

# DIVISION 16

## ELECTRICAL SPECIFICATIONS

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**Beverly Hills Condominium (Yonge Street & 16<sup>th</sup> Avenue)**

**Richmond Hill, Ontario**

**Project # 08 009**

Issued for Permit September 7, 2012



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**ELECTRICAL GENERAL REQUIREMENTS**


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**Part 1            General**

**1.1                INTENT**

- .1        This Section applies to all Sections of Division 16.
- .2        Conform to the applicable provisions of the owner's standard Form of general Specifications and the owners standard short form contract which are hereby considered an integral part of this Specification.
- .3        Provide fully tested and operational electrical systems in complete accordance with applicable codes, standards and bylaws.
- .4        Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, and other items and arrangements for the specified items are shown on drawings.
- .5        The specifications shall be read in conjunction with the drawings and shall comply with the latest edition of the Ontario Electrical safety code and the requirements of the authorities having jurisdiction. All equipment, wiring and wiring devices shall conform to the Canadian Electrical Code for the purpose for which they are intended to be used. All equipment shall be C.S.A. approved.

**1.2                CODES AND REGULATIONS**

- .1        Comply with the latest requirements of all relevant Standards and Codes of Authorities having jurisdiction. Standards to include the most recent version of the Electrical Safety Authority, Ontario Building Code, Ontario Electrical Safety Code and applicable regulations and by-laws of the local municipality.

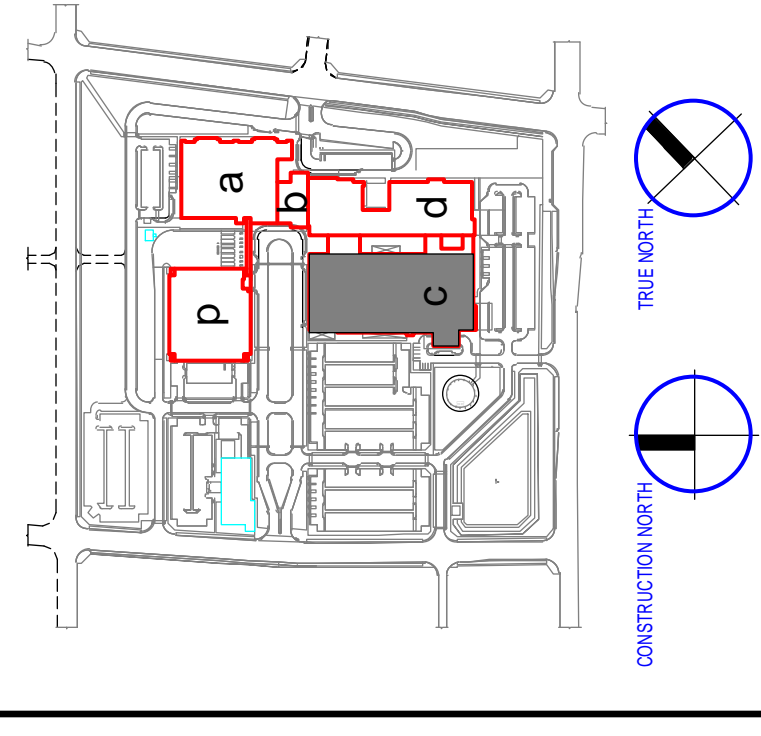
**1.3                SCOPE OF WORK**

- .1        This division shall include the supply of all materials and labour required for the complete installation of all electrical work for the building(s) on the site, as specified herein, and as shown on the drawings.
- .2        Items mentioned herein, and not shown on the drawings and vice-versa are to be covered by the Contract. All items which are necessary to form a complete and workable system shall be included in the Contract.
- .3        Without limiting the extent of the work, in any way, the contract shall generally consist of but not limited to the following:
  - .1        Incoming Hydro services.
  - .2        347/600 and 120/208V, 3 phase, 4 wire power and lighting distribution systems.
  - .3        Secondary distributions including Emergency Generator system.
  - .4        Metering provisions suitable to the local utilities and as shown on the drawings including Electronic sub-metering system.









CONSTRUCTION WORK  
 NOT FOR CONSTRUCTION

NO.	REVISIONS	ISSUED	DATE
04	ISSUED FOR IRLN TO SUBMISSION		27 FEB 2017
03	PERMIT FOR BUILDING ENVELOPE		12 DEC 2011
02	ISSUE FOR PROGRESS SET		14 OCT 2011
01	ISSUED FOR IRLN TO SUBMISSION		21 SEP 2011

Discrepancies must be reported immediately to the Architect before proceeding. Only figured dimensions are shown on this drawing. All dimensions are shown in metric. ALL DIMENSIONS ARE SHOWN IN METRIC.

ARCHITECTS IN JOINT VENTURE

**PARKIN**  
 ARCHITECTS LIMITED

**adamson**  
 ASSOCIATES ARCHITECTS

DRAWING TITLE  
**Interior Fit-up Package**  
**Block C Level B1 Basement Plan**  
 - Zone C3

DRAWN	CHECKED	DATE	ISSUED NO.
Author	MMU	03/2012	<b>06</b>
SCALE & AN			
1:100			
PROJECT NO.	1005-1003		



ALL PARTITIONS ARE 9' UNLESS INDICATED OTHERWISE  
 ALL FLOORING ARE 2'0 UNLESS INDICATED OTHERWISE

**ELECTRICAL GENERAL REQUIREMENTS**

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- .5 Panels and branch circuit wiring.
  - .6 Supply and installation of all wiring devices.
  - .7 Supply and installation of all lighting fixtures with lamps.
  - .8 Emergency lighting system.
  - .9 Exterior lighting system.
  - .10 Supply and installation of complete Fire Alarm System & Voice Communication system.
  - .11 Supply and installation of Snow Melting and Pipe Tracing system.
  - .12 Supply and installation of Electric Heaters.
  - .13 Connection and wiring of mechanical equipment as specified herein.
  - .14 Wiring of all garbage compactors, garage doors, elevators and all other miscellaneous equipment supplied by others.
  - .15 Empty conduit for a telephone system.
  - .16 Empty conduit for a Cable T.V. system.
  - .17 Empty conduit for a Security system.
  - .18 Building entrance control system.
  - .19 Supply and installation of the Trouble Monitoring system.
  - .20 Carbon monoxide monitoring system.
  - .21 Supply and installation of the Elevator Communication system.
  - .22 Electrical tracing of all piping subject to freezing, including exposed fire standpipe lines in garage, drum drips, incoming water lines, sanitary drainage lines and traps, cooling tower / fluid cooler piping. Refer to and co-ordinate with Mechanical Division for locations.
- .4 Before tendering, this Division shall examine the existing conditions at the site, the Architectural, Structural and Mechanical Drawings, and shall make themselves familiar with the building construction, architectural finishes, landscape and interior design, in order that the price may include everything necessary for the complete installation of the work.
  - .5 Should this Division desire to quote on the alternate materials or equipment, it must include in the base bid, the name of the manufacturer or supplier, a complete description of the substitute materials and any difference in price estimate for each substitution.
  - .6 Any article, material, operation or method listed herein requires that this Division supply all items listed of quality noted and quantity required and shall perform such operations according to the methods prescribed supplying all necessary labour and accessories.

**1.4 INSPECTIONS, PERMITS, CERTIFICATES AND FEES**

- .1 Apply, obtain and pay for all permits, fees, tests, connections, inspections, licenses, printing, certificates or charges necessary associated with the Work of this Division.
  - .2 This Division shall submit the required number drawings and specifications to the applicable utilities for approval prior to commencing any work.
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**ELECTRICAL GENERAL REQUIREMENTS**

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- .3 Furnish Certificate that all installed work conforms with all laws and regulations by utilities and authorities having jurisdiction, before final payment of contract is made.

**1.5 DEFINITIONS**

- .1 “Provide” - to supply, install and connect the products and services specified.
- .2 “Install” – to mount and wire the applicable device.
- .3 “Approved equal” – refers to alternate product selection as approved by the engineer.
- .4 “Supply” – to only supply a selected product.
- .5 “Typical” – a representative characteristic that is standard for all similar installations.
- .6 “Authorities having jurisdiction” - any and all agencies that enforce the applicable laws, ordinances, rules, regulations or codes that apply at the place of work.
- .7 “Exposed” – any work which is not concealed in a wall, shaft or ceiling cavities or spaces. Work behind doors, in closets or cupboards is considered exposed.
- .8 “Future” – a device to be installed at a later date and not to be included in this contract.
- .9 “Rough-in” – install all required items for future installation.
- .10 “Spare” – shall be a complete unit sized as shown on the drawings excluding fuse or breaker.
- .11 “Space” – space and bus provision for future installation of equipment.
- .12 “Temporary electrical services” - the complete installation, supply and maintenance of services, metering, feeders, sub-feeders, branch circuit wiring, switchgear, panelboards, wiring devices, lamps and all necessary connections.

**1.6 DESIGN REQUIREMENTS**

- .1 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits.
- .2 All materials and equipment shall be executed using only specified material and apparatus, except where the words, "or approved equal" occur.

**1.7 EXAMINATION**

- .1 Before tendering this Contractor shall examine the site, the architectural, structural, mechanical and electrical drawings, and he shall familiarize himself with the building construction and finishes in order that his tender may include everything necessary for the proper completion of the work.



**ELECTRICAL GENERAL REQUIREMENTS**

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- .2 It shall be this Division's responsibility that materials and equipment be brought into the building in such assemblies and sizes as to enter into the spaces where they are to be located and to be small enough to be joisted into the building without difficulty. Any cutting, patching, etc. involved in getting large assemblies into place shall be the responsibility of this Division.

**1.8 DRAWINGS**

- .1 All electrical drawings shall form an integral part of this specification.
- .2 The drawings shall be used in conjunction with all other Division drawings.
- .3 All drawings in this Division are diagrammatic and approximately to scale. Do not scale from the drawings, for dimensions refer to the appropriate trades drawings. Follow Manufacturer's recommendations for installation supplemented by contract documents, unless otherwise specified by the Engineer. Any discrepancies must be brought to the Engineer's attention in writing prior to the close of tenders.
- .4 Site conditions affecting locations or arrangements, shall be made on site with no extra charge to the contract.
- .5 Mounting heights shall be verified on site giving consideration to other trades, i.e. radiation devices. No conduits or wiring shall interfere with access to equipment.

**1.9 AS BUILT DRAWINGS**

- .1 Provide one full set of white prints, clearly marked as the work progresses and submit upon completion of the project. Drawings shall be kept at the site and shall be brought up to date as the work progresses. Drawings shall show all deviations from the original design including buried and concealed services and utilities and dimensioned locations. Drawings shall bear the contractor's corporate seal and state "AS BUILTS".

**1.10 SHOP DRAWINGS**

- .1 Shop drawings shall indicate the materials and/or equipment being supplied, all details of construction, accurate dimension, capacity, operating characteristics and performance and any other items listed in this Division's specifications.
  - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 Submit a minimum of 6 copies for all equipment.
  - .6 All shop drawings are to display the Contractor's stamps of approval.
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**ELECTRICAL GENERAL REQUIREMENTS**

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- .7 Shop drawings shall be supplied for all major equipment including but not limited to:
  - .1 Main Switchboard
  - .2 Emergency Generator, Transfer switches, etc.
  - .3 Panelboards and disconnect switches
  - .4 Lighting fixtures
  - .5 Fire Alarm system and components
  - .6 Approved distribution diagram from Hydro
  - .7 Fuses complete with co-ordination study.

**1.11 OPERATING MANUALS**

- .1 Provide for each system and principal item of equipment 3 bound copies for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .6 Supplier contact information.
- .3 Post instructions where directed.
- .4 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .5 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

**1.12 QUALITY CONTROL**

- .1 Provide CSA certified equipment and material.
- .2 Submit test results of installed electrical systems and instrumentation.
- .3 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to applicable parties.
- .4 Manufacturer's Field Reports: submit to Engineer and owner manufacturer's written report, within 5 days of review, verifying compliance of Work.

**ELECTRICAL GENERAL REQUIREMENTS**

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**1.13 EXTRAS**

- .1 Additional work required beyond the scope of this Contract shall be submitted in a quotation outlining the nature of the work and itemized breakdown costs of labour and material.
- .2 No "extra" will be recognized for payment, unless the work has been quoted on, and a written order obtained from the Owner or Engineer.
- .3 Location change of outlets shall be at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before final installation.

**1.14 WARRANTY**

- .1 This Division shall warranty:
  - .1 That all materials and workmanship used on the job are in strict accordance with the drawings and specifications.
  - .2 That the entire installation is of the best quality available to ensure first class construction and efficient operation, free from Mechanical and Electrical defects. Any such defect which may appear in any work within two (2) years after written acceptance of the same by the Owners (ordinary wear & tear, wilful damage by, or carelessness of the Owners staff and agents, excepted) shall be repaired or replaced by this Division without additional expense to the Owners. Where such defects occur this Division shall be held responsible for all costs incurred in making the defective work good.
  - .3 The period of this warranty shall, in no way, supplant any other warranty of longer period, but shall be binding on any work not otherwise covered.
  - .4 This warranty period shall start on the day when the entire installation is completed and accepted by the Owner.

**1.15 LIABILITY**

- .1 This Division shall:
    - .1 Assume full responsibility for layout out this divisions work and for any damages resulting from improper location or performance of this work including loss of materials or equipment.
    - .2 Supervise the laying out of their work and shall arrange it in co-operation with others who may be working on the premises while the work of this contract is in progress.
    - .3 Shall protect finished and unfinished work of this contract and/or work of others on the premises until the completed work has been accepted.
    - .4 Supply to other trades any equipment to be built-in by them or measurements to allow necessary openings to be left.
    - .5 Repair all disturbed or damaged surfaces or other parts of the building resulting from execution of the work for this Division, to the satisfaction of the Owner.
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**ELECTRICAL GENERAL REQUIREMENTS**

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**1.16 WORK INCLUDED**

- .1 This Subcontractor shall furnish, receive, assemble, install, connect and adjust for operation, all electrical equipment specified in this specification and as shown on the drawings, except as described under paragraph "Work Not Included".
  - .2 All cases pertaining to mechanical equipment, the electrical contractor shall supply and install all field wiring required to motors, starters, disconnects, thermostats and controls, complete with conduits for all circuits, unless noted or specified otherwise.
  - .3 An unfused disconnect switch shall be supplied and installed for all motors, equipment and where so required in compliance with the Canadian Electrical Code whether shown on the drawings or not.
  - .4 The supply and installation of lighting fixtures and lamps for indoor and outdoor, unless noted otherwise.
  - .5 Install all electrical heaters and applicable thermostats to these units, as per the drawings.
  - .6 This division shall be responsible for determining the quantities of material and equipment from the drawings, specifications and by site inspection and ensure all equipment supplied by others is of proper capacity and voltage.
  - .7 Water meter installation: 19 mm conduit shall be installed from the main water meter to exterior location, co-ordinate locations on site with the Mechanical Division.
  - .8 This Contractor shall provide control circuit power supplies as required to suit each systems' requirements.
  - .9 Thermostats:
    - .1 Install all thermostats (provided by others) within suites including conduit.
    - .2 This division shall be responsible for co-ordinating all thermostat locations with the Mechanical division, including unit mounted and remote mounted thermostats.
  - .10 Wiring for other divisions:
    - .1 Wire all motors, duct heaters, water heaters etc. including Disconnects.
    - .2 Wire all motor starters
    - .3 Install and wire all starting equipment and line voltage interlocking wiring, whether built-in or loose.
    - .4 Low voltage or line voltage thermostat wiring within suites.
    - .5 Provide 120 volt outlets for thermostatic controls.
    - .6 Provide, install and wire double voltage relays where required to complete the control system.
    - .7 Power wiring for boilers, water heaters and furnaces.
    - .8 Supply and install an emergency stop button at each boiler room door, wired to the control circuits of all boilers.
    - .9 Wire sprinkler flow alarm switches, supervised valves and sprinkler pressure switches as per Mechanical Division.
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**ELECTRICAL GENERAL REQUIREMENTS**

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- .10 Wire time switches and contactors supplied by other Divisions.
- .11 Wire all trap seal primers, location and quantity to be coordinated on site with the mechanical contractor.

**1.17 WORK NOT INCLUDED**

- .1 Motor drives will be supplied and installed by others with the driven equipment.
- .2 Flow switches, electrical motors, motor starters, thermostats, controls, relays, flow switches, pressure switches, pilot lights, safety devices, aquastats, control transformers and interlocks will be supplied by others unless otherwise noted.
- .3 Automatic temperature control wiring, low voltage control wiring, interlocking wiring for heating systems (boilers) and air-conditioning systems, unless otherwise shown on plans.

**1.18 OTHER TRADES**

- .1 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly, in writing, any defects which may interfere with proper execution of Work.
- .2 This Division shall confer with other Divisions installing equipment which may affect its' work and shall arrange its equipment in proper relation with the other apparatus, the building construction, and with the architectural finish. Special care shall be taken in the installation of all equipment where same is concealed to see that it comes within the specified or prescribed finished lines of floors, walls and ceilings.
- .3 This Division shall co-operate with other trades and contractors as required for the satisfactory completion of the work.

**1.19 SLEEVES, SUPPORTS AND HANGERS**

- .1 This division shall provide all sleeves, supports and hangers as required for all electrical work. This division shall ensure the load does not exceed the maximum loading as shown on the structural drawings.
- .2 This division is responsible for all being securely mounted and in the correct locations.

**1.20 CUTTING AND PATCHING**

- .1 Provide all cutting and patching required for the Work of Division 16. Where construction has proceeded without appropriate provisions for the installation of sleeves, conduits, outlet boxes etc. it shall be the responsibility of this division to do all necessary cutting and patching of the structure and/or finished surface to enable installation of such equipment.
- .2 Cutting and patching shall be done by skilled tradesman at the expense of this Division.
- .3 Patch and seal all openings with appropriate sealants, caulking or flame retardant materials restoring the penetration to its original rating to the satisfaction of the authorities having jurisdiction or the Engineer.

**ELECTRICAL GENERAL REQUIREMENTS**

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- .4 Fire stop all penetrations through all rated separations to maintain integrity of fire separations. Fire stopping materials to be ULC listed. Installations to conform to approved ULC details and standards.

**1.21 QUALITY ASSURANCE**

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians.
- .2 Site Meetings:
  - .1 Site Meetings: as part of Manufacturer's Field Services, schedule site visits, to review Work, at stages listed.
    - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of Work, after cleaning is carried out.

**1.22 WORKSHOP**

- .1 This division shall provide a temporary workshop, tool shop and storage space equipped with heating, lighting or any service required for it's own use. This contractor is responsible for any damages or losses. This space shall be removed and cleaned after completion of work.

**1.23 SYSTEM STARTUP**

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

**1.24 NOISE AND VIBRATION**

- .1 Equipment supplied and/or installed by this Division shall operate without objectional noise or vibration to the satisfaction of the Owner or representative.
- .2 All costs incurred to eliminate noise and vibration shall be at the cost of this Division with no extra given.
- .3 Sleeves and holes shall be packed with Rockwool insulation. Rigid conduits and cables installed and no movement is required shall be filled with a non-shrink concrete grout.
- .4 Transformers:

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- .1 Provide a 25mm thick neoperene/steel/neoprene waffle type isolation pad under each floor mounted transformer. Provide flat steel plates on top of pads for protection from channel edges.
- .2 Conduit connection shall be flexible metal type to allow for vibration isolation. Rigid conduit connections are not accepted.

