - Amag 840-KP (AWG #22, 6 conductors, shielded, stranded cable).
- .10 Electric strike depends on the door and locking hardware but needs to be 12v dc (AWG #18, 2 conductors, stranded cable).

## **PART 3 EXECUTION**

### **3.1 WIRING REQUIREMENTS**

- .1 New control panel to:
  - .1 Keypad: 4-#22 AWG FT6 shielded cable.
  - .2 Motion detector in 8-#22 AWG FT6 or 4-#22 AWG FT6 power loop normally closed and 4-#22 AWG FT6 detection loop supervised circuits.
  - .3 Door sensor: 4-#22 AWG FT6.
  - .4 Other sensors: 4-#22 AWG FT6.
  - .5 Telephone connection: 4-#22 AWG to CA38A jack in EMT. (Fax line and 1st line).
  - .6 Main power input: 15A 120V by others (on emergency system, if possible).
  - .7 Relays c/w wiring to BAS panel for lighting and HVAC critical monitoring.
  - .8 GSM wireless transmitter's remote antenna shall be in EMT conduit provided by electrical contractor.
- .2 All wiring and cable runs shall have sufficient wire at each end to facilitate final hook-up of the devices, appliances, and other equipment. Specifically, provide 2 metre spare cable at each device, neatly spooled and identified "SECURITY (DEVICE NAME)" in big black letters/tags. Provide 1 meter spare at new control panel.

### **3.2 INSTALLATION**

- .1 Install wiring and components to manufacturer's instructions.
- .2 Test all wires for breaks and continuity, provide written certification and test results to Engineer.
- .3 All wiring runs, whether in conduit or otherwise, shall be clearly identified at each end.
- .4 All wiring to equipment and devices is to be home run back to new control panel, no splices will be accepted.
- .5 All cable and wiring runs shall be concealed within the building walls, ceilings, or other parts of the structure wherever practicable.
- .6 Cable runs shall be bundled and tie wrapped and attached to building structure by suitable supports every 1 m to allow easy access to ceiling space. Furnish identification of bundle (security) circa every 5 metres.
- .7 Cable loosely laid on ceiling system will NOT be accepted.
- .8 Cables to be run concealed in drywall, outlets to be flush mounted.
- .9 No exposed wiring will be accepted.
- .10 All connections between the security system and any other electrical or electronic network must be in compliance with all applicable codes, ordinances, and acceptable industry standards.
- .11 As-built record drawings shall be produced showing the exact final wiring configuration in the building, as installed, a copy of which shall be furnished to the designated Owner's representative prior to building commissioning.
- .12 Provide relay in security panel and connect to light fixtures on night light circuit in such a way that when building is armed all night lights in buildings are shutdown.

### **3.3 WARRANTY**

- .1 All wiring installed shall be guaranteed for 12 months, including all parts and labour.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 INCLUDES**

- .1 Video cameras.
- .2 Video handling.
- .3 Recording devices.
- .4 Transmission methods.

### **1.3 REFERENCE DOCUMENTS**

- .1 National Fire Protection Association (NFPA)
  - .1 NFPA 101, Life Safety Code.
- .2 Electronic Industries Association (EIA)
  - .1 REC 12749, Power Supplies.
  - .2 RS 16051, Sound Systems.

### **1.4 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1, Ontario Electrical Code, (26th edition) Safety Standard for Electrical Installations.
- .2 Telecommunications Industry Association (TIA)
  - .1 ANSI/TIA-568 Series — Commercial Building Telecommunications Cabling Standard
- .3 Underwriters Laboratories (UL)

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for video surveillance equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .2 Submit:
    - .1 Functional description of equipment.
    - .2 Technical data sheets of all devices.
    - .3 Device location plans and cable lists.
    - .4 Video camera surveillance chart.
    - .5 Video interconnection detail drawings.

- .3 Shop Drawings:
  - .1 Submit drawings.
  - .2 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details, and identification labelling scheme.
  - .3 Submit zone layout drawings indicating number and location of zones and areas covered.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Submit 1 sample of each camera selected complete with housing, brackets, and mounting hardware.
  - .4 Camera will be returned for incorporation into work as appropriate.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .1 Submit UL Product Safety Certificates.
  - .2 Submit verification Certificate that service company is "UL List alarm service company".
  - .3 Submit verification Certificate that monitoring facility is "UL Listed central station".
  - .4 Submit verification Certificate that video surveillance system is "Certified alarm system".
- .6 Test and Evaluation Reports:
  - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .7 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .8 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work.