**1.25 CONCRETE WORK, EXCAVATION AND BACKFILLING**

- .1 All excavation, backfilling and concrete work for this division shall be done by others. All trench excavation shall be carried out in conformity with the requirements of the authorities having jurisdiction.

**1.26 MATERIALS AND EQUIPMENT**

- .1 Materials and equipment specifically outlined in this specification are which tender price shall be based.
- .2 Manufacturers and/or model numbers specified in this Division are only to be included in base bid. No substitutions shall be made without written approval.
- .3 Any failure in the alternate selection becomes the full responsibility of this contractor. The alternate selection must technically and physically be equal.
- .4 All equipment shall be new.
- .5 Materials and equipment shall confirm to the Ontario Electrical Code and CSA approved. CSA label to be legible upon installation of equipment.
- .6 Factory assemble control panels and component assemblies.

**1.27 TEMPORARY SITE SERVICES**

- .1 All temporary site services shall be provided by others. This contractor shall provide all necessary equipment, lamps etc. for their use.
  - .2 This contractor shall include in his tender for providing and maintaining all temporary electrical services in each building on the site including temporary shops during the construction of the project.
  - .3 Provide a suitable voltage, 3 phase service for operating crane(s) and elevator(s), during construction.
  - .4 Supply and install a 120/208 Volt, 3 phase, 4 wire service of adequate capacity for all temporary lighting throughout the building, also for operating the various trades power tools, welders, temporary heating, etc.
  - .5 Supply, install and maintain during the whole of the construction period temporary lighting in all corridors, stairwells and public areas, including re-lamping when necessary.
  - .6 Supply and install on every third floor of each building a temporary service panel board of 100 amp.ampacity. Provide receptacles as required adjacent to panel for use of other trades.
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**ELECTRICAL GENERAL REQUIREMENTS**

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- .7 This Division will be held responsible for maintaining all electrical services in a safe operating condition at all times.
- .8 All hoists, scaffolds, runways, planking and ladders required during the execution of his work shall be provided by this Division.

**1.28 WORKMANSHIP**

- .1 Only first-class workmanship will be accepted, including neatness, safety, efficiency etc.
- .2 All conduit and wiring not enclosed within floor slabs must be lined up parallel, or at right angles to the building walls. Equipment must be accurately alignment. In general, the entire work shall present a neat and clean appearance upon completion.
- .3 Any unsatisfactory work shall be rectified by this Division at its own expense. This Division shall pay the cost of all trades that may be affected by its work or correction.
- .4 There is no obligation on the part of the Owners or the Engineers to find defects in materials and workmanship at the date of installation. Defects may be found at any time during the construction period or the guarantee period.



**Part 2        Products**

**2.1        ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1        Unless otherwise noted motors for mechanical equipment shall be:
  - .1        120 Volts, single phase for all equipment ½ horsepower and less.
  - .2        600 Volts, three phase for all equipment ¾ horsepower and greater.
  
- .2        Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
  
- .3        Control wiring and conduit: except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings shall be provided by others.

**2.2        WARNING SIGNS**

- .1        Warning Signs: installed in accordance with requirements of authority having jurisdiction.

**2.3        WIRING TERMINATIONS**

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

**2.4        EQUIPMENT IDENTIFICATION**

- .1        Identify electrical equipment with lamacoid labelled nameplates
  - .1        Nameplates to be provided on distribution panels, branch panelboards, disconnects, splitters, transformers, starters, motor control centres, and major system components.
  - .2        Nameplates to include name and all voltage characteristics, phase and source of power.
  - .3        Nameplates to be black plastic laminated, with white engraved letters 19mm high as a minimum.
  - .4        Disconnects, terminal cabinets, pull boxes, junction boxes, starters and contactors to indicate equipment being controlled and voltage.
  - .5        Transformers to indicate capacity, primary and secondary voltages.
  - .6        Tag all breakers/fuses within panels to clearly identify what each circuit is protecting.

**2.5        WIRING IDENTIFICATION**

- .1        Identify wiring with permanent indelible identifying markings, on both ends of phase conductors of feeders and branch circuit wiring.
  
- .2        Colour coding as per the following:

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Neutral	White
Ground	Green
Single Phase wires	Red, Black
3 Phase wires (A,B,C)	Red (A), Black (B), Blue (C)

- .3 Maintain phase sequence and colour coding throughout.
- .4 Provide a directory of junction boxes, conduit, and conductor colour coding in the Main electrical room.

**2.6 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes, coverplates and metallic sheathed cables per the following:

Normal power	Blue
Emergency power	Orange
Fire alarm	Red
Voice communication	Yellow
Television	Green
Telephone	Green
Security	Brown

- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, at 15 m intervals and termination points.

**2.7 FINISHES**

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

**2.8 ACCESS DOORS**

- .1 Access doors shall be located where maintenance or adjustment is required on any electrical equipment. This division shall arrange and pay for these doors.
- .2 Sizes: Except as indicated otherwise, to be minimum sizes as follows:
  - .1 For body entry: 600 x 600 mm.
  - .2 For hand entry: 300 x 300 mm.
- .3 Construction: Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180°.

- .4 Materials
  - .1 Tiled or marble surfaces and other special areas: Stainless steel with brushed satin or polished finish.
  - .2 Other areas: Prime coated steel.
  - .3 Provide coloured marking devices on removable acoustical panel ceiling.
  - .4 Where an access door is part of a fire rated assembly it shall be approved for the appropriate circumstance.

**Part 3 Execution**

**3.1 INSTALLATION**

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

**3.2 NAMEPLATES AND LABELS**

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

**3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

**3.4 LOCATION OF OUTLETS**

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

**3.5 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to bottom of device unless specified or indicated otherwise. Mounting heights specified on drawings.

**3.6 CO-ORDINATION OF PROTECTIVE DEVICES**

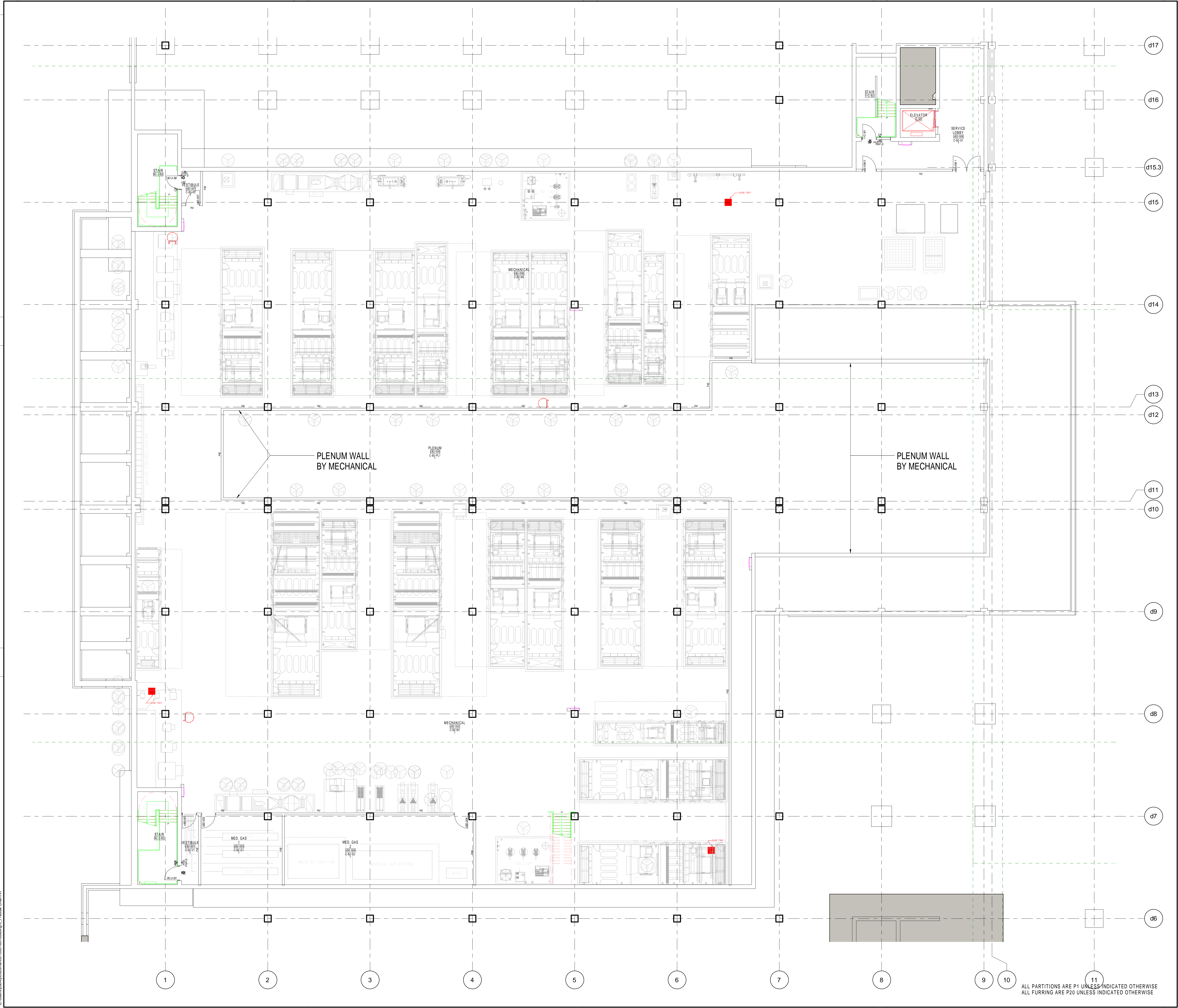
- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

**3.7 FIELD QUALITY CONTROL**

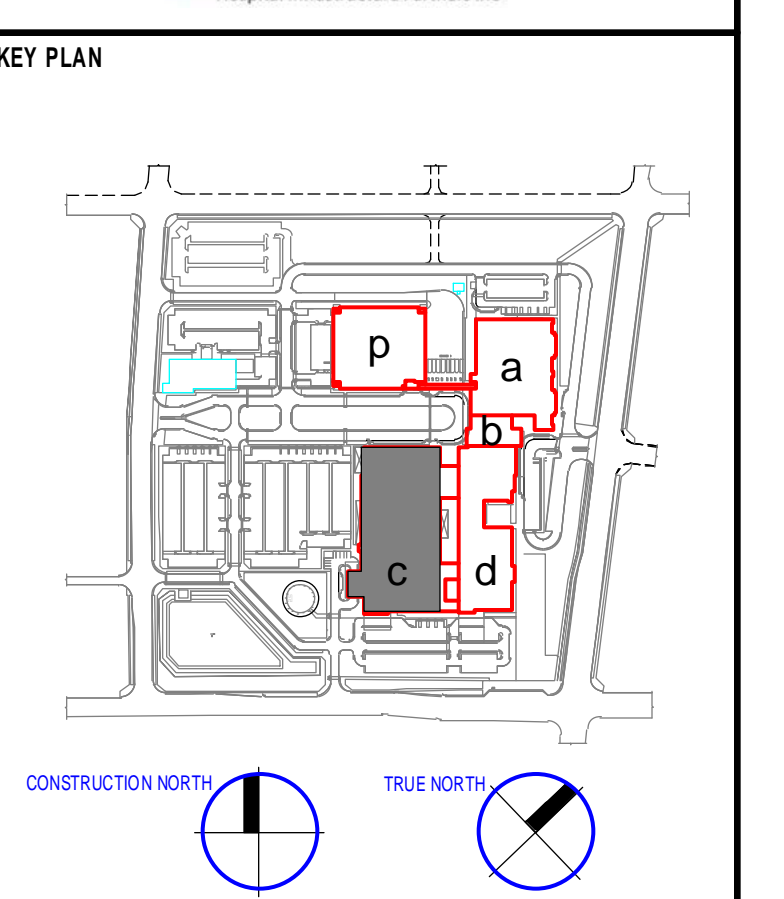
- .1 Load Balance:
    - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
    - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
    - .3 Provide upon completion of work, load balance report: phase and neutral currents on panelboards, dry-type transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
  - .2 Conduct following tests:
    - .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, relays, heaters and associated control equipment including sequenced operation of systems where applicable.
    - .5 Systems: Fire alarm system, voice communications.
    - .6 Insulation resistance testing:
      - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
      - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
      - .3 Check resistance to ground before energizing.
  - .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
  - .4 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
-



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ALL PARTITIONS ARE P1 UNLESS INDICATED OTHERWISE  
 ALL FURRING ARE P20 UNLESS INDICATED OTHERWISE



DRAWING STATUS  
**NOT FOR CONSTRUCTION**

NO.	ISSUED	DATE
04	ISSUED FOR 100% DD SUBMISSION	22 FEB. 2012
03	ISSUED FOR BUILDING ENVELOPE PERMIT	12 DEC. 2011
02	ISSUE FOR PROGRESS SET	14 OCT. 2011
01	ISSUED FOR 50% DD SUBMISSION	21 SEPT. 2011

REVISIONS

Discrepancies must be reported immediately to the Architect before proceeding. Only figured dimensions are to be used. Contractors must check all dimensions on site. This drawing is protected by copyright.

ALL DIMENSIONS ARE SHOWN IN METRIC.

ARCHITECTS IN JOINT VENTURE

**PARKIN**  
 ARCHITECTS LIMITED

+

**adamson**  
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STAMP	STAMP

DRAWING TITLE  
**Interior Fit-up Package  
 Block C Level B2 Basement Plan  
 - Zone C2**

DRAWN	AUTHOR	CHECKED	MMM

SCALE: 8 A0  
 1:100  
 DATE: 03/20/12

PROJECT NO.  
**1005-1003**

DRAWING NO.  
**Ac3-B22**

ISSUE NO.  
**06**

**ELECTRICAL GENERAL REQUIREMENTS**

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**3.8 CLEANING**

- .1 During construction, maintain Work in tidy condition, free from accumulation of waste products and debris. Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .2 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .3 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .4 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy with all work in good order..
- .5 Prior to final review remove surplus products, waste products, debris, tools, construction machinery and equipment.
- .6 Remove stains, spots, marks and dirt from electrical fixtures.
- .7 Clean lighting reflectors, lenses, and other lighting surfaces.
- .8 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .9 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**END OF SECTION**

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**Part 1            General**

**1.1                WORK INCLUDED**

- .1        Supply and install all grounding conforming to the Ontario Electrical Safety Code and the local supply Authority.

**Part 2            Products**

**2.1                MATERIALS**

- .1        Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.
- .2        Clamps for grounding of conductor: sized to electrically conductive underground water pipe.
- .3        Install connectors in accordance with manufacturer's instructions.
- .4        Protect exposed grounding conductors from mechanical injury.
- .5        Grounding conductors shall be copper or aluminum as indicated in the Ontario Electrical Safety Code.
- .6        Insulated grounding conductors shall be green in colour.

**Part 3            Execution**

**3.1                GROUNDING INSTALLATION**

- .1        Install a complete, permanent, continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with the Ontario Electrical Safety Code and requirements of local authority having jurisdiction.
- .2        Install connectors in accordance with manufacturer's instructions.
- .3        Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .4        Install a minimum of 4 ground rod electrodes for the main service.
- .5        Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .6        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, generators, elevators, distribution panels, outdoor lighting.
- .7        Where EMT is used, run ground wire in conduit.
- .8        Protect exposed grounding conductors from mechanical injury.

- .9 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .10 Where isolated ground receptacles are specified provide a separate ground and separate neutral from panel for each receptacle.
- .11 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .12 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station.
- .13 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction.
- .2 Perform test before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL**

- .1     All drawings are based on copper conductors unless specified otherwise.
- .2     Provide all wire and cables to suit requirements of systems as specified herein.
- .3     Identify all conductors as per section 16 000.
- .4     Aluminum sheathed, Armoured Cable, Thermoset insulated, ACM-8030 series etc. shall only be used where indicated on the drawings.

**1.2                STANDARDS**

- .1     All cables wires and cables shall be in complete accordance with current applicable codes, standards and bylaws

**Part 2            Products**

**2.1                GENERAL**

- .1     All branch circuit wiring including within suites shall be copper. The conductors illustrated on the drawings are copper, unless otherwise noted.
- .2     Conductors shall be minimum #12 AWG, unless run exceeds 30m conductor shall be sized to limit the voltage drop in accordance with Rule 8-102 of the Ontario Electrical Safety Code.
- .3     Wiring within residential suites for 15Amp circuits and motor controls may be #14 AWG.
- .4     All wiring shall be T90 insulation in EMT conduit with approved fittings.
- .5     Armoured cable may be used where concealed by a dropped ceiling, or drywall partition.
- .6     Wiring run on the surface shall be EMT or rigid steel conduit.
- .7     Underground and outdoor wiring shall be TWU insulation in PVC conduit or approved equal.
- .8     Wiring through or in all lighting fixtures shall be type GFT.
- .9     Wiring for signal systems shall be as shown on the drawings and/or in strict accordance with the manufacturers recommendations and specifications.

**2.2 BUILDING WIRES**

- .1 Conductors: stranded for minimum size 12 AWG for 15 Amp branch circuits less than 30m long. Runs longer than 30m or larger than 15 Amp to be sized to limit to the voltage drop in accordance with Rule 8-102 of the Ontario Electrical Safety Code.
- .2 Copper conductors: size as indicated on drawings, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated as indicated in Table D1 and Table 19 of the Ontario Electrical Safety Code.
- .3 Copper or Aluminum conductors: size as indicated on drawings with 600 V insulation as indicated in Table D1 and Table 19 of the Ontario Electrical Safety Code.

**2.3 MINERAL-INSULATED CABLES**

- .1 Manufacturer: 2 hour fire rated Mineral Insulated Pyrottenax MI cables or approved equal.
- .2 Insulation: Rated at 600 V.
- .3 Temperature: Rated at 90°C
- .4 Two hour fire rating as per ULC S-139 at 600 V.

**2.4 ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 - lead sheath over cable assembly and under armour.

**2.5 FIRE ALARM**

- .1 All fire alarm circuit wiring shall be copper conductors, insulation as in Table D1 and Table 19 of the Ontario Electrical Safety Code.
- .2 All fire alarm wiring shall be installed in a two hour fire rated enclosure in accordance with the Ontario Building Code or provide mineral-insulated cables.

**2.6 CONTROL WIRING**

- .1 Minimum size of #14 AWG.

**2.7 ALUMINUM SHEATHED CABLE**

- .1 General
  - .1 Where single conductor ACM-8030 aluminum alloy sheathed cables are specified for feeders they shall be installed in accordance with the manufacturers recommendations and requirements of the Ontario Electrical Safety Code.
  - .2 Where corrosive conditions may occur all cables shall have an overall PVC.
  - .3 No sheath currents shall be allowed to flow where cables exceed 250 MCM. All cable sheaths including the neutral shall be bonded and grounded at the supply end only and an insulating panel used at the opposite end.



- .4 Cables shall not be able to come into contact with each other or ground and must be spaced a minimum of one cable diameter from each other throughout the entire cable run.
  - .5 All cables must be neatly and securely fastened by means of approved aluminum cable clips, spaced at intervals not greater than 1500mm.
  - .6 Sheaths of the cable shall not be used for bonding of a wire system, separate ground conductors shall be installed in accordance with the current edition of the Ontario Electrical Code.
  - .7 Where NUAL corflex conductors are installed they shall be terminated in accordance with the manufacturers recommendations and the latest version of the Electrical Safety Code. Where aluminum corflex conductors are not provided by NUAL, they shall be terminated with high compression type lugs. Form connections with high compression type connectors of exact size to fit conductors; install with approved high compression hydraulic tools to exert uniform pressure on all sides of joint and assure a permanent high conductivity connection.
- 
- .2 Conductors: Copper, size as indicated.
  - .3 Insulation: type as indicated in Table D1 and Table 19 of the Ontario Electrical Safety Code.
  - .4 Sheath: aluminum applied to form continuous smooth, corrugated or seamless sheath.
  - .5 Outer jacket of PVC applied over sheath for direct burial and wet locations.
  - .6 Fastenings for aluminum sheathed cable:
    - .1 Approved aluminum cable clips.
    - .2 Spaced at intervals in accordance with the Ontario Electrical Safety Code.

**Part 3 Execution**

**3.1 GENERAL**

- .1 Install wiring as follows:
  - .1 In conduit systems unless otherwise noted.
  - .2 In wireways.
  - .3 In surface and lighting fixture raceways.
  - .4 All wiring in finished area shall be concealed.
  - .5 A minimum of 150mm shall be maintained between wiring and all water pipes, steam pipes, flues, ducts and other such work.
  - .6 All cables shall be identified at each piece of equipment.

**3.2 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:

- .1 In conduit systems unless otherwise noted.
- .2 In wireways.
- .3 In surface and lighting fixture raceways.
- .4 All wiring to be identified at each junction or pull box or where accessible.

**3.3 INSTALLATION OF MINERAL-INSULATED CABLES**

- .1 Run cable exposed or concealed, securely supported by approved supports.
- .2 Support 2 h fire rated cables at intervals in accordance with the Ontario Electrical Safety Code.
- .3 Make cable terminations by using factory-made kits.
- .4 Where cables are buried in cast concrete or masonry, sleeve for entry and exit of cables.
- .5 Do not splice cables.

**3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible.
- .2 Install in drywall ceiling or partitions.

**3.5 INSTALLATION OF ALUMINUM SHEATHED CABLE**

- .1 Group cables wherever possible on channels.
  - .1 Install cable in trenches.
- .2 Lay cable in cabletroughs.

**3.6 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

**3.7 INSTALLATION OF FIRE ALARM CABLES**

- .1 Install in rigid steel conduit or EMT and installed in a fire rated enclosure.

**3.8 INSTALLATION OF NON-METALLIC SHEATHED CABLE**

- .1 Install cables, straps and box connectors to cables as required.

**END OF SECTION**

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**Part 1            General**

**1.1                INTENT**

- .1        Supply and install all boxes, splitters and cabinets as illustrated on the drawings and specified herein necessary for the electrical work and as required to complete the installation.

**1.2                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings and product data for splitters in accordance with Section 16 000.

**Part 2            Products**

**2.1                SPLITTERS**

- .1        Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2        Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated on drawings.
- .3        At least three spare terminals on each set of lugs in splitters.

**2.2                JUNCTION AND PULL BOXES**

- .1        Welded steel construction with screw-on flat covers for surface or recessed mounting.
- .2        Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3        Minimum size: 150mm x 150mm unless otherwise specified.
- .4        Main communication junction boxes within suites shall be 350mm x 350mm x 101mm complete with receptacle recessed in location on drawings.

**2.3                CABINETS**

- .1        Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm plywood backboard for surface or flush mounting.
- .2        Type E: sheet steel, hinged door and return flange overlapping sides, handle, and catch, for surface mounting.

**Part 3            Execution**

**3.1                SPLITTER INSTALLATION**

- .1            Install splitters and mount plumb, true and square to the building lines.
- .2            Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2                JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1            Install pull boxes in inconspicuous but accessible locations.
- .2            Mount cabinets with top not higher than 2 m above finished floor.
- .3            Install terminal block as indicated in Type T cabinets.
- .4            Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

**3.3                IDENTIFICATION**

- .1            Provide equipment identification in accordance with Section 16 000.
- .2            Install lamacoid identification labels indicating system name, voltage and phase.

**END OF SECTION**

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**OUTLET BOXES, CONDUIT BOXES AND FITTINGS**


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**Part 1            General**

**1.1                INTENT**

- .1        Supply and install all boxes and fittings necessary for the electrical work and as required to complete the installation.
- .2        The drawings do not show boxes or fittings.

**Part 2            Products**

**2.1                OUTLET AND CONDUIT BOXES GENERAL**

- .1        Size boxes appropriately.
- .2        All boxes shall be electro-galvanized steel, all boxes shall be of size and type suitable for the applicable location and application.
- .3        Switches and receptacles shall be standard switch boxes.
- .4        Gang boxes where wiring devices are grouped, provide barriers to separate systems if required.
- .5        102 mm square or larger outlet boxes as required for special devices.
- .6        Blank cover plates for boxes without wiring devices.
- .7        All boxes which penetrate a vapour barrier shall be suitable type to maintain barrier integrity. Airtight electrical boxes shall be used for interior walls that separate suites and corridors.
- .8        Combination boxes with barriers where outlets for more than one system are grouped.

**2.2                SHEET STEEL OUTLET BOXES**

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

**2.3                MASONRY BOXES**

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

**OUTLET BOXES, CONDUIT BOXES AND FITTINGS**

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**2.4 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required. Minimum depth: 76mm.

**2.5 FLOOR BOXES**

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with appropriate faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 19 mm conduit. Minimum size: 73 mm deep.

**2.6 CONDUIT BOXES**

- .1 Cast boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

**2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

**2.8 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.

**2.9 SERVICE FITTINGS**

- .1 'High tension' receptacle fitting made of 2 piece stainless steel with housing finish for 1 duplex receptacle. Bottom plate with two knockouts for centered or offset installation.



**Part 3            Execution**

**3.1                INSTALLATION**

- .1     Height and location of outlet boxes shall be located appropriately on site avoiding interference with piping, equipment, ducts, conduits etc.
- .2     Support boxes independently of connecting conduits.
- .3     Lighting outlet boxes shall be equipped with suitable fixture studs to support a fixture.
- .4     Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .5     For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .6     Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

**3.2                IDENTIFICATION**

- .1     Provide equipment identification in accordance with Section 16 000.

**END OF SECTION**

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**Part 1            General**

**1.1                INTENT**

- .1        Supply and install all conduits necessary for the electrical work and as required to complete the installation.
- .2        Drawings do not show conduit runs.

**Part 2            Products**

**2.1                GENERAL**

- .1        Raceways as per drawings shall be rigid metal conduit, EMT, ENT, fibre or flexible conduit.
- .2        Size of conduit shall be in accordance with CSA and applicable standards.
- .3        All conduit and raceways shall be in accordance with the Electrical Safety Code and authorities having jurisdiction.
- .4        No conduit shall pass through structural elements or be larger than 32 mm installed in the floor slabs without the approval from the Structural Engineer.
- .5        All low voltage system distribution conduits shall be EMT.
- .6        Conduit shall be as sized on the drawings or sized that the conductors maybe installed without excessive strain.
- .7        Conduit installed underground shall be PVC.

**2.2                CONDUITS**

- .1        Rigid metal conduit: to CSA C22.2 No. 45, electro-galvanized steel, standard weight steel pipe connected with electro-galvanized steel threaded couplings.
- .2        Electrical metallic tubing (EMT): with couplings, size as indicated, “Scepter” or approved equal.
- .3        Electrical non-metallic tubing (ENT): Scepter or approved equal.
- .4        EMT couplings shall be set screw type. Concrete tight type shall be used in poured concrete floors. Raintight type shall be used in all exposed slabs external to the building.
- .5        Couplings: “Ericson” or approved equal couplings maybe used

**2.3                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.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

**2.4 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

**2.5 UNDERGROUND PVC DUCTS**

- .1 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.
- .2 Rigid PVC 90° and 45° bends.
- .3 Rigid PVC 5° angle couplings.
- .4 Expansion joints as required.

**2.6 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

**2.7 FISH CORD**

- .1 Minimum #8 Nylon Cord.

**Part 3            Execution**

**3.1                MANUFACTURER'S INSTRUCTIONS**

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

**3.2                INSTALLATION**

- .1        Proper allowance shall be made for thermal expansion and contraction of all conduits, etc. which shall be installed in such a manner that the strain and weight does not come upon connections and fittings, etc.
- .2        All conduits shall include pull boxes after every two 90 degree bends.
- .3        Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .4        The exact location of outlets and equipment is governed by structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels, equipment, etc. with the applicable trade. Do not pass conduits through structural members except as permitted by Structural Engineer.
- .5        Conduit installed in the poured floor slab or underground shall be rigid Genelcote or EMT where permitted by Code.
- .6        Where conduits enter boxes they shall be secured in place with galvanized locknuts and bushings. Conduit ends shall be carefully plugged during construction with plastic caps.
- .7        All motor feeder drops shall be rigid or EMT conduit with at least 900 mm flexible liquid tight conduit. Rigid conduit for a drop shall start 900 mm before the actual bend. Provide 2 additional clips before the actual bend. All other conduit work shall be EMT.
- .8        ENT conduits: shall be used in the Garage levels and within poured concrete walls or floor slabs. 50 mm concrete cover around conduit shall be provided. This conduit shall not penetrate a fire separation. No other type of conduit in the garage will be accepted.
- .9        Pull boxes shall be provided in all conduit or duct runs to allow the installation of the cables or wires.
- .10      Installed conduit shall avoid proximity to water pipes. In no case shall a conduit be within 300 mm of a pipe except crossings are unavoidable at which time the conduit will be a minimum of 50 mm away.
- .11      Surface mounted conduits may be run in mechanical and electrical rooms.

- .12 Conduit shall be sealed through penetrations through vapour barrier to maintain integrity of vapour barrier
- .13 All conduits shall be fastened with approved clips; nails are not accepted. All fastening of conduit on concrete block shall be with tampins; ramsetting will not be permitted.
- .14 Supporting conduit with tie wires, straps etc. is not accepted.
- .15 Surface mount conduits in unfinished areas including retail/commercial areas.
- .16 Conduits entering boxes shall be secured in place with galvanized locknuts and bushings. Conduit ends shall be carefully plugged during construction with plastic caps.
- .17 Use flexible conduit for connection to motors and transformers in dry areas and connection to lighting fixtures to provide vibration isolation.
- .18 Use liquid tight flexible conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .19 Where conduits enter boxes they shall be secured in place with galvanized locknuts and bushings. Conduit ends shall be carefully plugged during construction with plastic caps.
- .20 Conduit used below grade shall be Scepter P.V.C. of the rigid type. Connected to rigid elbows at all points where it penetrates through a floor slab and shall run 900 mm below finished floor. When crossing foundation walls, sleeves shall be provided. P.V.C. conduit shall be encased in 75 mm of concrete. Provide ground wires as required.
- .21 "Scepter" ENT conduits shall only be used in the Garage levels and within poured concrete walls or floor slabs, No other conduit will be approved. This Division shall ensure a minimum of 50 mm of concrete cover around conduit. Under no circumstances shall this conduit penetrate a fire separation.
- .22 A separate ground wire will be required when using ENT.
- .23 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- .24 Minimum conduit size for lighting and power circuits: 19 mm.
- .25 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .26 Mechanically bend steel conduit over 19 mm diameter.
- .27 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .28 Install fish cord in empty conduits.
- .29 Run 2- 25 mm spare conduits up to ceiling space from each panel.

- .1 Terminate these conduits in junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .30 Run 2- 50 mm spare conduit up to ceiling space from each distribution panel.
  - .1 Terminate these conduits in junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .31 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .32 Dry conduits out before installing wire.
- .33 Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stop material.

### **3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines, in a neat and workmanlike appearance.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Running threads are prohibited, Ericson couplings maybe used.
- .5 Group conduits wherever possible on channels.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CONCEALED CONDUITS**

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

### **3.5 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Locate to suit reinforcing steel.
  - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.

- .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter, or approved by Structural Engineer.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.
- .8 Conduits shall not be passed through structural members without the approval the Structural Engineer.

**3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

- .1 Run PVC conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
  - .1 Provide 50 mm of sand over concrete envelope below floor slab.
  - .2 Conduit joints shall have red oxide on threads and shall be pitched on the outside to ensure a watertight joint.

**3.7 WATER METER INSTALLATION**

- .1 19 mm conduit shall be installed from the main water meter to exterior location, co-ordinate locations on site with Division 15.

**3.8 CONDUITS UNDERGROUND**

- .1 Located minimum 915 mm below finished grade.
- .2 Slope conduits to provide drainage.
- .3 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

**END OF SECTION**



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**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Materials and installation for incoming Hydro Service(s).
- .2        Materials and installation for duct bank.

**1.2                RELATED SECTIONS**

- .1        Section 16 321 - Main Switchboard.

**1.3                REFERENCES**

- .1        All current applicable standards
  - .1        American National Standards Institute (ANSI)
  - .2        Canadian Standards Association (CSA International)
  - .3        Utility Standards.
  - .4        Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .5        National Electrical Manufacturers Association (NEMA)

**1.4                COORDINATION**

- .1        Confirm exact location with the local hydro utility prior to the installation of the duct bank.

**Part 2            Products**

**2.1                GENERAL**

- .1        Primary and secondary ducts complete with fish wire of sufficient strength.

**2.2                GROUNDING**

- .1        Provide four 19mm x 3000mm ground rods with copper loop and sufficient cable length to suit Powerstreams details.

**Part 3            Execution**

**3.1                GENERAL**

- .1        Install all applicable components with Powerstream Inc. construction standards.

**END OF SECTION**

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**Part 1            General**

**1.1            INTENT**

- .1        Supply and install all wiring devices indicated on the drawings and specified herein.

**1.2            SECTION INCLUDES**

- .1        Switches, receptacles, wiring devices, occupancy sensors, cover plates and their installation.

**1.3            REFERENCES**

- .1        Canadian Standards Association (CSA International).

**Part 2           Products**

**2.1            GENERAL**

- .1        Outlets one manufacturer throughout project: Leviton, Hubbell, Smith and Stone or approved equal.

**2.2            SWITCHES**

- .1        Switches shall be standard grade, rocker type, decora series, white in colour.
- .2        Time switches: 24 hour Astronomic dial, 40 A, 120 V, install as per manufacturers instruction. Tork 7000 series or approved equal.

**2.3            RECEPTACLES**

- .1        Duplex receptacles shall be standard/residential grade, decora series, white in colour, 125 V, 15 Amp, U ground.
- .2        Other receptacles with ampacity and voltage as indicated.
- .3        Receptacles within dwelling units with the exception of receptacles used for microwaves, refrigerators, freezers or kitchen counters shall be tamper-resistant. These receptacles shall indicate "TAMPER RESISTANT" OR "TR" in accordance with CSA C22.2 No.42

**2.4            PHOTOELECTRIC LIGHTING CONTROL**

- .1        Mounting as indicated on drawings.
- .2        Capable of switching wattage design on drawings.
- .3        Switching on lights at 20 lx.
- .4        Switching off lights at 500 lx.
- .5        Switching time delay of 30 s to avoid false switching.

- .6 Install photoelectric controls in accordance with manufacturer's instructions.
- .7 Photoelectric control shall be Tork 2000/3000 Series or approved equal.

**2.5 COVER PLATES**

- .1 Colour: white bakelite
- .2 Cover plates from one manufacturer throughout project.
- .3 White cover plates, thickness 2.5 mm for wiring devices mounted in flush or surface mounted outlet box.
- .4 Weatherproof spring-loaded cover plates, complete with gaskets for receptacles indicated as weatherproof on drawings.

**2.6 CONTACTORS**

- .1 Electro-magnetically operated, Mechanically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .2 Breaker or Fused switch combination contactor as indicated.
- .3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .4 Mount in CSA Enclosure 1 unless otherwise indicated.
- .5 Include following options in cover:
  - .1 Red indicating lamp.
  - .2 Stop-Start pushbutton.
  - .3 Hand-Off-Auto selector switch.
  - .4 On-Off selector switch.

**2.7 OCCUPANCY SENSORS**

- .1 Provide and install all occupancy sensors, power packs/base, relays and all other items required to complete the system.
- .2 Shop Drawings shall be provided as per Section 16 000.

**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 as indicated on drawings.
- .2    Receptacles:
  - .1    Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2    Mount receptacles at height as indicated on drawings.
  - .3    Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3    Cover plates:
  - .1    Protect cover plate finish with paper or plastic film until painting and other work is finished.
  - .2    Install suitable common cover plates where wiring devices are grouped.
  - .3    Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .4    Occupancy Sensors:
  - .1    Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
  - .2    Test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.
  - .3    Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely check the installation prior to energizing the system. Each installed occupancy sensor shall be tested in the test mode to see that lights turn off and on based on occupancy.

**END OF SECTION**

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**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Materials and components for dry type transformers up to 600 V primary, equipment identification, noise/vibration equipment and transformer installation.

**1.2                REFERENCES**

- .1        The transformer shall conform to A.S.A. C57.12 NEMA TRI, CEMA L2 current standards and CSA approved.
- .2        All transformers must conform to CAN/CSA-C802.

**1.3                PRODUCT DATA**

- .1        Submit product data in accordance with Section 16 000.

**Part 2            Products**

**2.1                TRANSFORMERS**

- .1        Use transformers of one manufacturer throughout project.
- .2        Transformers installed in sprinklered areas shall have a sprinklerproof shield.
- .3        Design:
  - .1        Type: K-13 factor dry type, 1.2 kV class.
  - .2        Basic Impulse Level (BIL): 10 kV.
  - .3        1 or 3 phase, 60 Hz with voltages and capacity per drawing.
  - .4        Voltage taps: (4) – 2 ½ %, (2) - F.C.A.N. (2) - R.C.B.N.
  - .5        Insulation: Class H, 150 degrees C temperature rise for windings and 55 degrees C temperature rise for lead connections when operated continuously at rated voltage and full load current.
  - .6        Sound level: Current standard
  - .7        Equipped with terminal boards, tap changing links, solderless connection and ventilated case enclosure.
  - .8        Manufacturer: Marcus Transformer or approved equal.

**2.2                EQUIPMENT IDENTIFICATION**

- .1        Provide equipment identification in accordance with Section 16 000.
- .2        Nameplate wording: indicate Manufacturer's name, Rating in kilovolt-amperes, Rated full-load temperature rise, Primary and secondary voltage ratings, Frequency in hertz, and Rated impedance, if of the power or distribution type.