## **1.6 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit maintenance data for incorporation into manuals. Include the following:
  - .1 System configuration and equipment physical layout.
  - .2 Functional description of equipment.
  - .3 Manufacturer's Instructions for operation, adjustment, and cleaning.
  - .4 Illustrations and diagrams to supplement procedures.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors or in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect video surveillance materials from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan.

## 1.8 WARRANTY

- .1 Project Warranty: 1 year from substantial completion.
  - .1 Extended warranty period must include warranty against meeting specified performance requirements, for specified time period.
  - .2 Manufacturer's Warranty: submit, for Departmental Representative's and Consultant's acceptance, manufacturer's standard warranty document executed by authorized company official.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- .1 Contractor is to supply, install and terminate these products unless noted otherwise.
- .2 Contractor to provide all cabling, conduit from device up inside wall to corridor ceiling space, boxes, etc. cabling to have green jacket. Cables to be FT6 (plenum rated) and supported minimum every 5' by J Hooks.
- .3 The video surveillance system will be a Exacq server type recorder with Northern or HikVision high resolution digital cameras, strategically located in hallway and outdoors. Refer to drawings for location.
  - .1 Outdoor Cameras-Northern or HikVision 4MP variable focus with vandal dome.
  - .2 Indoor Cameras-Northern or HikVision 4MP with vandal dome.
  - .3 Outdoor Camera Mounts Hikvision Wall bracket and pendant cap –Hikvision WMS, PC155.
  - .4 Ceiling mount boxes for Indoor Camera. Arlington Fixture Box mounting bar kit PN FS420SCL
  - .5 Network Video Recorder- Exacq PoE NVR with ??TB Hard Drive - see additional info.
  - .6 Port Modular Unloaded Patch Panel with Wall mount rack at It Rack Wiring Closet. Refer to drawing for location.
  - .7 2 Port Surface Boxes at camera locations
  - .8 CAT 6 wiring - Green
  - .9 26" LED Monitor and shelf to be provided by contractor for Exacq recorder.
- .4 The contractor will be responsible for the installation of green jacketed Cat-6 cabling with one cable home run from each device to the patch panel.
- .5 The contractor will be responsible for the installation of a green jacketed Cat-6 network drop from the IT data rack to the location of the recorder.
- .6 The contractor will be responsible to keep all cabling runs under 300'. The use of switches on each floor may be required to attain this.

- .7 The contractor will be responsible to provide and install a 450VA UPS (Surge and battery. For the ExacQ Recorder.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Contractor to supply and terminate end devices. Contractor to provide boxes, cable, conduits from device up inside wall to corridor ceiling space, etc. for complete system.
- .2 Install cable as indicated on riser diagram in corridor ceiling space.
- .3 The outdoor cameras will each require a flush mounted waterproof single gang electrical box and 21mm conduit. The conduit will run from the camera location to the nearest hallway ceiling space where wiring will continue. Provide coil of 2m at exterior camera locations.
- .4 The contractor will be responsible for supplying and installing all cable and required conduit for the system as described in this document and on the drawings. Within the building cable to be installed primarily in corridor ceiling space.
- .5 All camera cables will be homerun and labelled at both ends and run from each camera to the appropriate equipment.
- .6

### **3.2 WARRANTY**

- .1 Contractor shall provide a 1 year parts and labor warranty against defective workmanship and/or system component failure.