**Part 3            Execution**

**3.1                INSTALLATION**

- .1    Mount dry type transformers up to 45 kVA on floor, wall or adequately suspended from slab.
- .2    Mount dry type transformers above 45 kVA on floor.
- .3    Provide a 25 mm thick neoprene/steel/neoprene waffle type isolation pad (50 durometer maximum) between each floor mounted transformer and housekeeping pad. Provide flat steel plates on top of pads for protection from channel edges. Provide neoprene mounts for suspended transformers.
- .4    Conduit connection shall be flexible metal type to allow for vibration isolation.
- .5    Install floor mounted transformers on a 100 mm concrete base.
- .6    Ensure adequate clearance around transformer for ventilation.
- .7    Install transformers in level upright position.
- .8    Remove shipping supports only after transformer is installed and just before putting into service.
- .9    Loosen isolation pad bolts until no compression is visible.
- .10    Make primary and secondary connections in accordance with wiring diagram.
- .11    Energize transformers after installation is complete.

**END OF SECTION**

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**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        Materials and installation for switchboards.
- .2        Materials and installation for load break switches and enclosures.

**1.2            RELATED SECTIONS**

- .1        Section 16 491 - Fuses.

**1.3            REFERENCES**

- .1        All current applicable standards
  - .1        American National Standards Institute (ANSI)
  - .2        Canadian Standards Association (CSA International)
  - .3        C.E.M.A. and I.E.E.E.
  - .4        Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .5        National Electrical Manufacturers Association (NEMA)

**1.4            DESCRIPTION OF SYSTEM**

- .1        Primary switchgear assembly to include:
  - .1        Enclosure.
  - .2        Load interrupter switch.
  - .3        Busbar.
  - .4        Metres

**1.5            SHOP DRAWINGS**

- .1        Submit shop drawings in accordance with Section 16 000.
- .2        Indicate:
  - .1        Floor anchoring method and dimensioned foundation template.
  - .2        Dimensioned cable entry and exit locations.
  - .3        Dimensioned cable termination height.
  - .4        Dimensioned position and size of busbars and details of provision for extension.
  - .5        Dimensioned positions of main connections, including air clearances and support insulators.
  - .6        Overall length, height and depth of complete switchgear.
  - .7        Layout of internal and front panel components suitably identified.
  - .8        Time current characteristics curves of protection devices.

**1.6 STORAGE AND PROTECTION**

- .1 Store switchgear on site in protected, dry location. Cover with plastic to keep off dust.

**1.7 DELIVERY AND STORAGE**

- .1 Ship and store switchgear assembly in upright position.
- .2 Store in weather protected, warm, dry enclosure.
- .3 Keep doors locked and protect instruments from damage and dust.

**1.8 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 16 000 – Operating Manuals.
- .2 Include: 3 spare fuses for each size and type.
- .3 Compartments for spare fused switch assemblies shall be fully equipped.

**Part 2 Products**

**2.1 GENERAL**

- .1 Rating: indoor, 347/600 Volts, three phase, four wire, grounded, capacity as per drawings rated for 100%.
- .2 Primary enclosure: metal enclosed free standing, indoor, floor mounted, containing fusible switches as per drawings.
- .3 Cubicles: Free standing, dead front with sprinkler hoods.
- .4 Provision for installation of power supply authority metering in main electrical room.
- .5 Distribution section.
- .6 Hinged access panels with captive knurled thumb screws.
- .7 Metering provisions to suit the local P.U.C., arrangement shall be as indicated on the drawings. Provide all necessary metering cabinets, meter sockets, C.T.'s etc.
- .8 Ventilating louvers and panels/doors shall be on the front and rear.
- .9 Switchboard shall be sprinklerproof.
- .10 The structure shall consist of metal enclosed assemblies. The front enclosure shall include separate compartments for each switch and metering section.
- .11 All joints for buses and interconnections shall be high pressure silver to silver contacts. Insulated bus supports shall be flame retardant.

- .12 Clamp type terminals shall be provided for all incoming or outgoing cables unless bus duct connections are shown.
- .13 All hinged panels and doors shall be made of smooth steel reinforced for required rigidity and supported on concealed type hinges.
- .14 On the load side of the main switch a set of standard CT's and PT's complete with voltmeter, ammeter, and selector switches for the customers' use. Selector switches shall be installed on the face of the switchboard.
- .15 Switched instruments and controls shall be of the rotary operating type with positive means of maintaining contact positions.
- .16 Provision for future extension on either side of cubicle unit.
- .17 Provisions shall be made in the main bus for mounting all Hydro metering current transformers.
- .18 Provide bus connections, clamp type terminals, ground bus cubicles for metering and provision for future addition of fused switch assemblies.
- .19 Units designated as "spare" shall be a complete fusible unit, size as shown.
- .20 Units designated as "space" shall be space and bus provision for future installation of fusible units, size as shown.
- .21 All bus connections shall be tightened with a torque wrench to the manufacturers' recommendations.
- .22 Manufacturer: Cutler Hammer, Siemens or approved equal.

## **2.2 GROUNDING**

- .1 Copper ground bus not smaller than 50 x 6 mm extending full width of the assembly.
- .2 Ground bus shall be provided bolted to each unit and shall include a cable clamp for station ground connection as required by Section 10 of the Ontario Electrical Code.
- .3 Lugs at each end for grounding cable.
- .4 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

## **2.3 SUPPLY AUTHORITY METERING**

- .1 Mounting and wiring for following, supplied by supply authority:
  - .1 Current transformers.
  - .2 Watthour metre.
- .2 Receptacle: 120V, single phase, 60Hz, U-ground, duplex in each meter.

**2.4 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 16 000.
- .2 Lamacoid nameplates:
  - .1 Switchgear designation.
  - .2 Individual cubicle designations.
  - .3 Complete switchgear voltage.
  - .4 Main cubicle labelled: "Main Switch".
  - .5 Distribution units labelled.

**2.5 ENCLOSURE**

- .1 Main incoming section to contain:
  - .1 Ammeter and selector switch.
  - .2 Voltmeter and selector switch.
  - .3 Provision for metering.
- .2 Distribution sections to contain:
  - .1 Fusible disconnects sized as indicated.
  - .2 Copper bus, from main section to distribution sections.
- .3 Blanked off space(s) for future units.
- .4 Provision for future extension at either side.

**2.6 FINISHES**

- .1 Thoroughly clean equipment and apply a durable protective finish.
  - .1 Cubicle exteriors painted grey.
  - .2 Cubicle interiors painted grey.

**2.7 MAIN SWITCH**

- .1 Open type load break bolted contact switch for switchboard mounting and 100% rated.
- .2 Switches of continuous ampere rating as indicated, load-break bolted contact type with interrupting capacity to withstand and close onto circuits having available fault currents and shunt trip of 200,000 Amps rms symmetrical, for operation with a zero sequence ground fault relay, with HRC fuses.
- .3 Quick make, quick break, stored energy operating mechanism for electrical closing operation.
- .4 Switches front accessible for quick and easy installation or removal.
- .5 Manufacturer: Pringle

**Part 3            Execution**

**3.1                INSTALLATION**

- .1    Set and secure switchgear assembly in place on a 100 mm concrete base, rigid, plumb and square.
- .2    Make field connections in accordance with manufacturer's recommendations.
- .3    Connect ground bus to building system ground.
- .4    Check factory made connections for mechanical security and electrical continuity.
- .5    Check fuse sizes and relay settings against shop drawings.
- .6    Check fuse sizes and trip unit settings against co-ordination study to ensure proper working and protection of components.
- .7    Install main switch in accordance with manufacturer's instructions.
- .8    Run grounding conductor bare copper in conduit from ground bus to ground.
- .9    Check trip unit settings and fuse sizes against co-ordination study to ensure proper working and protection of components.

**3.2                FIELD QUALITY CONTROL**

- .1    Manufacturer shall make inspections and supervise the installation of the main switchboard. The inspection shall comprise of an examination of such equipment for the following:
  - .1    The type of equipment installed is that designated by the Contractor Documents.
  - .2    The wiring connections to all equipment components comply with H.E.P.C. of Ontario and C.S.A. requirements.
  - .3    The equipment has been installed in accordance with the manufacturers' recommendations.
  - .4    The ground fault device is set to the manufacturers' recommendations and is site tested.
- .2    The manufacturer shall supply reasonable amounts of technical assistance in respect to any of the above items. During the period of supervision or inspections, a technician shall be made available on site by the manufacturer.
- .3    Operate load switch closing and tripping mechanisms, to verify correct functioning.
- .4    Check insulation of switchgear assembly with megger. If values not satisfactory with current Electrical code, clean and dry switchgear and repeat tests until readings acceptable to manufacturer. Volt-ohm meter test are not acceptable.
- .5    Check phase rotation of each feeder.

- .6 Place primary switchgear in service and check ammeter and voltmeter readings to ensure proper functioning of instruments and satisfactory phase balance of loads.
- .7 Check fuses for correct type and rating.
- .8 Check for grounding and neutral continuity between station ground and system neutral.
- .9 Have representative commission final installation and certify proper operation and installation.

### **3.3 METER INSTALLATION**

- .1 Make connections in accordance with diagrams.
- .2 If applicable, ensure power factor corrective equipment connected on load side of meter.
- .3 Install instruments on switchboard.
- .4 Ensure adequate spacing between current transformers installed on each phase.
- .5 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.
- .6 Install meters in location free from vibration and shock.
- .7 Make connections in accordance with diagrams.
- .8 If applicable, ensure power factor corrective equipment connected on load side of meter.
- .9 Connect meter cabinets to ground.
- .10 Locate meters within 9 m of instrument transformers. Use 39 mm conduit for interconnections. Use separate conduit for each set of current transformer connections, exclusive for metering.

**END OF SECTION**



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**Part 1            General**

**1.1            INTENT**

- .1        Supply and install a standby power system to supply emergency electrical power in event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.

**1.2            REQUIREMENTS OF REGULATORY AGENCIES**

- .1        An electric generating system, consisting of a prime mover, generator, governor, coupling and all controls, must have been tested, as a complete unit, on a representative engineering prototype model of the equipment to be sold.
- .2        The generator system as a minimum shall conform to the requirements of the current issue of the CAN/CSA-C282, "Emergency electrical power supply for buildings".
- .3        The unit shall be supplied with Canadian Standards Association certification.

**1.3            MANUFACTURER QUALIFICATIONS**

- .1        This system shall be supplied by Total Power Ltd. or an approved equal company that is regularly engaged in the production of engine-alternator sets, automatic transfer switches, and associated controls, thereby providing one-source responsibility for the generating system and accessories.
- .2        The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.
- .3        The manufacturer must provide within their installation manual the recommended piping material for the exhaust system.

**1.4            SYSTEM DESCRIPTION**

- .1        Generating system consists of:
  - .1        Diesel engine.
  - .2        Alternator.
  - .3        Alternator control panel.
  - .4        Automatic transfer equipment.
  - .5        Battery charger and battery.
  - .6        Automatic engine room ventilation system.
  - .7        Fuel supply system.
  - .8        Exhaust system.
  - .9        Steel mounting base complete with battery rack.
  - .10      Synchronizing panel.
  - .11      Manual by-pass switch.
- .2        System designed to operate as a standby emergency electrical power supply.

**1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 16 000.
- .2 Include:
  - .1 Engine: make and model, with performance curves.
  - .2 Alternator: make and model.
  - .3 Voltage regulator: make, model and type.
  - .4 Automatic transfer switch: make, model and type.
  - .5 Alternator control panel: make and type of meters and controls.
  - .6 Governor type and model.
  - .7 Automatic engine room ventilation system.
  - .8 Cooling air requirements in m<sup>3</sup>/s.
  - .9 Fuel consumption.
  - .10 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
  - .11 Continuous full load output of set at 0.8PF lagging.
  - .12 Description of set operation including:
    - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
    - .2 Manual starting.
    - .3 Provide Safety Indicators and shutdowns as noted in current C282, Table 1. The indicator/function shall include but not be limited to the following:
      - .1 Overcranking.
      - .2 Over speed.
      - .3 High engine temp.
      - .4 Low lube oil pressure.
      - .5 Short circuit.
      - .6 Alternator overvoltage.
      - .7 Lube oil high temperature.
      - .8 Over temperature on alternator.
      - .9 Automatic Transfer switch in by-pass mode.
    - .4 Manual remote emergency stop.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 16 000.
  - .2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:
    - .1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel
-

system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.

- .2 Technical data:
  - .1 Illustrated parts lists with parts catalogue numbers.
  - .2 Schematic diagram of electrical controls.
  - .3 Flow diagrams for:
    - .1 Fuel system.
    - .2 Lubricating oil.
    - .3 Cooling system.
  - .4 Certified copy of factory test results.
  - .5 Maintenance and overhaul instructions and schedules.
  - .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

## **1.7 WARRANTY**

- .1 The standby electric generating system components, complete engine-generator and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of 24 months from the date of acceptance by Owners. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge.
- .2 The warranty period shall commence when a building occupancy is issued. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

## **1.8 EXTRA MATERIALS**

- .1 Provide maintenance materials, include:
  - .1 [2] Fuel filter replacement elements.
  - .2 [2] Lube oil filter replacement elements.
  - .3 [2] Air cleaner filter elements.
  - .4 [2] Sets of fuses for control panel.
  - .5 Any special tools for unit servicing.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 The emergency power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel and exhaust components have all been sized and designed around *Generac Power System's* equipment. Should any substitutions be made, the contractor shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs which may result from such

substitutions. As part of the submittals, the substitute manufacturer shall supply as a minimum engine, alternator and control panel wiring diagrams and schematics. Acceptable alternates shall include: Kohler, Cummins Power Generation, Onan, Caterpillar Inc.

- .2 The generator set LTP kW rating shall be as stated on the drawings which includes a minimum 10% reserve capacity.

## **2.2 DIESEL ENGINE-GENERATOR SET**

- .1 The prime mover shall be a liquid cooled, diesel fueled, turbocharged after-cooled engine of 4-cycle design. It will have a 6 cylinder block with a minimum displacement of 12.0 liters (729 cubic inches), with a minimum rating of 427 BHP. The unit requires a rated output as per drawings at an operating speed of 1800 RPM.
- .2 The engine is to be cooled with a unit mounted high static radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating with a normal engine coolant level. The radiator shall be designed for operation in 122 degrees F, 50 degrees C ambient temperature.
- .3 The intake air filter(s) with replaceable element must be mounted on the unit. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s). Engine coolant and oil drain extensions, equipped with pipe plugs, must be provided to outside of the mounting base for cleaner and more convenient engine servicing. A fan guard must be installed for personnel safety.
- .4 The engine shall have a battery charging DC alternator with a transistorized voltage regulator. Remote 2-wire starting shall be by a solenoid shift, electric starter.
- .5 The engine fuel system shall be designed for operation on No. 2 diesel fuel. A Primary Fuel Oil Filter shall be provided on the fuel oil supply line leaving the Day Tank including ball type service valves, water separator, manual fuel priming pump, fuel shutoff solenoid and all fuel lines must be installed at the point of manufacture. The manufacturer shall supply flexible fuel lines installed on the set, for connection to the fuel piping by Division 15. Provide a day tank: ULC listed 910 litre (200 imperial gallon) single-wall domestic fuel oil storage tank complete with saddles or pipe supports, complete with sufficient fuel for all testing purposes, plus a full tank upon turnover to owner, tank whistle, fuel sight gauge, float level switches to control electric fuel pump (where required), and "Low Fuel Alarm". The tank is to be complete with a minimum of 6 female threaded connections on top. All fuel and vent piping to be schedule 40 steel piping, fuel gauge, and end plugs for a complete system shall be supplied and installed by this Contractor. Fuel oil minimum capacity for one tank is 1.25 m<sup>3</sup>, dual tank systems a minimum of 2.50 m<sup>3</sup>. Fuel oil pump set, where supplied, is to be located within fuel containment area. Pump discharge relief valves to be adjusted to relieve system pressure at 1 psig above top of day tank outlet to generator.
- .6 The Primary Diesel Fuel Filter shall be capable of removing contaminants of 10 microns. Element shall be replaceable paper type.

- .7 The engine shall have a unit mounted, thermostatically controlled water jacket heater(s) to aid in quick starting. The wattage shall be as recommended by the manufacturer. The contractor shall provide proper branch circuit from the normal utility power source.
- .8 Sensing elements to be located on the engine for low oil pressure shutdown, high coolant temperature shutdown, low coolant level shutdown, over speed shutdown and over crank shutdown. These sensors are to be connected to the control panel using a wiring harness with the following features: wire number labeling on each end of the wire run for easy identification, each sensor connection shall be sealed to prevent corrosion and all wiring to be run in flexible conduit for protection from the environment and any moving objects.
- .9 Provide the following items installed at the factory:
  - .1 The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. This shall include also all approved flange nuts, bolts and washers for all connections.
- .10 The following equipment is to be provided by the engine-generator set manufacturer and shipped loose with the unit: hockey puck type muffler, spring vibration isolators complete with neoprene isolation pads, operators manuals.
- .11 Engine speed shall be controlled by a synchronous governor with no change in alternator frequency from no load to full load. Steady state regulation is to be 0.25%.
- .12 One step load acceptance shall be 100% of engine-generator set nameplate rating and meet the requirements of NFPA 110 paragraph 7.13.7
- .13 The generator system shall support generator start-up, load transfer and fire pump startup within 15 seconds.

### **2.3 ALTERNATOR**

- .1 The alternator shall be a 4 pole revolving field type, 12 lead, wired for 347/600 VAC 3 phase, 4 wire, 60hz, sized as per drawings with a permanent magnet driven exciter. Photosensitive components will not be permitted in the rotating exciter. The stator shall be direct connected to the engine to ensure permanent alignment. The generator shall meet temperature rise standards for Class "H" insulation, operate within Class "F" standards for extended life. All leads must be extended into an AC connection panel. The alternator shall be protected by internal thermal overload protection and an automatic reset field circuit breaker.
- .2 One step load acceptance shall be 100% of engine-generator set nameplate rating and meet the requirements of NFPA 110 paragraph 5-13.2.6. The generator set and regulator must sustain at least 300% short circuit current for 10 seconds during 3 phase fault.
- .3 Output load terminals complete with rated lugs that are an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. A fully rated, isolated neutral must be included by the generator set manufacturer to insure proper sizing.

- .4 The electric plant (engine and alternator) shall be mounted with internal vibration isolation onto a welded steel base.
- .5 Provide a mainline circuit breaker carrying the UL/CSA mark shall be factory installed. The breaker shall be rated as per drawings and mounted in the genset connection box. The line side connections are to be made at the factory. The circuit breaker shall incorporate an auxiliary/alarm switch, wired to the generator controller for alarm when the breaker is in the “OFF” or “TRIPPED” position. Output lugs shall be provided for load side connections. A system utilizing manual reset field circuit breakers and current transformers is unacceptable.

## **2.4 CONTROLS**

- .1 The generator control system shall be a fully integrated microprocessor based control system for standby emergency engine generators meeting all requirements of the latest edition of CSA-C282.
- .2 The generator control system shall be a fully integrated control system enabling remote diagnostics and easy building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: engine protection, alternator protection, speed governing, voltage regulation and all related generator operations. The generator controller must also provide seamless digital integration with the engine’s electronic management system if so equipped. Generator controller’s that utilize separate voltage regulators and speed governors or do not provide seamless integration with the engine management system are considered less desirable.
- .3 Communications shall be supported with building automation via the Modbus protocol without network cards or protocol exchangers. Optional internet and intranet connectivity shall be available.
- .4 The control system shall provide an environmentally sealed design including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The use of non-encapsulated boards, edge cards, and pc ribbon cable connections are considered unacceptable.
- .5 Circuit boards shall utilize surface mount technology to provide vibration durability. Circuit boards that utilize large capacitors or heat sinks must utilize encapsulation methods to securely support these components.
- .6 A predictive maintenance algorithm that alarms when maintenance is required. The controller shall have the capability to call out to the local servicing dealer when maintenance is required.
- .7 Diagnostic capabilities should include time-stamped event and alarm logs, ability to capture operational parameters during events, simultaneous monitoring of all input or output parameters, callout capabilities, support for multi-channel digital strip chart functionality and .1msec data logging capabilities.
- .8 The control system shall provide pre-wired customer use I/O: 4 contact inputs, 2 analog inputs, 4 relay outputs, and communications support via RS232, RS485, and an optional

modem. Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. In addition, custom ladder logic functionality shall be supported to provide application support flexibility. The ladder logic function shall have access to all the controller inputs and customer assignable outputs.

- .9 The control panel will display all user pertinent unit parameters including:
  - .1 Engine and alternator operating conditions
  - .2 Oil pressure and optional oil temperature
  - .3 Coolant temperature and level alarm
  - .4 Fuel level (where applicable)
  - .5 Engine speed
  - .6 DC battery voltage
  - .7 Run time hours
  - .8 Generator voltages, amps, frequency, kilowatts, and power factor
  - .9 Alarm Status
  - .10 Current Safety Indicators and shutdown conditions per CAN/CSA-C282
  - .11 Alarm Log of last twenty alarm events (date and time stamped)
- .10 For system reliability and security concerns, access to and manipulation of the internal operating parameters and alarm limits shall be conducted via password protected PC based software by trained personnel. System configuration support shall be provided locally or remotely by the manufacturer's servicing representatives.
- .11 The following equipment is to be installed at the engine-generator set manufacturer's facility:
  - .1 A DPDT relay shall be socket mounted in the generator control panel and operate on engine start and run for customer connection to motorized dampers, and fire alarm zone as required.

## **2.5 UNIT ACCESSORIES**

- .1 The following equipment is to be installed at the engine-generator set manufacturer's facility:
  - .1 The unit will provide means for attaching a flexible coupling between the engine radiator and the building cooling air discharge duct.
  - .2 A heavy duty, lead acid 24VDC battery set rated at 925 CCA, 2 x BCI group 31 shall be installed by the generator set manufacturer. Provide all inter-cell and connecting battery cables as required. Provide battery rack.
  - .3 Provide an automatic dual rate battery charger. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The output voltage is to be determined by the charge current rate. The charger must be protected against a reverse polarity connection. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.
- .2 The following equipment is to be provided by the engine-generator set manufacturer and shipped loose with the unit:



- .1 Exhaust silencer shall be provided of the size as recommended by the manufacturer and shall be minimum hospital grade. The muffler system shall consist of a hockey puck type muffler, Silex model ICE or approved equal, located above the generator with either single or dual inlets. Division 15 is to install the muffler, supply all piping after the muffler to terminate the exhaust pipe with an open end vertical exhaust pipe complete with 50mm open end bottom drain outlet. Division 15 shall insulate the muffler and all piping. These components must be properly sized to assure operation without excessive back pressure when installed.
- .2 Spring type vibration isolators of the type, size and number recommended by the manufacturer or acoustical consultant shall be supplied loose to support the engine generator set to reduce transmitted vibration. The spring isolators shall be bolted to the housekeeping pad and ribbed neoprene isolation pads under the spring base to prevent the genset from "walking".

## **2.6 AUTOMATIC TRANSFER SWITCH**

- .1 The Automatic Transfer Switch must be CSA approved to CAN/CSA-C22.2 No. 178 standard as a complete assembly.
  - .2 Transfer switch shall be complete with a minimum one-way bypass to emergency and shall be 100% rated continuous amperes as noted on plans.
  - .3 Operation on rated voltage, 3 phase, 4 wire, 60 cycles, 0.8 pf on normal or standby sources.
  - .4 Transfer switch shall transfer the load from normal to emergency when voltage on any one phase falls to 70% or less for three seconds and shall automatically restore power to normal when voltages reaches 90% or more on all three phases for a period of two minutes.
  - .5 Transferring from normal to emergency, an auxiliary contact shall first close the load.
  - .6 Switch shall include a plant exerciser timer for weekly automatic starting to simulate a power failure. All controls shall be of the latest microprocessor design.
  - .7 Mounting shall be in a separate wall mounted or floor standing cabinet
  - .8 Include in the transfer switch the following time delays:
    - .1 Nominal 3-second time delay on engine start and transfer to override harmless power dips and outages.
    - .2 Maintained test switch to simulate normal source failure.
    - .3 Engine start contact. Pre and post elevator transfer contacts. Provide 2-N.O. contacts and 2-N.C. contacts
    - .4 Auxiliary contact on same shaft as main contacts (closed on normal)
    - .5 Auxiliary contact on same shaft as main contacts (closed on emergency)
    - .6 Full phase protection. Two of the phase relays are nominal 70% to 90% type and one is close differential type factory set for 92% to 95% pickup, 83% to 85% dropout.
-

- .7 Lockout relay on emergency source, sensitive to voltage and frequency to prevent transfer until the emergency source is approximately at normal voltage and speed.
- .8 Adjustable time delay on retransfer to normal source with 5 minutes unloaded running time of standby plant. Built-in circuitry automatically nullifies this time delay if the emergency source fails and power is available at normal source.
- .9 The control panel shall be complete with an in-phase monitor, or on breaker style transfer switches, a time delay in the neutral position, to prevent damage to large motors on transfer.
- .10 The transfer switch shall be equipped with N.O. and N.C. output contacts and an indicator light for “ATS in bypass mode”.
- .11 The automatic transfer switch shall be ASCO 7ATB Open Transition Series, Cutler Hammer model 4BIH series with ATC-600 controller, or approved equal

## **2.7 FACTORY TESTING**

- .1 Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Submit records of tests. Tests shall include:
  - .1 Verifying all safety shutdowns are functioning properly.
  - .2 Verify single step load pick-up per NFPA 110-1996, Paragraph 5-13.2.6.
  - .3 Verify transient and voltage dip responses and steady state voltage and speed (frequency) checks.

## **2.8 OWNER’S MANUALS**

- .1 Three (3) sets of owner’s manuals specific to the product supplied must accompany delivery of the equipment as per section 16 000. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

## **2.9 SERVICE**

- .1 Supplier of the electric plant and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. A service maintenance contract shall also be made available to the owner, after final commissioning is completed.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations, as reviewed by the Engineer.

**3.2                FIELD QUALITY CONTROL**

- .1            Performance tests (in accordance with the current C282):
  - .1            The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:
    - .1            Ensuring the engine starts (both hot and cold) within the specified time.
    - .2            Verification of engine parameters within specification.
    - .3            Verify no load frequency and voltage, adjusting if required.
    - .4            Test all automatic shutdowns and alarms of the engine-generator.
    - .5            Full load test.
    - .6            Balance loading of spring isolators at each point of loading.
  - .2            Verification of exhaust system, fuel system and ventilation system as installed by others.

**END OF SECTION**

**DISCONNECT SWITCHES - FUSED AND NON-FUSED**

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**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Supply and install fused and non-fused disconnect switches.

**1.2                RELATED SECTIONS**

- .1            Section 16 491: Fuses – Low Voltage.

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International).

**Part 2            Products**

**2.1                DISCONNECT SWITCHES**

- .1            Fusible and non-fusible disconnect switches shall be Type 'A' horsepower, rated in CSA enclosure for indoor use and weatherproof CSA enclosure for outdoors.
- .2            Disconnect switches shall have ample gutter space for top or bottom wiring and shall have fully visible blades when in OFF position with cover open.
- .3            Quick-make, quick-break action.
- .4            Mechanically interlocked door to prevent opening when handle in ON position.
- .5            Fuses: size as indicated, in accordance with Section 16 491: Fuses - Low Voltage.
- .6            Disconnects shall be suitable for operation under full load.
- .7            Disconnect switches located in sprinklered areas shall be sprinklerproof.
- .8            Provision for padlocking.
- .9            ON-OFF switch position indication on switch enclosure cover.
- .10          All disconnect switches in public areas shall be tamperproof.
- .11          Manufacturer: Siemens or Cutler Hammer.

**2.2                EQUIPMENT IDENTIFICATION**

- .1            Provide equipment identification in accordance with Section 16 000.
- .2            Indicate name of load controlled on nameplate.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install an unfused disconnect switch for all motors and equipment unless a built-in disconnect is provided as an integral part of the starter.
  
- .2        Disconnect switch locations shall comply with the Electrical Safety code and the authority having jurisdiction.

**END OF SECTION**

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**Part 1            General**

**1.1                INTENT**

- .1        Supply and install panelboards complete with breakers or fuses as shown on the drawings.

**1.2                REFERENCES**

- .1        The panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of EEMAC and CSA.

**1.3                SHOP DRAWINGS**

- .1        Submit shop drawings in accordance with Section 16 000.
- .2        Shop Drawings to include as a minimum; electrical detail of panel, branch breaker type, quantity of breakers or fuses, ampacity and enclosure dimension.

**Part 2            Products**

**2.1                GENERAL**

- .1        Mains, number of branch circuits, branch breakers and fused QMQB units of sizes, voltage, capacity and quantity circuit breakers or fuses as indicated on drawings.
- .2        All connected loads shall be balanced across each phase in the panel.
- .3        Bus and breakers or fuses rated as indicated on drawings.
- .4        Gutter shall be of suitable size to accommodate feeders and branch circuit wiring.
- .5        Gutter space to be provided if required on drawings for metering purposes.
- .6        Panelboards shall have short circuit ratings not less than 18,000 (10,000 for loadcentres) amperes RMS symmetrical.
- .7        Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Provide door-in-door type construction so that the trim may be opened to access wireways without removing the trim from the panel. All trims shall have concealed mounting hardware when the door is closed.
- .8        Panelboard trims shall cover all live parts. Switching device handles shall be accessible.
- .9        Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent typewritten identification.
- .10      Panels located within sprinklered areas shall be complete with sprinklerproof protection.
- .11      Steel cabinet shall have a single door, key lock. Two keys for each panelboard and key panelboards alike shall be turned over to owner upon completion.



- .12 Wiring shall be in a neat workmanship fashion.
- .13 Copper or aluminum bus with neutral of same ampere rating as mains.
- .14 Main bus bars shall be plated, sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.
- .15 Full-size insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
- .16 Trim with concealed front bolts and hinges.
- .17 Run 2- 50 mm spare conduit up to ceiling space from each recessed distribution panel.
  - .1 Terminate these conduits in junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .18 Power panels shall contain circuit breakers or fusible units as shown on the drawings only.
- .19 Panelboards shall be of one manufacturer; Siemens or Cutler Hamer.

## **2.2 POWER PANELS**

- .1 Power panels shall have fusible switches or breakers with ratings indicated on the drawings. Fuses shall not be replaced with breakers and vice-versa unless approved by the Engineer.
- .2 Fusible Switch Type:
  - .1 Fusible switch units shall be quick-make, quick-break design.
- .3 Circuit Breaker Type:
  - .1 Power panels and the devices contained therein shall have fully rated interrupting ratings as indicated on the drawings. Panelboards shall have molded case circuit breakers.
- .4 Run 2- 50 mm spare conduit up to ceiling space from each recessed distribution panel.
  - .1 Terminate these conduits in junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

## **2.3 BRANCH CIRCUIT PANELBOARDS**

- .1 Panelboards shall have circuit breakers as indicated on the drawings.
- .2 Panelboards shall be 120/208V, 3 phase, 4 wire, unless otherwise indicated.
- .3 Panelboards in closets and service rooms shall be surface mounted.

- .4 Panelboards in common areas shall be flush mounted
- .5 Trim and door finish: grey enamel
- .6 Run 2- 25 mm spare conduits up to ceiling space from each panel.
  - .1 Terminate these conduits in junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

#### **2.4 SUITE PANELBOARDS**

- .1 Panels (load centres) for each suite shall be 120/208 V, Single phase, 3 wire.
- .2 250 V rated.
- .3 Steel cabinet, single door, finger lift lock.
- .4 Panel to be flush mounted.
- .5 Breakers: Flush mounted, plug-in or bolt on, quantity as per drawings.
- .6 Trim and door finish: white.
- .7 Typewritten directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

#### **2.5 CUSTOM BUILT PANELBOARD ASSEMBLIES**

- .1 125 mm relay section on one side of panel as indicated for installation of low voltage remote control switching components.
- .2 Contactors in mains as indicated.
- .3 Feed through lugs.

#### **2.6 CIRCUIT BREAKERS**

- .1 Circuit breaker to operate automatically by means of thermal and magnetic tripping, trip indicated and time delay on overloads.
  - .2 Breakers: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
  - .3 Circuit breakers to have minimum 18 kA symmetrical rms interrupting capacity rating.
  - .4 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
  - .5 Ground fault interrupter breakers shall be provided as indicated on drawings.
  - .6 Breakers feeding bedroom receptacles shall be “arc fault interrupter” type.
  - .7 Breakers shall be single pole or multi pole with a single handle for common trip.
-

- .8 Size of breakers as indicated on drawings.
- .9 Ground fault interrupter breakers shall be provided as indicated on drawings.
- .10 Twin breakers are not accepted.
- .11 Moulded case Circuit breakers:
  - .1 Molded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics. Ground fault protection shall be provided where indicated.
  - .2 Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- .12 Bolt-on type:
  - .1 Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
  - .2 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management and control system (EMCS) panels and fire alarm panels.
- .13 Breakers shall be of one manufacturer: Siemens or Cutler Hamer
- .14 Breakers applied following manufacturer's guidelines and accepted best practice.

## **2.7 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 16 000.
- .2 Complete circuit directory with typewritten legend showing location and load of each circuit.

**Part 3          Execution**

**3.1              INSTALLATION**

- .1      Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2      Install surface mounted panelboards on 19mm plywood backboards pre painted grey glyptol. Where practical group panelboards on common backboard.
- .3      Connect loads to circuits.
- .4      Connect neutral conductors to common neutral bus with respective neutral identified.
- .5      Ground and neutral conductor shall be provided for each three branch circuits, connected to different phases of a three phase main at the panels.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

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

**1.2                SHOP DRAWINGS AND PRODUCT DATA**

- .1    Submit shop drawings and product data in accordance with Section 16 000.
- .2    Submit fuse performance data characteristics for each fuse type and size above 600 A. Performance data to include: average melting time-current characteristics.
- .3    Fuse supplier shall provide a fuse co-ordination study for review by Engineers.

**1.3                DELIVERY AND STORAGE**

- .1    Ship fuses in original containers.
- .2    Do not ship fuses installed in switchboard.

**1.4                MAINTENANCE MATERIALS**

- .1    Provide maintenance materials in accordance with Section 16 000.
- .2    Provide three spare fuses of each type and size in a locked cabinet within the main electrical room.

**Part 2            Products**

**2.1                FUSES GENERAL**

- .1    Fuses: product of one manufacturer for entire project: Bussmann or Gould Shawmut.
- .2    Fuses shall be sized in accordance with load criteria and manufacturers' recommendations.

**2.2                FUSE TYPES**

- .1    Fuses greater than 600 Amps:
  - .1        Class L fuses (formerly HRC-L ).
    - .1            Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2    Fuses less than or equal to 600 Amps:
  - .1        Class J fuses (formerly HRCI- J).
    - .1            Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum; used for transformers and motors.

- .2 Type J2, fast acting; used for all other circuits.

**2.3 FUSE STORAGE CABINET**

- .1 Fuse storage cabinet, floor mounted, hinged, lockable front access door located in the main electrical room.

**2.4 EQUIPMENT IDENTIFICATION**

- .1 Clearly indicate on the inside cover of each fusible unit, the amperage rating, and catalogue number of replacement fuses to be used.

**Part 3 Execution**

**3.1 INSTALLATION**

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

**END OF SECTION**

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**Part 1           General**

**1.1            INTENT**

- .1       Provide an infra-red scan complete with report for all major electrical equipment.

**Part 2           Products**

**2.1            GENERAL**

- .1       Ninety days prior to the expiry of the manufacturers' and this Contractors' warranty on the major electrical devices, this Contractor shall provide an infra-red scan and sub-sequent report.
- .2       The scanning shall be inspected with an infra-red Fast Scan Thermal Imaging camera with video tape capabilities as well as facilities for taking black and white infra-red thermograms of all hot spots encountered and temperature differences.

**Part 3           Execution**

**3.1            PROCEDURE**

- .1       The infra-red inspection shall include equipment, joints and connections on the following equipment:
  - .1       Main Switchboards
  - .2
  - .3       Distribution Power panels
  - .4       Disconnect switches
  - .5       Splitters
  - .6       Transformers
- .2       An infra-red report, signed by a Professional Electrical Engineer or Certified Thermographer complete with colour photographs, black and white thermograms of all hot spots and suggested recommendations for repair shall be submitted within two weeks of scanning.

**END OF SECTION**

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**Part 1            General**

**1.1            INTENT**

- .1        Supply and install all electric heaters and thermostats as indicated on the drawings and specified herein.

**1.2            PRODUCT DATA**

- .1        Submit product data in accordance with Section 16 000.
- .2        Submit product data sheets for electric heaters.
  - .1        Include product characteristics, performance criteria, physical size, limitations and finish.

**1.3            CLOSEOUT SUBMITTALS**

- .1        Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 16 000.

**Part 2            Products**

**2.1            MANUFACTURERS**

- .1        Acceptable manufacturers: Stelpro, Chromalox or approved equal.

**2.2            GENERAL**

- .1        Supply and install electric baseboard heaters, unit heaters, convection heaters and force flow heaters, as specified on the drawings.
- .2        Supply and install thermostats, control transformers, contactors and mounting hardware, as required to ensure proper operation.
- .3        Cabinet: aluminum, fitted with brackets for rod or wall mounting.
- .4        Electric heating equipment shall be installed and wired in accordance with O.H.E.P.C. regulations and Provincial Inspection Department requirements.

**2.3            ELECTRIC DUCT HEATERS**

- .1        If required will be supplied and mounted by the Mechanical Division.
- .2        This Division shall provide power supply, wiring and disconnect switch only.

**2.4            CONTROLS**

- .1        Wall mounted or unit mounted thermostats as per drawings
- .2        Thermostats located in public areas shall be tamperproof.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations indicated on drawings.
- .3 Make power and control connections.
- .4 Baseboard heaters shall be mounted 40 mm above finished floor unless otherwise noted.
- .5 Ensure heaters and controls operate correctly.

**END OF SECTION**

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**Part 1        General**

**1.1        INTENT**

- .1        Supply and install all interior and exterior fixtures as specified on the drawings.

**1.2        SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with Section 16 000 - Submittal Procedures.
- .2        Include all available photometric data for public area fixtures.

**Part 2        Products**

**2.1        GENERAL**

- .1        Letter at each fixture designates type as per schedule on drawings.
- .2        All exterior lighting shall be controlled by a photo-cell, unless otherwise noted.