### **3.3 INSTALLATION REQUIREMENTS**

- .1 Install one Category 6+ UTP cable to each area location identified on drawings. Cable installation methods shall comply with the system manufacturers specifications, EIA/TIA 568 series requirements, and/or BICSI Installation Methods. Must be certified Cat6 end to end. Design intent is that no cabling run is over 90M.
- .2 Contractor to install one Category 6+ UTP cable from the IT data rack shown on the attached drawing to the NVR location. Contractor to contact UCDSB project manager for IP address.
- .3 When coming through ceiling spaces in wiring closets wiring sleeves must be installed. Suggest an 18" long piece of 2" EMT conduit.
- .4 No exposed cables are to be ran across ceilings or walls. All conduit to painted to match and routing to be approved by UCDSB prior to installation.
- .5 Where cables are ran above drop ceilings or ceiling with access above them J hooks must be utilized. Caddy CAT CM Product Line or equivalent spaced no more than 5' apart. J hooks to be utilized on all runs in ceiling access spaces. Cables are not to be ran through open web steel joists. Support off bottom of joist with j hook. J hooks are not to be attached to pencil rod.
- .6 All cables must be grouped together using Velcro straps to organize cabling at racks. No zip ties allowed anywhere.
- .7 A full set of as-built drawings shall be provided upon completion of the project. Drawings will show final location of the Equipment racks, elevation draws of equipment rack detail patch panel organization, location of each outlet and the associated ID number, any consolidation panels or pull boxes. Cable pathway must also be shown.
- .8 Contractor to provide report on testing results to prove certified Cat6.
- .9 Contractor responsible for their own ladders and lifts if required.



- .10 All firewalls are to be re-instated using Hilti Fire Stop Caulking FS ONE #259579
- .11 School floorplans with data closet location have been attached for reference.
- .12 Switches can be located in the same rooms as the IT data switches but will require their own cabinet.
- .13 CAT6 cable to link switches to NVR if required when under 300'. If over 300' Fibre link required (Note T).
- .14 At NVR location provide 26" LED screen and keyboard and workstation for it to sit on.
- .15 Switches for cameras - Acceptable products TrenNet TPE-TG160G TPE-TG240
- .16 ExacQ DVR recorder: EXACQ | IP08-20T-2Z-2 Network Video Recorder, 4U, 128 IP Camera, 16 TB, Provided by contractor.
- .17 Camera system to provide 7 days of storage at 10 frames per second.
- .18 2 hour training session (in person) to be provided upon completion of the project. Contractor responsible For Software install on two board computers.
- .19 All work is to be performed outside of regular school hours 8am – 2:30pm
- .20 Fiber Optic cabling requirements – Acceptable Materials
- .21 Fiber solution to be complete including all required parts to make link of closets. Parts below are for recommended cabling and may not include all required components. Up to contractor to provide a complete solution.
- .22 6 Strand OM3 Fiber with LC connectors, FT6 rated, tight buffered, fibre patch cord each end. Speed for uplink is 1GB.
  - .1 Acceptable manufacturers:
    - .1 Leviton
    - .2 Berk-Tek
    - .3 Panduit
    - .4 Superior Essex
- .23 Remove all old analog cameras and recorder. Including coaxial cable. Recorder and cameras to be turned over to UCDSB.
- .24 Contractor to provide ceiling tiles for locations cameras are removed from "Certainteed PBT197".
- .25 Patching and painting as required by contractor. When patching of masonry is required it is expected to match existing as close as possible.
- .26 Old Video security system to remain functional until new system is ready to be brought online.
- .27 Cameras being mounted in ceiling tiles require an Arlington Fixture Box and Mounting bar kit P/N FS420SCL

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

### **1.2 REFERENCES**

- .1 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S524, Standard for the Installation of Fire Alarm Systems.
  - .2 CAN/ULC S525-16-REV1, Audible Signal Devices for Fire Alarm Systems, Including Accessories.
  - .3 CAN/ULC S527-11-AMD-1 (2014), Standard for Control Units for Fire Alarm Systems.
  - .4 CAN/ULC S528, Manual Pull Stations for Fire Alarm Systems, Including Accessories.
  - .5 CAN/ULC S529, Standard for Smoke Detectors for Fire Alarm Systems.
  - .6 CAN/ULC S531, Standard for Smoke Alarms.
  - .7 CAN/ULC S536, Standard for Inspection and Testing of Fire Alarm Systems.
- .2 National Research Council Canada
  - .1 NRCC NBCC, National Building Code of Canada.
- .3 Ontario Regulation
  - .1 ONTARIO OBC, Ontario Building Code.
- .4 Underwriters Laboratories of Canada (ULC)