**2.2        LAMPS**

- .1        Incandescent:
  - 1.        All incandescent lamps shall be provided with medium base, 120 Volt, frosted lamps, rated 1000 hours, wattage as per drawings, unless otherwise noted.
- .2        Fluorescent:
  - .1        Straight 915 mm lamps shall be rapid start, T8, 25 watts unless otherwise noted.
  - .2        Straight 1200 mm lamps shall be rapid start, T8, 32 watts unless otherwise noted.
- .3        H.I.D. Fixtures and Lamps:
  - .1        Lamps shall be rated 120 V, wattage as per drawings.
- .4        Exit lights:
  - .1        Lamps shall be rated 120 V, wattage as per drawings.

**2.3        BALLASTS**

- .1        Fluorescent fixtures:
    - .1        Rating: 120 V, 60 Hz, unless otherwise noted.
    - .2        Rapid start, electronic.
    - .3        Totally encased and designed for 40°C ambient temperature.
    - .4        Power factor: minimum 95%.
    - .5        Operating frequency of electronic ballast: 21 kHz minimum to operate without visible flicker.
    - .6        Ballast Factor: greater than 0.90
    - .7        Mounting: integral with luminaire.
-

- .2 H.I.D. ballast: design:
  - .1 Rating: 120 V, 60 Hz, unless otherwise noted.
  - .2 Provide circuitry for quartz re-strike if applicable
  - .3 Totally encased and designed for 40 °C ambient temperature.
  - .4 Power factor: minimum 95 %.
  - .5 Minimum starting temperature: minus 29°C at 90% line voltage.

**2.4 INCANDESCENT DIMMERS**

- .1 Shall fit single-gang standard switch box.
- .2 Gangable without removing side sections or derating capacity.
- .3 Push to turn ON or OFF without disturbing preselected brightness setting.
- .4 Rated: 120 V
- .5 No perceptible flicker at any point in dimming range and no perceptible humming.
- .6 Operate at ambient temperature of 0 to 40°C.

**2.5 LUMINAIRES**

- .1 Incandescent luminaire design:
  - .1 Rating: 120 V, wattage as per drawings.
  - .2 Luminaire designed for mounting as per drawing.
- .2 Fluorescent luminaire design:
  - .1 Rating: 120 V, wattage as per drawings.
  - .2 Luminaire designed for mounting as per drawing.
  - .3 Cove lighting to be continuous
- .3 H.I.D. luminaire design:
  - .1 Rating: 120 V, wattage as per drawings.
  - .2 Luminaire designed for mounting as per drawing complete with stand-by quartz lamp if applicable.

**2.6 EMERGENCY BATTERY UNIT**

- .1 Supply and install a 6 volt D.C., long life, sealed, lead emergency battery unit in the diesel generator room and in any location shown on the drawings. The unit shall be complete with a cordset and two 9 watt lamp heads.
- .2 The battery unit shall be fastened directly to the wall, as high as possible, to clear all electrical and mechanical equipment. Provide a single receptacle adjacent unit.
- .3 The battery unit shall be manufactured by AimLite or approved equal, unless otherwisely noted.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Supply and install luminaires as indicated on drawings, as per manufacturers recommendations.

**3.2 WIRING**

- .1 Connect luminaires to lighting circuits with minimum #10 copper conductor.

**3.3 LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations support luminaires from structure or ensure ceiling can support weight in accordance with local inspection requirements.

**3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

**3.5 INCANDESCENT DIMMERS**

- .1 Install dimmers in accordance with manufacturer's instructions.
- .2 Connect lamp circuits to dimmer.
- .3 Demonstrate that dimming systems are installed as indicated.
- .4 Demonstrate that dimming systems operate as intended and that there are no problems in starting lamps, nor in keeping them lit and flicker-free at any setting of dimming intensity control.

**END OF SECTION**



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**Part 1            General**

**1.1                RELATED DOCUMENTS**

- .1        Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification Sections, apply to this section.
- .2        All contract documents and addendum

**1.2                RELATED SECTIONS**

- .1        Section 16 141 - Electrical Devices.

**1.3                PRODUCT DATA**

- .1        Submit product data in accordance with Section 16 000.
- .2        Shop drawings to include:
  - .1        Single line diagrams
  - .2        Internal wiring
  - .3        Wire counts
  - .4        Physical dimension of each item
  - .5        Manufacturer's installation instructions.

**1.4                SUMMARY**

- .1        The Electrical Contractors, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The electrical contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning relay lighting control system as described herein and shown on the plans.
- .2        This section includes the following:
  - .1        General specification for the relay lighting control system.

**1.5                MANUFACTURERS REQUIREMENTS**

- .1        Basis of design product: Leviton Manufacturing Co. Inc. GreenMAX or subject to compliance and prior approval with specified requirements of this section, one of the following:
  - .1        Leviton Manufacturing Co. Inc. GreenMAX
- .2        Other manufacturers who wish to bid must submit a complete bill of materials and company information listing qualifications and experience to the Specifier ten working days prior to bid date for permission to bid. All manufacturers must comply with the specifications herein in every detail.
  - .1

**1.6 MANUFACTURERS SERVICES**

- .1 Shop Drawings: Shop Drawings shall be submitted for approval within 30 days after receipt of contract. No fabrication of equipment is to proceed prior to approval of these drawings. Submittal package shall contain:
  - .1 A complete bill of materials
  - .2 Sets of catalog cuts for standard equipment
  - .3 Sets of shop drawings detailing all mechanical and electrical equipment including one line diagrams, wire counts, internal wiring, and physical dimensions of each item. Marked up catalog cuts are unacceptable.
- .2 Jobsite Checkout: Upon completion of all contractor's wiring, and after all fixtures are installed and lamped, the contractor shall request the services of a factory representative to completely check out the system prior to energizing the system. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.
- .3 Documentation: Two complete sets of as-built drawings shall ship with the equipment when it leaves the factory, along with operations and maintenance manuals for the relay system.
- .4 Ballasts: It shall be the responsibility of the installing contractor to insure that any fluorescent ballasts supplied are compatible with the equipment being furnished on this project.
- .5 Installation Instructions: Installing contractor shall follow manufacturer's installation instructions.
- .6 Within two weeks after system turn-on is completed, the manufacturer shall provide three sets of operation and maintenance manuals along with a copy of the written warranty.

**1.7 QUALITY ASSURANCE**

- .1 Source Limitations: Obtain lighting controls from a single source with total responsibility for compatibility of lighting control system components specified in this Section, in division 13 Section "Lighting Controls" and in Division 16 section "Relay Lighting Controls".
- .2 Performance Testing Requirements: All equipment shall be 100% tested. Sample testing is not acceptable.
- .3 All standard system line voltage components shall be UL listed and so labeled when delivered to the job site.
- .4 Building Codes: All specified relays and control devices shall comply with the National Electrical Code. All units shall also comply with applicable local building codes.
- .5 Installer Qualifications: Installer shall be experienced in performing the work of this section, and specialize in installation of work similar to that required for this project.

- .6 Source Limitations: To assure compatibility, obtain relay systems and controls from a single source with complete responsibility over all lighting systems and controls, including accessory products.
- .7 Manufacturer Requirements
  - .1 Experience: The manufacturer shall have been continuously engaged in the manufacture of architectural lighting controls, and relays for no less than ten years.
  - .2 Testing: Manufacturer shall perform functional testing of all components to confirm proper operation prior to shipment.

**1.8 DELIVERY, STORAGE & HANDLING**

- .1 General: Comply with Division 16 000 Product Requirements Section.
- .2 Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- .3 Delivery: Materials must be delivered in a timely manner to other trades.
- .4 Storage and Protection: Store materials away from exposure to harmful construction and weather conditions and at temperature and humidity conditions recommended by the manufacturer.

**1.9 WARRANTY**

- .1 Manufacturer's Warranty: All equipment shall be warranted free of defects in materials and workmanship.
- .2 Warranty Period: 24months from date of shipment or two years from date of turn-on, whichever occurs first. Relay modules shall be warranted for a period of ten years.
- .3 Owner Rights: Manufacturer's warranty is in addition to, not a limitation of, other rights the Owner may have under contract documents.

**Part 2            Products**

**2.1                DESCRIPTION**

- .1    Digital network lighting control system
  1. Configurable relay cabinets
  2. Remote low voltage input cabinets
  3. Digital switches
  4. Low voltage control devices
  5. Latching, Return to Closed (RTC) Latching and dimming / switching relay modules
  6. Distributed scheduling functions
    - a. Cabinets continue to operate on last established schedule in the event of a network malfunction
    - b. Network interruption alarm is displayed on Handheld Display Unit (HDU) and/or remote computer connected to Internet
  7. Configuration, programming and monitoring via HDU
    - a. Remote configuration, programming and monitoring available with Internet connection
    - b. System to be fully functional without a connected HDU
- .2    Relay Insert Panel provides data bus and data intercommunication between all Relay Modules and Command Module.
- .3    Integral power supply for Command Module, Relay Insert Panel, HDU, and other accessories.
  1. 70W (2.9 amperes) output at +24VDC.
- .4    System programming and firmware upgrades
  1. Local
    - a. Uploaded via USB 2.0 ports on HDU and/or Command Module
      - 1) System software can be stored on a Flash memory stick or thumb drive
    - b. Automated process upgrades entire system once operator initiates the update sequence.
    - c. Automated system can upgrade firmware to specific devices or all system components at one time, as selected by the user.
      - 1) All devices can be upgraded from a single system connection point and location.
  2. Remote via Internet
    - a. Uploaded to Command Module
      - 1) Requires Owner-provided Ethernet connection to Internet with static IP address.
        - .1 Entire system to require only one Internet address and connection.
    - b. Upgrade procedure to be initiated by Owner and managed by the Command Module.
    - c. Automated system

- 1) Allows user to select specific devices or all system devices for firmware upgrades.

## **2.2 Performance Criteria**

- .1 Event Scheduling, Daylight Harvesting Occupancy Sensing, Manual Switching, to control lighting with the following hierarchy:
  1. Emergency: Highest priority, over-rides all other inputs.
  2. Power failure: All RTC relays close upon loss of system power.
  3. Bypass Switches: Second priority, over-rides all other inputs except Emergency
  4. Events scheduled via Calendar and Agendas
- .2 Power failure recovery — All devices return to their previous status prior to power loss.

## **2.3 Network protocols**

- .1 LumaCAN
    5. Daisy chain topology
    6. Maximum branch length of 1600 feet
      - a. Devices located at branch ends must have their termination jumpers in the ON position.
  - .2 Ethernet
    1. Command Modules only
    2. Can be configured as a bridge between LumaCAN branches
    3. Can be used as an Internet connection
      - a. Remote firmware upgrades, monitoring and programming possible via Internet
    4. Ethernet switches can be used to extend system coverage area by linking Command Modules
  - .3 As specified in Article 2.3, Paragraph B.2.c, GreenMAX control cabinets natively support RS485 master/slave token passing using the BACnet® protocol to facilitate interoperation with building automation systems and other intelligent field devices.
  - .4 BACnet IP
    - .1 Read-only device description for Relay Cabinets
      - .1 For use with Building Management System (BMS) software that does not support writing of device descriptions.
  - .5 Re-name groups and relays via the BMS network, if it supports this function
  - .6 Support all 16 BACnet priorities
    1. Separate Priority Array for each relay
    2. 1 is highest, 16 is lowest
    3. Higher priority maintains control until a “relinquish” command is issued
    4. Top three priority levels permanently assigned to Internal Main Bypass, Emergency Power and Internal Relay Bypass
    5. Individual control of all other priorities
-

- .7 Support 252 Analog / Binary Outputs
- .8 Support 240 Analog / Binary Inputs

**2.4 Network cable**

- .1 LumaCAN: Cat 6
- .2 Ethernet: Cat 5 or better
- .3 BACnet IP: Cat 5 or better
- .4 Terminations: RJ-45 connectors

**2.5 System PROGRAMMING**

- .1 Relay Operation
  - 6. Configure pulsed output
    - a. Vary duration of relay closure from one (1) to sixty seconds (60).
  - 7. Configure Blink Warn
    - a. Allow definition of Blink length and interval for each relay
      - 1) System to ship with default settings.
  - 8. Return to Closed functionality
  - 9. Enable/disable zero-cross technology
  - 10. Assign relay to a group
    - a. System shall have the ability to assign relays to control groups.
- .2 Photocell control
  - 1. Open or closed loop operation
  - 2. Eight (8) independent pairs of rising and falling trigger point values per photocell input.
  - 3. Delay times of thirty (30) seconds to thirty (30) minutes
  - 4. ON/OFF behavior
    - a. Auto ON with Manual Override
    - b. Blink Warn Sequence
- .3 Occupancy Sensor configuration
  - 1. Control eight (8) relays or one (1) group of relays
  - 2. Allow programming of each relay or group with the following operational behaviors:
    - a. Auto ON/ Auto OFF
      - i) Occupancy detection signal closes the assigned relays or groups (turns lights ON)
      - ii) Vacancy detection signal opens the assigned relays or groups (turns lights OFF) after a programmed light hold (delay) time has expired
    - b. Auto ON/Auto OFF with light hold off
    - c. Manual ON/Auto OFF with light hold off
    - d. Manual ON/Auto OFF
    - e. Manual ON/Manual OFF

- f. Manual ON/Manual OFF with light hold off
  - 3. Set Light Hold (delay) Times from thirty (30) seconds to thirty (30) minutes
  - .4 Emergency Input configuration
    - 1. Allow user to program each individual relay's response to Emergency signal
  - .5 Low voltage switches
    - 1. Program delay time within each area or zone
      - a. Thirty (30) seconds to thirty (30) minutes
    - 2. Select button type
      - a. Momentary or maintained
    - 3. Select switch station type
      - a. Single button operation or dedicated ON and OFF buttons
    - 4. Assign each switch to individual relays or groups
  - .6 Digital switches
    - 1. Program delay time within each area or zone
      - a. Thirty (30) seconds to thirty (30) minutes
    - 2. Assign each switch to individual relays or groups
  - .7 Native BACnet-compatible scheduling objects
  - .8 System Time Clock
    - 1. Coordinate the operation of all system components.
    - 2. Able to continue execution of scheduled operations if the network connection is lost.
    - 3. Time and date
      - a. Manual controls
      - b. Programmable to automatically respond to Network Time Protocol (NTP) when connected to the Internet.
  - .9 Scheduling
    - 1. Relay or group ON at specific time
    - 2. Relay or group ON at specific time with light hold off
      - a. Thirty (30) seconds to thirty (30) minutes
    - 3. Relay or group OFF at specific time
    - 4. Daily Agendas
      - a. Define an agenda for each 24 hour day.
        - 1) Agenda to include up to twelve (12) transitions for each relay or group
        - 2) Transitions to last one (1) minute or longer.
      - b. Schedule Agendas to occur:
        - 1) Between specified dates.
        - 2) On a specific date.
        - 3) On a date relative to the current date.
      - c. Allow user to override an agenda with a new one in real time.
      - d. Allow user to define Agendas and assign them to relays and / or groups.
    - 5. Calendars
-



- a. Allow programming of up to sixteen (16) Calendars.
  - 1) Each calendar to contain a record of Daily Agendas.
- .10 Astronomical Clock
  - 1. Allow twelve (12) or twenty-four (24) Hour display formats
  - 2. Allow selection of Automatic Daylight Savings Time adjustment
  - 3. Allow user to enter Latitude data
  - 4. Allow user to program Sunrise/Sunset times with optional offsets
- .11 Low voltage inputs
  - 1. Compatible with any momentary or maintained switch operating at +24 VDC
  - 2. Compatible with any photocell and/or occupancy sensor requiring +24 VDC power and providing either a dry contact closure or 0 — 10 VDC signal via three-conductor wiring
    - a. +24 VDC, Com, Signal
      - 1) If +24 VDC is supplied to the device by an external power supply, use two-wire Com and Signal configuration

## **2.6 GREENMAX RELAY CABINETS**

- .1 Command Modules, Remote Input Modules and Relay Modules to be installed in the field without voiding UL listing.
- .2 Performance Criteria
  - .1 Capacities
    - .1 Eight (8), sixteen (16), thirty-two (32) or forty-eight (48) single- or dual-pole relays.
    - .2 Optional Factory Installed Low Voltage Input cards
      - .1 NOTE TO SPECIFIER: If GreenMAX relay cabinets are ordered without an optional Low Voltage input card, a Remote Input Cabinet will be required in order to add low voltage inputs to the system.
      - .2 Eight (8) or sixteen (16) inputs
  - 3. Physical
    - a. Removable locking hinged door.
      - 1) Removing the door from its hinges shall not defeat the locking mechanism.
    - b. Able to be delivered empty of electronics
      - .3 To facilitate handling, rough-in, preliminary wiring and flexible project scheduling.
    - c. Rear panel to have both key-hole mounting slots and round clearance holes
    - d. Cabinet sidewalls to be clear of knockouts or other obstacles to allow custom conduit layout patterns.
    - e. Ventilated covers and bottom panel
    - f. NEMA1 cabinet to provide cooling to circuit conductors without the use of any moving parts such as a fan.
    - g. Circuit wiring concealed by covers that provide maximum arc flash protection
      - 1) Low-voltage electronics can be serviced without Personal Protective Equipment

- 2) Low voltage and high voltage compartments to be separated for optimal safety.
- 3) Covers to be easily removed and replaced.
- 4. Electrical
  - a. Relays shall be rated to switch voltages from 24 to 277VAC and +24VDC.
  - b. Short Circuit Current Rating (SCCR) of the assembled cabinet, regardless of its specific configuration, to be 25,000 Amperes at 277VAC.
- .3 Physical
  - .1 Material
    - .1 Steel
  - .2 Finishes
    - .1 [Leviton] Standard Green.
  - .3 Relay Insert Panel
    - .1 Allow relays modules to be installed, removed and relocated without internal rewiring or mounting screws
  - .4 Grounding points
    - .1 Cabinet to provide bonding location for the Command Module in the upper left wire-way
    - .2 Cabinet to provide grounding location consisting of two threaded screw holes at bottom of enclosure
      - .1 Hole spacing to allow use of typical equipment ground bus-bars in place of screws
      - .2 Cabinet to include a green grounding screw as a designated grounding point

## **2.7 GreenMAX COMMAND Modules**

- .1 Description
  - .1 Field-installable and/or replaceable self-contained units with Emergency input.
  - .2 Integral overload and short circuit protection.
    - .1 Provides separate overload protection for:
      - .1 System processor
      - .2 LumaCAN devices including the Low Voltage Input card.
  - .3 Supplies power to all electronics in the Relay Cabinet
  - .4 Supplies power to digital switches and Handheld Display Unit via LumaCAN
  - .5 Can supply +24 VDC to other low-voltage inputs
  - .6 Can contain an optional Low Voltage Input (+24VDC) card suitable for termination of eight (8) or sixteen (16) low voltage inputs.
- .2 Emergency Signal Input
  - .1 Input for a hardwired emergency override signal
    - .1 Requires external contacts
    - .2 Activates Emergency status when a signal of +24VDC is present
    - .3 Releases Emergency status when signal falls to zero (0VDC ).