### **1.3 DESCRIPTION OF SYSTEM**

- .1 Scope of work to upgrade existing system.
  - .1 Provide all labour, materials, and equipment to remove the existing Simplex fire alarm control panel and replace it with a new Simplex 4100ES Addressable Fire Alarm Control Panel complete with all required modules and accessories.
  - .2 The contractor shall:
    - .1 Disconnect and remove the existing panel, ensuring existing wiring is preserved for reconnection.
    - .2 Install the new 4100ES panel in the same location, complete with enclosure, power supply, CPU, and interface modules as required.
    - .3 Reconnect existing field wiring, devices, and circuits to the new panel. Verify wiring integrity and replace any damaged conductors discovered during installation.
    - .4 Ensure all existing and new devices are addressed, programmed, and fully synchronized with the 4100ES system.
    - .5 Perform a complete verification of the system in accordance with CAN/ULC-S537, including device testing, annunciator functions, and communication with the monitoring station.
    - .6 Provide updated "as-fitted" drawings and programming files upon completion.

- .7 Train the Owner's representative in the operation of the new fire alarm control panel.
- .8 Provide new addressable loop for detection devices and audible circuits for new addition, c/w conduit wiring all required devices.
  - .1 Fully Supervised System includes:
    - .1 Control panel, microprocessor-based addressable Central Processing Unit to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals and signaling to Central Agency.
    - .2 Trouble signal devices.
    - .3 Power supply facilities.
    - .4 Manual alarm stations.
    - .5 Automatic alarm initiating devices.
    - .6 Audible signal devices.
    - .7 Annunciators, (Integral with Control and Remote panels), to indicate separately each device.
    - .8 Alarm and Trouble Transmitter.
    - .9 Ancillary devices.
    - .10 Event log (historic event recorder).
    - .11 Zone Adapter Module.
    - .12 Relays for fan shutdown/start-up.
    - .13 Line Fault Isolators at all stairwells, between floors, fire separation crossings and for each 2000 meter square of building area as per ULC standards.
    - .14 Programmable relays for magnetic door lock release on alarm, loss of power to the fire alarm control panel or detection of fault in the electrical circuit between the fire alarm control panel and the magnetic lock controller.
    - .15 Other related equipment as required to complete the system.

#### 1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Include:
  - .1 Layout of equipment.
  - .2 System addresses.
  - .3 Complete wiring diagram, including schematics of modules.
  - .4 Graphic plot plan c/w addresses.

#### 1.5 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for Fire Alarm System for incorporation into manuals.

- .2 Include:
  - .1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.
  - .2 Technical data - illustrated parts lists with parts catalogue numbers.
  - .3 Copy of approved shop drawings.

## **1.6 MAINTENANCE MATERIALS**

- .1 Provide maintenance materials in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Include:
  - .1 Provide a list of recommended spare parts. In the case of a standard spares kit, the content of the kit shall be listed.

## **1.7 MAINTENANCE**

- .1 Provide one year's free maintenance with two inspections by manufacturer during year. Inspection tests to conform to CAN/ULC S536. Submit inspection report to Engineer.

## **1.8 TRAINING**

- .1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

## **1.9 AS-BUILTS**

- .1 Provide 'as-builts' drawings upon completion showing all devices c/w addresses including line isolator locations and conduit runs.

# **PART 2 PRODUCTS**

## **2.1 MATERIALS**

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer. Addressable type unless otherwise noted.
- .2 Power supply: to CAN/ULC S524, and NBCC.
- .3 Audible signal devices: to ULC S525.
- .4 Control unit: to ULC S527.
- .5 Manual fire alarm stations: to CAN/ULC S528.
- .6 Smoke detectors: to CAN/ULC S529.
- .7 Smoke alarms: to CAN/ULC S531.

## **2.2 SYSTEM OPERATION**

- .1 Single stage operation. Operation of any alarm initiating device to:
  - .1 Cause audible signal devices to sound throughout building.
  - .2 Transmit signal to remote agency via telephone lines.
  - .3 Cause zone of alarm device to be indicated on control panel.
  - .4 Cause ventilating fans to shut down or start.

- .5 Cause fire doors and smoke control doors if normally held open, to close automatically.
- .6 Fire alarm system shall automatically shut down the A/C systems and fans which are fitted with duct smoke detectors or otherwise indicated. Provide relay as required.
- .2 The system shall be provided with capability for walk testing.

## 2.3 CONTROL PANEL

- .1 DCLA System style in accordance with CAN/ULC S524. Minimum of one loop per floor and one spare loop capacity.
- .2 Each device individually addressed unless otherwise noted.
- .3 Non-coded.
- .4 Enclosure: CSA Enclosure 1, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys, wall mounted, max. 750 mm width.
- .5 Central Processing Unit (CPU):
  - .1 The CPU is to monitor and control the entire system and allow control of all systems components connected to the system. The CPU shall be of modular design.
  - .2 The Central Processing Unit (CPU) shall be complete with forty (40) character alphanumeric display and keypad. All components shall be fully operational while the system is operating on the standby batteries.
  - .3 Basically, all events are to be logged automatically in the system for future review. Change-of-status, alarm, and fault messages along with time of day and date shall be logged. This may be accomplished through using either an internal memory log or a 24 V dc integral printer.
  - .4 The CPU electronics shall be microprocessor-based. Basic life safety software shall be retained in erasable programmable read only memory (EPROM) and executed from random access memory (RAM) to allow password protected field editing. The CPU shall have the capacity to monitor the number of addressable points required for this project plus 25% spare capacity.
  - .5 The CPU must incorporate circuitry to continuously monitor the communications and data processing cycles of the microprocessor. On CPU failure, an audible and visual trouble signal shall initiate and provide a remote trouble at Fire Department Control panel.
  - .6 The CPU shall be equipped with software routines to provide event-initiated programs (EIP) whereby the receipt of an alarm or supervisory trouble condition may be programmed to operate any or all of the system's control points. EIP actions for life safety functions shall be retained in the non-volatile PROM memory for reliability. The CPU shall also be retained in the non-volatile PROM memory for reliability. The CPU shall also be capable of reprogramming these EIP functions in the field and retaining the changes in the RAM memory until a new set of PROM are programmed.
  - .7 The control unit shall be able to process and evaluate incoming signals from addressable devices such as automatic detectors, manual pull station, supervisory valves, etc., via DCLA style link.
  - .8 The control unit shall be able to handle the following maximum number of addressable links and field-programmable zones:
    - .1 Up to four addressable links per control unit.
    - .2 Up to 100 detection devices per line. Maximum initial loading to be no more than 80.
  - .9 Provide operating power for the detection devices through a regular two-wire line.

- .10 Each addressable line module is to have its own microprocessor-based circuit, working independently from the central processor board located in the control unit and independently from each other.
- .11 All addressable circuits shall be monitored against open circuits and ground faults. Should a malfunction occur in any circuit, this must result in an indication of a trouble condition of this address location at the Control Panel while all other addresses continue operating normally.
- .12 Should a detection device respond with either an alarm or trouble condition, its location must be displayed along with its user text of 40 characters. For maintenance purposes, the panel shall have the ability to display the address information of the device in alarm/trouble condition.
- .13 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and c/w individual bypass switch.
  - .1 Contacts: 2 A, 120 V ac, for functions such as release of door holders or initiation of fan shut down. Provide also 2 N.O. and 2 N.C. contacts for security system monitoring of 'trouble' and 'alarm' connections to Control panel.
  - .2 Contact terminal size capable of accepting 22-12 AWG wire.
- .14 The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.
  - .1 The following Historical Alarm log events shall be stored:
    - .1 Alarms.
    - .2 Alarm acknowledgement.
    - .3 Trouble acknowledgement.
    - .4 Supervisory acknowledgement.
    - .5 Alarm verification tallies.
    - .6 Trouble Historical log cleared.
- .15 Provide a general evacuation switch in the control panel to provide the fire department the option of causing a general alarm.
- .6 General System Operation:
  - .1 Reset of the alarm system and return of the control panel to normal operation will be accomplished as follows:
    - .1 Resetting the fire alarm system shall not be possible until all the alarm zones have been reset or properly cleared after the Code required time delay.
  - .2 A supervisory input signal initiated by the actuation of a standpipe supervised valve shall cause:
    - .1 An audible trouble signal shall sound only at the control panel until acknowledged by authorized personnel.
    - .2 A latched-type visual indication of the location of the supervisory zone on the control panel.
    - .3 Print out of the time, date, and the trouble zone on the printers.
    - .4 An open circuit fault on a supervisory circuit shall result in a specific trouble indication.