- .2 Controls all relays as assigned by the user regardless of processor operation.
- .3 Provides +24VDC to external contacts
- .3 Low Voltage Input Card Option
  - .1 Allows user to configure inputs
    - .1 0 – 10VDC analog
    - .2 +24VDC switched
    - .3 Contact closure.
  - .2 +24 VDC power supply
    - .1 70W (2.9 amperes) capacity
    - .2 Input devices can use external power supplies
  - .3 Compatible with the following devices
    - .1 Occupancy sensors
    - .2 Photocells
    - .3 GE switches
    - .4 External Contacts
    - .5 Multi-button low voltage switches
    - .6 ON/OFF dedicated button low voltage switches
- .4 Controls
  - .1 Handheld Display Unit
    - .1 Current Operating Status
    - .2 Errors
    - .3 Current Time
    - .4 Alarms
    - .5 Astronomical Time Clock settings
    - .6 Monitor Menus
    - .7 Control Menus
    - .8 Configuration Menus
    - .9 Remote Manual operation of all system relays
    - .10 Inspection of both digital and low voltage inputs
      - .1 State
      - .2 Status
      - .3 Current value
    - .11 Schedule monitoring and adjustment
    - .12 Temporary override of schedule on a day by day basis
  - .2 High Resolution Color Graphic Display Screen
  - .3 LED Status Indicators
    - .1 Individual Relays
      - .1 Manual Actuator indicating ON/OFF state
    - .2 Microprocessor Online
    - .3 Ethernet Link

- .4 Relay Communication
- .5 +5 VDC Power Supply Normal Operation
- .6 LumaCAN communication
- .5 Electrical
  - 5. Grounding point provided in left wire-way
- .6 Physical
  - 6. Can be tilted forward for easy access to digital connection points without removal from relay cabinet.

**2.8 GreenMAX handheld display unit ((HDU)**

- .1 Description
  - .1 Performs system programming, configuration and monitoring from any LumaCAN or Ethernet port
    - .1 Ethernet ports
      - .1 As indicated on drawings (system must be interconnected with lighting control network)
    - .2 LumaCAN port locations:
      - .1 Relay cabinets
      - .2 Digital switches
      - .3 Low voltage input cards
      - .4 Remote Input Cabinets
- .2 Storage locations
  - .1 Inside of any relay cabinet door
  - .2 Remote Docking station
- .3 Display
  - .1 High-resolution color graphic display
- .4 As specified in Article 2.9, Paragraph D, GreenMAX uses RJ-45 connectors, which are widely available and easy to make in the field. This industry-leading design lowers the material cost of the lighting control system and makes installation simpler, faster, and more cost-effective. Systems that require more complicated and expensive connectors should not be acceptable on this project.
- .5 Network interfaces
  - .1 LumaCAN
    - .1 Green RJ-45 input
  - .2 Ethernet
    - .1 Black RJ-45 input
- .6 As specified in Article 2.9, Paragraph E, the GreenMAX HDU includes automatically rechargeable batteries that allow nine hours of operation while disconnected from a network charging station. The user can monitor, adjust and program the system from any

network location. Systems that fail to offer this flexibility and ease of use will raise the Owner's costs for operation and maintenance, and should not be acceptable on this project.

- .7 Power
  - .1 Rechargeable batteries
  - .2 Nine (9) hours of operation under battery power
  - .3 Batteries are recharged automatically via network connection

**2.9 GREENMAX REMOTE LOW VOLTAGE INPUT CABINETS**

- .1 Fully functional as independent LumaCAN network nodes
  - .1 Can be connect to network at any location: direct dedicated connection to a Relay Cabinet is not required
- .2 Eight (8) or sixteen (16) Low Voltage inputs
- .3 Provides power to LumaCAN digital devices
- .4 Provides a connection point for the HDU
- .5 Integrated power supply
  - .1 Supply 100 – 277VAC
  - .2 Rated output at 70W of +24 VDC power via LumaCAN
  - .3 Connected devices can be self-powered.
- .6 Input types
  - 7. Occupancy sensors
  - 8. Photocells
  - 9. Contact closures
  - 10. Low Voltage switches

**2.10 GREENMAX Relay MODULES**

- .1 Single Pole, Latching Relay
  - .1 Supported and listed loads
    - .1 24-277VAC, 20A Tungsten Halogen Incandescent
    - .2 24-277VAC, 30A Ballast
    - .3 347VAC, 20A Ballast
    - .4 120VAC 1/2hp Motor, 277VAC 1hp Motor, 240VAC 1hp Motor
- .2 Single Pole, Return To Closed, Latching Relay
  - .1 Supported and listed loads
    - .1 24-277VAC, 20A Tungsten Halogen Incandescent
    - .2 24-277VAC, 30A Ballast
    - .3 347VAC, 20A Ballast

- .4 120VAC 1/2hp Motor, 277VAC 1hp Motor, 240VAC 1hp Motor
- .3 Double Pole, Latching Relay
  - .1 Supported and listed loads
    - .1 208/240VAC, 20A Tungsten Halogen Incandescent
    - .2 208/240/480VAC, 30A Ballast
    - .3 600VAC, 20A Ballast
    - .4 208/240VAC 1hp Motor
  - .4 Double Pole, Return To Closed, Latching Relay
    - .1 Supported and listed loads
      - .1 208/240VAC, 20A Tungsten Halogen Incandescent
      - .2 208/240/480VAC, 30A Ballast
      - .3 600VAC, 20A Ballast
      - .4 208/240VAC 1hp Motor
  - .5 Physical
    - .1 All relay modules to have identical dimensions and occupy a single mounting space, allowing any number of each type to be used in the Relay Insert Panel
    - .2 Installation and removal via retaining tabs: no screws or internal wiring required
    - .3 All relays to have manual actuator handles
      - .1 Allow changing the relay state without tools
      - .2 Allow controlled circuits to be powered as soon as they are wired, without energized Command Module electronics.
      - .3 Manual actuator accessible in low voltage compartment only
  - 11. Supported Wire Sizes
    - a. 6 – 14 AWG
    - b. Input and output terminals to be freely torque-able to the required specification without risk of damage.
  - 12. Manufacturer to provide barriers for installation between relays.
  - .6 Electrical
  - 13. Latching Modules
    - a. Electrically held relays are unacceptable due to parasitic power loss
    - b. Single-pole and dual-pole modules
    - c. SCCR (Short Circuit Current Rating) of 25,000 amps
    - d. Available with and without Return to Closed (RTC) function
    - e. Compatible with Sentry Switches and AS100 switches
  - 14. Dimming – Switching Module
    - a. All specifications of the Latching Module above apply
    - b. Single-pole
    - c. Additional 0 – 10VDC control point
      - 1) Suitable for dimming 0 – 10V fluorescent ballasts
      - 2) Suitable for dimming LEDs that accept 0 – 10VDC control signals

**2.11 Digital Switches**

- .1 Configurations
  - .1 One (1), two (2), or four (4) buttons
- .2 Colors
  - .1 White
  - .2 Ivory
  - .3 Light Almond
  - .4 Gray
- .3 RJ-45 connectors
  - .1 LumaCAN input
  - .2 LumaCAN throughput
  - .3 Hand Held Display Unit access to entire network
- .4 Custom Engraving
  - .1 To be available for the following:
    - .1 Individual buttons
    - .2 Station wallplates
  - .2 Engraved characters to be of a contrasting color as shown on drawings

**2.12 COMPONENTS**

- .1 Relay Cabinets
- .2 Relay Modules
- .3 Remote Low Voltage Input Cabinets
- .4 Handheld Display Unit
- .5 HDU Docking Station
- .6 Digital Switches
- .7 Digital Keyswitch
- .8 Accessories
  - .1 Occupancy Sensors
  - .2 Photocells

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Coordinate, receive, mount, connect, [and place into operation] all equipment.
-

- .2 Install equipment in accordance with manufacturer's installation instructions.
- .3 Install relay cabinets in locations where audible noise is acceptable.
- .4 Use only with 75° C (167° F) copper wire at 75% ampacity.
- .5 Provide complete installation of system in accordance with Contract Documents.
- .6 Maintain performance criteria stated by the manufacturer without defects, damage, or failure.
- .7 Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- .8 As specified in Article 3.1, Paragraph F, interior sensors work mainly with diffused light and have a much higher lighting gain than exterior sensors. Electric light sources can affect these sensors unless the sensors are shielded from the light given off by electric light sources.
- .9 Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.
- .10 Furnish all conduit, wire, connectors, hardware, and other incidental items necessary for a properly functioning lighting control and relay system as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by the manufacturer without defects, damage, or failure.
- .11 Compliance: Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- .12 Circuit Testing: The contractor shall test that all branch load circuits are operational before connecting loads to system load terminals, and then de-energize all circuits before installation.
- .13 Application of Power: Power shall not be applied to the relay system during construction and prior to turn-on unless specifically authorized by written instructions from the manufacturer.
- .14 Programming: Program low-voltage and or digital switch functionality remotely from the control cabinet.
- .15 Terminate and test all network cable assemblies. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to factory-certified service engineer prior to scheduling commissioning activity.

### **3.2 SITE VERIFICATION**

- .1 Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.
-



**3.3 FIELD MEASUREMENTS**

- .1 The electrical contractor shall be responsible for field measurements and coordinating the physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.

**3.4 INSPECTION**

- .1 Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

**3.5 SITE PROTECTION**

- .1 Contractor shall protect installed product and finished surfaces from damage during all phases of installation including storage, preparation, testing, and cleanup.

**3.6 COMMISSIONING**

- .1 Provide factory-certified field service engineer to ensure proper system installation and operation under following parameters:
  - .1 Certified by the equipment manufacturer on the system installed.
  - .2 Site visit activities:
    - .1 Verify connection of power feeds and load circuits.
    - .2 Verify connection of controls.
    - .3 Verify system operation control by control, circuit by circuit.
    - .4 Obtain sign-off on system functions.
    - .5 Demonstrate system capabilities, operation and maintenance and educate Owner's representative on the foregoing.
  - .3 At least three site visits to accomplish the following tasks:
    - .1 Prior to wiring
      - 1) Review and provide installer with instructions to correct any errors in the following areas:
        - a) Low voltage wiring requirements
        - b) Separation of high and low voltage wiring runs
        - c) Wire labeling
        - d) Load schedule information
        - e) Switching cabinet locations and installation
        - f) Physical locations and network addresses of controls
        - g) Ethernet connectivity
        - h) Computer-to-network connections
        - i) Load circuit wiring
        - j) Connections to other systems and equipment
        - k) Placement and adjustment of Occupancy Sensors
        - l) Placement and adjustment of Photocells
      - .2 After system installation
        - 1) Check and approve or provide correction instructions on the following:
          - a) Connections of power feeds and load circuits
          - b) Connections and locations of controls
          - c) Connections of low voltage inputs
          - d) Connections of the data network

- 2) Turn on system control processor and upload any pre-programmed system configuration
- 3) Verify cabinet address(es)
- 4) Upload pre-programmed system configuration and information to switching and/or dimming cabinets
- 5) Check load currents and remove bypass jumpers
- 6) Verify that each system control is operating to specification
- 7) Verify that each system circuit is operational according to specification
- 8) Verify that manufacturers' interfacing equipment is operating to specification
- 9) Verify that any computers and software supplied by the manufacturer are performing to specifications
- 10) Verify that any remote WAN (Wide Area Network) connections are operating properly
- 11) Have an owner's representative sign off on the above-listed system functions
- .3 Before project completion and hand-off
  - 1) Demonstrate system capabilities and functions to owner's representative
  - 2) Train owner's representative on the proper operation, adjustment, and maintenance of the system.
- .2 Notification: Upon completion of the installation, the contractor shall notify the manufacturer that the system is ready for formal checkout. Notification shall be given in writing a minimum of 21 days prior to the time factory-trained personnel are required on site. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to manufacturer prior to scheduling commissioning activity. Manufacturer shall have the option to waive formal turn-on.
- .3 Turn-On: Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Manufacturer's Rep or, if waived, Contractor shall completely check the installation prior to energizing the system. Each installed relay system shall be tested for proper ON/OFF operations, and proper LED illumination. Each installed control cabinet shall be tested verifying that each controlled load adjusts to the selected setting and that all switch LED's illuminate properly.
- .4 At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

### **3.7 MAINTENANCE**

- .1 Enable the end user to order new equipment for system expansion, replacements, and spare parts.
  - .2 Make new replacement parts available for a minimum of ten years from the date of manufacture.
  - .3 As specified in Article 3.7, Paragraph D, Leviton Manufacturing provides telephone technical support by factory personnel 24 hours a day, 7 days a week. Project cost overruns and delays can occur without this service. Answering services can add to frustration and delay the resolution of any problems or issues. Manufacturers who do not offer factory-direct technical support on a 24/7 basis should not be acceptable on this project.
  - .4 Provide factory-direct technical support hotline 24 hours per day, 7 days per week.
-

- .5 Offer renewable annual service contracts, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system commissioning.

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

- .1        Section includes all Materials and installation for the fire alarm and voice communication system.
- .2        Supply and install and place in operating condition all Fire Protection Alarm and Communication equipment, accessories and material necessary to provide a two stage fire alarm system with voice communication.

**1.2                REFERENCES**

- .1        Underwriter's Laboratories of Canada (ULC)
  - .1        CAN/ULC-S524: Standard for the Installation of Fire Alarm Systems.
  - .2        CAN/ULC-S525: Audible Signal Device for Fire Alarm Systems.
  - .3        CAN/ULC-S526: Visual Signal Devices for Fire Alarm Systems.
  - .4        CAN/ULC-S527: Control Units.
  - .5        CAN/ULC-S528: Manual Pull Stations for Fire Alarm Systems.
  - .6        CAN/ULC-S529: Smoke Detectors for Fire Alarm Systems.
  - .7        CAN/ULC-S530: Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .8        CAN/ULC-S531: Standard for Smoke Alarms.
  - .9        CAN/ULC-S536: Inspection and testing of Fire Alarm Systems.
  - .10       CAN/ULC-S537: Verification of Fire Alarm Systems.
  - .11       CAN/ULC-S541: Speakers for Fire Alarm Systems.
  - .12       CAN/ULC-S553: Installation of Smoke Alarms.
  - .13       CAN/ULC-S561: Installation And Services For Fire Signal Receiving Centres And Systems

**1.3                SUBMITTALS**

- .1        Shop Drawings:
  - .1        Submit shop drawings in accordance with Section 16 000.
  - .2        Include:
    - .1        Layout of equipment and zoning.
    - .2        Manufacturer's printed product literature
    - .3        Complete wiring diagram, including schematics of modules.
    - .4        Control panel and modules.
    - .5        Storage batteries and Battery charger.
    - .6        Manual pull stations, all heat and smoke detectors.
    - .7        Alarm speakers, horns and Visible appliances if applicable.
    - .8        Main and remote annunciators.
    - .9        Electro-magnetic door holder-releases.

- .2 Quality assurance:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties and verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.
  - .2 Manufacturer's Field Reports: manufacturer's report showing location of each device and certifying the test results of each device.
- .3 Closeout Submittals:
  - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 16 000.
  - .2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.
  - .3 Submit to Authority of Jurisdiction 2 sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.
    - .1 System wiring diagrams:
      - .1 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
      - .2 Show modules, relays, switches and lamps in control panel.

#### **1.4 QUALITY ASSURANCE**

- .1 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

In preparing the bid, the manufacturer shall indicate the number of hours necessary to complete this inspection prior to closing of tenders. On completion of this inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the Engineer. All costs involved in this inspection both from the manufacturer and the Electrical Contractor work, shall be included with the Electrical Contractors' tender price.

The manufacturer shall supply to the Electrical Contractor reasonable amounts of technical assistance with respect to any changes necessary to conform to all work.

- .2 Warranty Service:
  - .1 Provide two year's warranty for the entire system, warranty to start after the owner has taken possession of the Building.

**Part 2      Products**

**2.1      GENERAL**

- .1 All equipment shall be listed by Underwriter's Laboratories of Canada and shall include, but not to be limited to, a Central Equipment Control Unit, Fire Command Control Centre, Alarm Initiating Devices and Telephone Devices.
- .2 All devices are located on the drawings and shall be wired in accordance with the manufacturers' recommendations.
- .3 The Installed system shall comply with the applicable provisions of U.L.C. and applicable Building Codes and shall meet all requirements of the local authorities having jurisdiction.
- .4 All fire alarm equipment shall be supplied by one manufacturer; Mircom, or approved equal.

**2.2      MATERIALS**

- .1 Equipment and devices shall be ULC listed and labelled and supplied by a single manufacturer.

**2.3      SYSTEM DESCRIPTION**

- .1 Provide a complete, electrically supervised, manual and automatic, zoned, annunciated, two stage fire alarm and voice communication system.
  - .2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating two-stage alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to fire department.
  - .3 Modular in design to allow for future expansion.
  - .4 Operation of system shall not require personnel with special computer skills.
  - .5 System to include:
    - .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling; master telephone, microphone with necessary switches and controls.
    - .2 Power supplies.
    - .3 Initiating/input circuits.
    - .4 Output circuits.
    - .5 Telephone circuits.
    - .6 Auxiliary circuits.
    - .7 Amplifiers.
    - .8 Wiring.
    - .9 Manual and automatic initiating devices.
-

- .10 Audible signalling devices
- .11 End-of-line resistors.
- .12 Local and Remote annunciators if applicable.
- .6 Provide separate circuits from control panel to each zone of initiating devices.  
Transmission of signals from more than one zone over common circuit to control panel is prohibited.
- .7 Possible to transmit voice message from central control unit to specific areas or zones, while maintaining alert/evac tone to other zones, by means of master microphone and speaker circuit selection switches.
- .8 The selective operation and status indication of smoke relief dampers where automatic operation is not provided by direct connection of an initiating device.
- .9 Refer to the Drawings for the sequence of operations.
- .10 Possible to silence signals by "alarm silence" switch at control unit, after minimum 60s period of operation.
- .11 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .12 Annunciation of supervisory signals from gate valve monitor switches, pressure switches, etc. where shown on the drawing.
- .13 Actuation of any supervisory device to:
  - .1 Cause electronic latch to lock-in supervisory state at central control unit.
  - .2 Indicate respective supervisory zone at central control unit and remote annunciator.
  - .3 Cause audible signal at central control unit to sound.
  - .4 Activate common supervisory sequence.
- .14 Should a fault occur in the system wiring, power supply, amplifiers, tone generators, or critical components, the system shall:
  - .1 Individually annunciate the zone and the component of the system in which the fault has occurred.
  - .2 Sound a "Trouble" indicator at the control equipment location, the Fire Command Centre and at other locations as shown on the drawings. These trouble indicators shall have individual, automatically restoring silencing control.
  - .3 Individually annunciate at the Fire Command Centre all supervisory (fault) indications affecting the operation of the audio system.
- .15 Resetting alarm/supervisory device not to return system indications/functions back to normal until control unit is reset.
- .16 Trouble on system to:
  - .1 Indicate circuit in trouble on central control unit.



- .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; visual indication to remain until trouble is cleared and system is back to normal.
- .17 Troubles on system: suppressed during course of alarm.
- .18 Trouble condition on any circuit in system not to initiate alarm conditions.