- .5 Manual pull station, heat detectors, or flow switches will immediately cause the system to activate and report an alarm condition without verification requirement.
- .3 The system will be programmable on site as outlined below:
  - .1 The fire alarm system shall allow for on-site loading or editing of the fire alarm programs as required to accommodate and facilitate expandability, building parameter changes or changes as required by the authority having jurisdiction.
  - .2 Fire alarm programs shall be written in an equation format comparable to ladder logic equations. The equations shall consist of input and output statements providing selective input/output control functions based on binary logic (and, or, not, timing) and other specially coded operational commands.
  - .3 Programming or editing a forty (40) character description label shall be made possible for any system monitor or control point. Extension of messages for any system point or group of points shall be field programmable.
  - .4 Assigning the same control point more than one level of control priority in different equations shall be possible to allow for automatic and/or manual override functions.
  - .5 Following conditions shall exist when disabling any part of the system.
    - .1 When a point has been disabled from the system it shall not disable the supervisory circuit for that zone. Tampering with the wiring of the disabled circuit shall initiate a point trouble condition at the Control Panel CPU.
    - .2 For an alarm received from any other monitor circuit which has not been disabled, the system shall operate as programmed.
    - .3 Whenever an initiating circuit has been disabled or disconnected a trouble condition shall be initiated and its location displayed at the main CPU and the monitoring control centre.
  - .6 All on-site programming or editing changes to the fire alarm system shall be password protected.

## 2.4 POWER SUPPLY

- .1 The Control Panel is to contain the power supply for the entire system. 120 V ac, 60 Hz input, 24 V dc output from rectifier to operate alarm and signal circuits, with standby power of gel cell battery minimum expected life of four years, sized in accordance with OBC (1/2 hour).
- .2 The power supply unit must contain suitable over-voltage protection to prevent any malfunction or damage which might occur from line power surges.
- .3 Upon loss of mains power, the power supply unit must contain suitable over-voltage protection to prevent any malfunction or damage which might occur from line power surges.
- .4 When battery voltage drops below 22 V, a fault indication is to be provided to indicate a battery fault condition.
- .5 A visible and audible signal is to be generated to indicate that the control unit is operating under emergency power.
- .6 The master fault indicator on the control unit is to be illuminated until power has been returned.
- .7 When the AC power is restored, the control unit must automatically revert to normal operation without requiring any manual restarting procedures.

- .8 Battery Charger shall be designed to suit the characteristics of the battery providing automatic boost charge facility when the battery bank potential falls below acceptable voltage for maintaining a working system and return to float charge when the battery bank reaches maximum acceptable voltage.
- .9 Automatic equalizing type battery charger must be rated to recharge to at least 70% within 12 hours, and to operate from 120 V, 60 Hz, single phase input.

## **2.5 MANUAL ALARM STATIONS**

- .1 Manual alarm stations: pull lever, break glass, wall mounted flush type, non-coded single pole normally open contact for single stage. All manual stations shall be addressable type.
- .2 Provide acrylic cover on all manual pull stations.

## **2.6 AUTOMATIC ALARM INITIATING DEVICES**

- .1 All automatic alarm initiating devices shall be addressable.
- .2 Heat detectors, fixed temperature, non-restorable, rated 90°C, moisture proof. Low profile.
- .3 Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute. Low profile type.
- .4 Heat detector base to be compatible with smoke detectors.
- .5 Smoke detector: ionization type.
  - .1 Plug-in type.
  - .2 Wire-in base assembly with integral continuously lit red LED, when in alarm mode. Flashing or alarm pulsating is not acceptable.
  - .3 Base compatible with heat detectors.
  - .4 Low profile type.
- .6 Duct type smoke detectors; ionization type addressable c/w remote indicating lamp.
- .7 All devices to be low profile type.

## **2.7 ADDRESSABLE INTERFACE MODULE**

- .1 Addressable interface module: to interface non-addressable devices to the addressable loop including each sprinkler alarm and supervisory device, actuated as a distinct and separate address for each sprinkler supervisory device.

## **2.8 AUDIBLE/VISUAL SIGNAL DEVICES**

- .1 Horns/Strobe unit, 24 V dc, current limiting electronics, red flush mounted, Zenon tube 15-75cd, equal to Edwards #757 series.

## **2.9 GRAPHIC ZONE MAP**

- .1 Graphic Zone Map:
  - .1 Floor plan, graphic style at: 1:200 scale. Include:
    - .1 Building outline.
    - .2 Entrance and exit locations.
    - .3 "You are here" indication.
    - .4 Zone boundaries.



- .5 Tunnel plan.
- .6 North arrow.
- .7 Stairwells.
- .8 Elevators.
- .2 Construct graphic in black on white non-fade medium. (Do not use ink as it will fade).
- .3 Address (Zone) wording to correspond to panel annunciator wording.
- .4 Upper case mechanically printed lettering. Sized for each reading.
- .5 Building orientation to suit exact building layout when viewed from front.
- .6 Building outline and zone boundaries to be distinguished by line thicknesses, line types, etc.
- .7 Set in polished metallic frame with mark resistant Lexan overall cover.
- .8 Suitable for screw fixing to wall.
- .9 Submit three copies of graphic drawings for Engineer's approval prior to manufacturing.
- .10 Minimum size 600 mm x 600 mm.

#### **2.10 F.A. ADDRESSES LIST**

- .1 A list of F.A. addresses and their wordings to be approved during construction stage by the users.

#### **2.11 DOOR HOLDERS**

- .1 Automatic door holders, wall, or floor mounted type, 120 V type complete with relay release on F.A. Provide 120 volt supply to each device.

#### **2.12 SYSTEM MANUFACTURERS**

- .1 Acceptable material: Simplex

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install systems in accordance with CAN/ULC S524.
- .2 Install main control panel and connect to ac power supply, ac dc standby power. Install unit so that alphanumeric display is between 1500 mm and 1700 mm A.F.F.
- .3 Locate and install manual alarm stations and connect to the addressable loop.
- .4 Locate and install detectors and connect to the addressable loop. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors.
- .5 Connect addressable loops to main control panel.
- .6 Locate and install bells and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel. Alternate signal circuits within floor space, i.e., circuit 'A' device adjacent to circuit 'B' device.
- .8 Locate and wire door releasing devices.

- .9 Install all wiring for fire alarm system monitoring, control, and communication circuits in conduit. Minimum conduit size shall be 21 mm. All wiring must be clear of shorts, opens, and grounds on completion of installation. All wires must be clearly identified at all termination points.
- .10 Ensure wire and cable are copper conductors with insulation rated at 300 V minimum, as follows:
  - .1 Fire alarm addressable circuits shall be #18 AWG twisted shielded pair. Maximum allowable length of run (wire distance) must not exceed 762 m.
  - .2 Signal circuit: 300 V 105°C PVC insulated copper conductors. Minimum conductor size #12 AWG. Voltage drop must not exceed the maximum permissible value recommended by the manufacturer.
  - .3 All wiring to be in conduit.
- .11 Provide wiring to sprinkler system devices as indicated and connect to panel, addressable.
- .12 Ground panel and conduits.
- .13 Provide output signal to Building Energy Management System and wire to EMCS.
- .14 Provide connection to security system for remote monitoring of 'alarm' and 'trouble'.
- .15 All Fire Alarm devices shall have both the device and it's base labelled with p-touch to indicate building (if in a campus), floor, column line, device type. i.e. device labelled as T2-5-G3-SD would indicate tower 2, floor 5, column G3, smoke detector. This description should also be indicated at the annunciator and control panel.
- .16 All fire alarm work is to be logged in at the main security station by the contractor, and shall indicate the location of the work, a description of the work, and the name of the contractor performing the work.
- .17 The installing contractor shall notify the building owner of verification times, so the owner can include their maintenance contractor in review.

### 3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements. and CAN/ULC S536.
- .2 Fire alarm system:
  - .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate general alarm ancillary devices.
  - .2 Test to demonstrate correct operation of each interlock device, auxiliary device, by-pass switches.
  - .3 Check annunciator panels to ensure zones are shown correctly.
  - .4 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of trouble signals and the capability for providing a subsequent alarm during any imposed single circuit fault condition (open, ground).
  - .5 Perform the system verification and certification per Clause 3.3 "Verification and Certification".

### 3.3 CERTIFICATION AND VERIFICATION

- .1 Verify system to "CAN/ULC S537".
- .2 Verification is the responsibility of the manufacturer for testing the wiring in relation to field devices operation.

- .3 To avoid unnecessary alarms during testing, the system's program shall be capable of being temporarily disabled to disconnect only the audible signals that are being tested. Reenable the zones after the testing is performed at the end of the day.
- .4 Inspect and test wiring to every device to verify the removal of the device or breaking the wire will cause a trouble condition at the Control Panel.
- .5 Inspect all equipment installed as part of the system for visible damage or tampering which may be a potential problem with its intended operation.
- .6 Activate each manual initiating device to verify and ensure their proper operation.
- .7 Test each self-restoring heat detector utilizing a heat source to test the device operation.
- .8 Test each ionization smoke detector. Detector operation shall be tested by introducing "smoke" into the detector head.
- .9 Test all audible signals for proper operation. Tests shall be made to determine that the signal is audible throughout the area and above the normal ambient noise level.
- .10 Verify all field wiring and terminate on a single conductor per terminals basis.
- .11 Test system annunciators to ensure proper operation correct zoning and visibility of window inscriptions. All lamps and indicators shall be tested for proper operation.
- .12 Test all control equipment for proper operation. Inspect and test all cable terminals, plug connectors, plug-in modules circuitry, lamp sockets, and controls to confirm that their mechanical and electrical connections and mounting are acceptable to confirm their electrical supervision.
- .13 Test ancillary equipment connections. Inspect such equipment to ensure that faults and malfunctions will not interfere with the alarm system.
- .14 Test the following control functions for proper supervision, operation, and annunciation.
  - .1 The Central station connection.
- .15 Only make changes to the system program or zone identifications as approved by authorized personnel.
- .16 Notify and demonstrate the complete system to Owner's representative and Building Inspection's representatives only after testing and verification performances has been completed and all deficiencies rectified. In their presence, demonstrate the proper functioning of the system. Have system manufacturer's certified technician present.
- .17 Upon completion of the inspection and when all of the above conditions have been performed and complied with, the manufacturer shall issue to the Owner's representative the following:
  - .1 A copy of the inspection report identifying the location of each device and certifying the test results of each device.
  - .2 A certificate of verification confirming that the inspection has been completed and outlining the conditions upon which such an inspection and certification have been rendered.
  - .3 Proof of liability insurance for the inspection.
- .18 All costs involved in this inspection for both the manufacturer's and the Contractor's work shall be included in the overall tender price.

### 3.4 VERIFICATION RECORDS

- .1 Complete accurate records of the verification shall be maintained with the following requirements but not limited to:
  - .1 Show the date on which each device and equipment has been verified.

- .2 Show the date of all deficiencies encountered in the control system equipment, wiring, and field devices.
- .3 Show the date when the deficiencies have been corrected and re-verified.
- .4 Show dB levels measured during verification.

### **3.5 INTEGRATED SYSTEMS TESTING**

- .1 Fire Alarm System:
  - .1 Following are tests required to show system integration with other systems.
  - .2 Initiate a fire alarm via a manual pull station verify the following:
    - .1 Alarm initiated.
    - .2 Elevators return to ground level.
    - .3 Signal sent to central alarm facility.
    - .4 Signal sent to building automation system for fan shutdown.
    - .5 Signal sent to security system.
    - .6 Alarm annunciates at fire control panel.
    - .7 Magnetic hold open devices release & door close.
    - .8 Fire shutters release & close.
    - .9 Pressurization and/or smoke EVAC fans start.
    - .10 All magnetically locked doors release.
    - .11 Audible devices are operating.
  - .3 Verify connection to fire pump for power available monitoring by disconnecting normal & emergency source to fire pump.
  - .4 Verify generator set monitoring by initiating a trouble & alarm condition at generator.
  - .5 Throughout the tests utilize the emergency voice communications systems for instructions & verifications at various levels.
  - .6 Initiate a first stage alarm and allow verification timer to time out and start second stage alarm.
  - .7 Verify connections to elevators.

**END OF SECTION**