**2.4 CONTROL PANEL AT CACF**

- .1 Annunciator modules with electronically supervised LED's and engraved alarm zones designations. A LED shall be provided for each signal initiating zone as shown on the drawings and schedules.
- .2 Fire Command Control Centre shall be located where shown on the drawings and shall contain all controls necessary for the manual operation of the Life Safety System.
- .3 Fire Alarm Control Unit(s) shall be of Modular construction for ease of expansion and servicing and shall be of solid state design.
- .4 Continuously supervise all wiring extended between Fire Alarm Control Panel and Fire Command Control Centre.
- .5 Shall supervise all wiring to alarm initiating devices, annunciator lamps and filaments, battery connections and audio interface wiring for breaks or grounds.
- .6 An open, short or ground in the system shall cause an audible trouble signal in the control panel and external remote trouble indicator to sound until the trouble is corrected, but not cause an alarm to sound.
- .7 Enclosure:
  - .1 CSA Enclosure, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys.
  - .2 Provide modular type panel installed in flush or surface mounted steel cabinet with hinged door and cylinder lock.
  - .3 Switches and other controls: not accessible without use of key.
  - .4 Design of control panel: neat, compact assembly containing parts and equipment required to provide specified operating and supervisory functions of system.
  - .5 Control panel components: CSA approved and approved by control panel manufacturer for use in control panel.
  - .6 Panel cabinet: finished on inside and outside with factory-applied enamel finish.
  - .7 Provide main annunciator located on exterior of cabinet door or visible through cabinet door.
  - .8 Provide audible trouble signal.
  - .9 Provide permanent identification plates, attached to rear face of panel viewing window, for lamps and switches.
  - .10 Permanently label switches.
  - .11 Provide panel with following switches:

- .1 Trouble silencing switch which silences audible trouble signals without extinguishing trouble indicating lamp(s).
    - .1 Silencing switch: Upon correction of trouble condition, audible signals will again sound until switch is returned to its normal position.
    - .2 Silencing control shall have a timer delay silencing of signals for a fixed time after the initiation of alarm to provide a minimum alarm sound period.
  - .2 Evacuation alarm silencing switch which when activated will silence alarm notification appliances without resetting panel, and cause operation of system trouble signals. Subsequent alarm(s) from additional zone(s) not originally in alarm to cause activation of notification appliances even with alarm silencing switch in "silenced" position.
  - .3 Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of system and zone trouble signals.
  - .4 Reset switch which when activated will restore the system to normal standby status after cause of alarm has been corrected, and activated initiating devices reset.
    - .1 Operation of reset switch to restore activated smoke detectors to normal standby status.
  - .5 Fan control module for HVAC shutdown and bypass switches. Operation of the switch to allow equipment to operate with detectors in alarm and cause operation of system trouble signals. Shall have indicating switches and status lamps for connection to double voltage relays in the fan control units. Connections shall be made as drawn on the drawings and master control schedules.
1. The Fire Alarm Tone Generator(s) shall be fully supervised and shall operate an individual fault lamp on tone generator and at the Fire Command Control Centre and shall also transfer to back up toner card or generator in case of failure.
- .8 Supervised, modular design with plug-in modules:
- .1 Alarm receiver with trouble and alarm indications and provision for remote supervised annunciation.
  - .2 Spare zones: compatible with smoke detectors and open circuit devices.
  - .3 Space for future modules.
  - .4 Latching type supervisory receiver circuits. Discrete indication for both off-normal and trouble.
- .9 Components:
- .1 Alarm receiver panel with trouble and alarm indications.
  - .2 Common control and power units:
    - .1 Control panel containing following indications and controls:
      - .1 "Power on" LED (green) to monitor primary source of power to system.
      - .2 "Power trouble" indication.
-

- .3 "Ground trouble" indication.
- .4 "Remote annunciator trouble" indication.
- .5 "System trouble" indication.
- .6 "Elevator Emergency Recall" indication.
- .7 "System trouble" buzzer and silence switch c/w trouble resound feature.
- .8 System reset switch.
- .9 "Lamp test" switch.
- .10 "Alarm silence" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound.
- .11 "Trouble silence" switch.
- .12 "Signals silenced" indication.
- .13 "Lamp Fail" indication.
- .14 Auxiliary Disconnect.
- .15 "Trouble" annunciator module with a solid state sounding device and automatically restoring silencing button.
- .16 Individual fault lamps shall be provided for the "Amplifier System", "Speaker Lines", "Microphone", "Master Handset", "Handset Lines", "Tone Generator", "Fire Alarm System" "Battery Charger".
- .17 "System test" switch shall be provided to automatically simulate a circuit fault condition on all audio circuitry, to test both the supervision circuitry and associated indicators. This test button shall also test all fire alarm annunciator LED's.
- .2 Integral power supply, battery charger and standby batteries.
- .3 Master power supply panel to provide 24 V dc to system from 120 V ac, 60 Hz input.
- .4 Fire department connections:
  - .1 Plug-in module for tripper type municipal box.
  - .2 Fire department bypass switch c/w indicator for trouble at panel.
- .3 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and c/w individual bypass switch.
  - .1 Contacts: for functions such as release of door holders or initiation of fan shut down.
- .10 Alarm Switches:
  - .1 Waterflow alarm switch: Shall be Potter Type. Units shall have pneumatic retards adjustable from 0 to two (2) minutes.
  - .2 O.S. and Y supervisory switches: O.S. & Y valves as indicated shall be monitored by Potter Type valve supervisory switches.
- .11 Amplifiers:
  - .1 Shall be fully supervised and shall automatically disconnect themselves from the system should an internal fault occur this condition shall operate an individual

- fault lamp on the faulty amplifier and annunciate at the Fire Command Control Centre.
- .2 A standby amplifier per channel shall automatically provide power to ensure no diminution of system operation. All amplifiers shall use computer grade solid state components and shall be located in the same room with the fire control panel.
- .12 Communication system.
- .1 ULC listed for use with fire alarm system. Provide intelligible, low-level, voice reproduction and incorporate one-way voice communication to speaker circuits in building.
- .2 Integrated system for use in fire alarm and emergency paging.
- .1 Capability to sound either alert/alarm tone or voice message to whole building or parts at same time.
- .2 Provide Paging Zone Selectors with "Individual Zone" page selection switches as per drawings.
- .3 Selection switches shall be of the maintained contact type with a distinct built-in mechanical indicator to provide a visual indication of operation and shall have individual "Tone" select slide switches.
- .4 Each zone shall have a minimum of 2 circuits. Each zone shall have a fault indication. Zones shall be as shown on the drawing.
- .3 Manual control of building speaker circuits: via dedicated speaker circuit toggle switches at control panel.
- .4 Master microphone: housed in CCU, push-to-talk, dynamic, noise-cancelling type. Any automatic alarm tone on system may be overridden (after initial inhibit period of 60 seconds) by master microphone. Using microphone to enable authorized personnel to broadcast voice messages over selected system speakers. When such voice messages are completed, system to revert to previous state unless reset or manually controlled by authorized personnel. Include LED indicators to visually display sound output level and lamp to indicate when alarm tone is selected and and "All Call Page" and "General Evacuation" switches.
- .5 Two-way voice communication system:
- .1 Two-way voice communication to each floor or zone: via Emergency Telephones. Master telephone and power supply: housed in central control panel, c/w flexible, coiled, self-winding, 1.5 m extension cord.
- .2 Manual selection of telephone circuits on floor-by-floor or area-by-area basis. Each telephone circuit to have own selection switch at control panel. Incoming call from remote telephone to activate call-in signal and flash circuit status indicator. Lifting master handset and operating circuit selector switch to illuminate circuit status indicator steady, and connect circuit to telephone voice channel, selected by microprocessor at control panel. Subsequent call-ins: indicated with flashing indicator at control panel, but not connected until their circuit selector switch is activated.
- .3 Announcements/voice messages to be made from remote telephone to certain areas or whole building over system speakers, through phone/paging interface at control panel.
-

**2.5 POWER SUPPLY**

- .1 120 V, 60 Hz primary source of power for system from the buildings emergency distribution system, with standby battery power
- .2 Service shall be through an approved overcurrent device identified in a permanent manner by the words, "Fire Alarm System" on a red lamacoid nameplate.
- .3 Voltage regulated, current limited distributed system power.
- .4 Primary power failure or power loss (less than 102V) will activate common trouble sequence.
- .5 Standby power for the fire alarm and complete audio system shall be provided by connection to the Emergency Generator Main Distributor Panel and standby battery and charger.
- .6 Standby battery and Charger:
  - .1 Shall be an automatic rate compensated, unit capable of recharging the batteries to 70% capacity within 12 hours.
  - .2 Sufficient capacity to operate the entire system for 24 hours with power remaining for total audio for 2 hours.
  - .3 Batteries shall be lead acid Model enclosed in a steel cabinet, minimum expected life of 4 years, sealed and maintenance free.
  - .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .7 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .8 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

**2.6 MANUAL ALARM STATIONS**

- .1 Provide non-coded single action, open circuit type with mechanical reset features.
  - .1 General alarm key switch for two stage system.
- .2 Stations: semi-flush mounted and interior or weatherproof type as indicated.
  - .1 For surface mounting provide station manufacturer's approved back box.
  - .2 Back box finish to match station finish.
- .3 Equip each station with terminal strip with contacts of proper number and type to perform functions required.
- .4 Stations: type not subject to operation by jarring or vibration.
  - .1 Break-glass-front stations are not permitted; pull-lever break-rod type is acceptable provided presence of rod is not required to reset station.

- .5 Station colour: red polycarbonate (Lexan)
- .6 Provide station with visible indication of operation.
- .7 Restoration to require use of key.
  - .1 Keys: identical throughout system for stations and control panel(s).
- .8 Mount stations at height specified on drawings.
- .9 Break-glass and tool operated test feature.
- .10 Where weatherproof stations are required, provide stations with cast metal, weatherproof housings with hinged access doors.
  - .1 Finish housings with red enamel paint and provide signage indicating "FIRE ALARM" with white letters.

## **2.7 EMERGENCY TELEPHONE CIRCUITS**

- .1 Telephone circuits for connection of remote emergency telephones: wired in class A configuration to central control unit.
- .2 Two way communication via telephone voice circuits between master telephone handset and remote telephones. Telephone circuits: controlled by CCU.
- .3 Field wiring of telephone circuits between remote handsets and CCU supervised for open circuits and grounds.

## **2.8 AUTOMATIC ALARM INITIATING DEVICES**

- .1 Heat Detectors:
  - .1 Heat detectors: provide heat detectors designed for detection of fire by combination temperature rate-of-rise and fixed temperature principle.
  - .2 Heat detectors, fixed temperature, non- restorable, rated 57 or 93 °C.
  - .3 Heat detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 or 93 °C, rate of rise 8.3 °C per minute.
  - .4 Combination Fixed Temperature Rate-Of-Rise Detectors: designed for surface and semi-flush outlet box mounting and supported independently of conduit, tubing or wiring connections.
  - .5 Contacts: self-resetting after response to rate-of-rise actuation
  - .6 Operation under fixed temperature actuation to result in external indication.
  - .7 Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes to operate on fixed temperature principle only.
  - .8 Fixed Temperature Heat detectors: designed for surface or flush outlet box mounting and supported independently of conduit, tubing or wiring connections.
  - .9 Detectors: hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.

- .10 Detector operation: not be subject to thermal time lag.
  
  - .2 Smoke Detectors:
    - .1 Smoke detector: ionization and photo-electric type.
    - .2 Detectors: 2-wire or 4-wire type.
    - .3 Plug-in type with fixed base.
    - .4 Sensor shall have a normal sensitivity of 2.0% as measured in a ULC smoke box.
    - .5 Means to perform a functional test on the detector without the need of generating smoke. Test method shall be capable of testing sensitivity of smoke in the chamber and test all other detector functions.
    - .6 Wire-in base assembly with integral red alarm LED.
    - .7 Provide necessary control and power modules required for operation integral with control panel.
    - .8 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.
    - .9 Detector shall incorporate a solid state voltage regulator which can maintain detection sensitivity over an input voltage range of 8.5-35 VDC. Current limiting shall protect the detector against power surges and noise protection shall be provided. .
    - .10 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.
    - .11 Provide remote indicator lamps for each detector that is concealed from view.
    - .12 Each detector: plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.
    - .13 Standby current 100 micro Amps.
    - .14 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.
    - .15 The unit shall contain no moving parts, one chamber shall be for detection and the second chamber shall function as a reference to stabilize the detector for changes in temperature, humidity and pressure.
    - .16 Screen each detector to prevent entrance of insects into detection chamber(s).
    - .17 Ionization Detectors: multiple chamber type responsive to both invisible and visible particles of combustion.
      - .1 Detectors: not susceptible to operation by changes in relative humidity.
      - .2 Used in areas susceptible to dust, such as Main electrical room, Transformer Vault etc.
    - .18 Photoelectric Detectors: operate on light scattering principle using LED light source.
      - .1 Detector: respond to both flaming and smoldering fires.
  
  - .3 Mount detectors at underside of ceiling unless otherwise indicated.
  
  - .4 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.
-

**2.9 ALARM INITIATING DEVICE SPACING AND LOCATION**

- .1 Locate detectors minimum 1000 mm from air discharge or return grille, and not closer than 300 mm to lighting fixtures.
- .2 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.

**2.10 DUCT SMOKE DETECTORS**

- .1 Provide detectors installed in ducts of ionization type and listed by ULC duct installation.
- .2 All detectors shall be supplied and wired by this Division, mounted by Division 15.
- .3 Provide integral control and power modules required for operation with main control panel.
- .4 Detectors exposed to the environment shall be provided with a 50 watt utility strip heater within an insulated weatherproof enclosure.
- .5 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.
- .6 Space within enclosure / housing to be open to the inside of the ductwork. Insulation to be 40 mm thick, rigid foil faced on sides and on service cover.
- .7 Pressure switch for pressurization fans to be mounted inside the detector enclosure.
- .8 Detectors used in stair pressurization fans shall be located at 2400 mm above the stair landing within the stairs on the face of the shaft.
- .9 Locations detectors:
  - .1 At the intake of every pressurization fan and on the discharge of all air handling units, 1 for every 1.40 m<sup>2</sup> area of duct area.
  - .2 Locate in a straight section of duct, 3 times minimum the duct width past any turn or elbow.
  - .3 Wiring by this division to Control panel.
- .10 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit. Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.
- .11 Provide a separate, fused power circuit for each smoke detection initiating circuit.
- .12 Failure of power circuit: indicated as a trouble condition on corresponding initiating circuit.
- .13 Provide duct detectors in accordance with the latest edition of CAN/ULC-S524.



- .14 Activation of duct detectors to cause shutdown of associated air handling unit/pressurization fan and annunciation or trouble at control panel.
- .15 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.
- .16 Provide remote indicator lamp for each detector.
- .17 Permanently label remote indicator with description of associated air handling unit(s).
- .18 Provide each detector with remote test switch.
- .19 Permanently label test switch with description of associated air handling unit(s).

**2.11 SMOKE ALARMS AND CARBON MONOXIDE DETECTORS**

- .1 Smoke alarms located within suites shall be self contained hardwired, 120 V, unswitched, ceiling mounted.
- .2 Units shall have two ionization chambers.
- .3 Units shall contain power on indication, test button and built-in buzzer with 85 dB sound level.
- .4 Locations as per drawings.
- .5 Carbon monoxide alarms shall be the same as above only in a combinational smoke and carbon monoxide unit.
- .6 All smoke alarms and or C.O. detectors shall be wired so if one detector operates all will operate within the suite.
- .7 Listing: Smoke Alarms to conforming to CAN/ULC-S531, Carbon Monoxide Alarms conforming to CAN/CSA-6.19, combination units to be listed with both.

**2.12 AUDIBLE SIGNAL DEVICES**

- .1 Devices shall be re-entrant type speaker
- .2 Housing in die-cast aluminum frames, short rapidly-flared, folded.
- .3 Grilles finished in high gloss enamel.
- .4 Speakers:
  - .1 Cone type: recessed, 70 Volt, 101 or 202 mm as per drawings, round:
    - .1 Fire-retardant, moistureproof.
    - .2 Ceiling or wall mounted as per drawings.
    - .3 Taps at 1 Watt for most areas and ¼ watt for small enclosed areas.
    - .4 Protected with light grey acrylic finished baffles.
    - .5 Flush back box.

- .6 Located in finished areas of building.
- .5 Provide remote system trouble buzzer arranged to operate in conjunction with panel's integral trouble signal.
- .6 Remote trouble buzzer
  - .1 Provide trouble buzzer at control panel arranged to operate in conjunction with panel's integral trouble signal.
  - .2 Provide trouble buzzer with white on red engraved identification sign which reads "FIRE ALARM SYSTEM TROUBLE".
- .7 Provide appliances specifically listed for outdoor use in locations exposed to weather.
- .8 Finish appliances in red enamel.
- .9 For surface mounting provide appliance manufacturer's approved back box. Back box finish to match appliance finish.

**2.13 END-OF-LINE DEVICES**

- .1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit.
- .2 Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel.

**2.14 REMOTE ANNUNCIATOR PANELS (WHERE APPLICABLE)**

- .1 Provide panel where indicated on drawings.
- .2 LED type with designation cards to indicate zone.
- .3 LEDs to annunciate alarm and trouble.
- .4 Wired in multiple with main control panel.
- .5 LED test button.
- .6 Backlighted nameplates.
- .7 The annunciator shall contain a trouble buzzer and trouble lamp.
- .8 Provide modular type panel installed in flush steel cabinet with hinged door and cylinder lock.

**2.15 ELECTRO-MAGNETIC DOOR HOLDER-RELEASES**

- .1 Mount armature portion on door. Armature complete with adjusting screw for setting angle of contact plate.
- .2 Mount electro-magnetic release on wall or in wall recess behind door.

- .3 Activation of fire alarm system to release doors on circuit to close.
- .4 Door holders: not require battery backup power.

**2.16 VALVE TAMPER SWITCHES**

- .1 Provide switches to monitor open position of valves controlling water supply to sprinkler systems.
- .2 Switch contacts to transfer from normal position to off-normal position during first two revolutions of hand wheel or when stem of valve has moved not more than one-fifth of distance from its normal position.
- .3 Provide switch with tamper resistant cover.
- .4 Removal of the cover to cause switch to operate into off-normal position.

**2.17 OFF-PREMISES FIRE ALARM**

- .1 Provide auxiliary connection to base fire alarm system in accordance with the latest edition of CAN/ULC-S561.

**2.18 WIRING**

- .1 All wiring to be installed in conduit and conform to all applicable codes.
- .2 Wiring shall be sized in accordance with Class 2 requirements
- .3 AC signal circuits shall be sized in accordance with Class 1 requirements but shall be protected from mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class 1 requirements.
- .4 Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.
- .5 Conductors shall be solid copper.
- .6 Minimum size of any conductors shall be:
  - .1 Alarm receiving circuits:
    - .1 #22 AWG for five or more conductors in a cable:
    - .2 #18 AWG for 3 or 4 conductors in a cable.
    - .3 #14 AWG for 1 or 2 conductors in a cable or individual conductors in conduit
    - .4 Wire resistance of circuits shall not exceed 50 ohms.
  - .2 Audible signal circuits:
    - .1 #14 AWG for 1 or 2 conductors in a cable, on individual conductors in conduit.
    - .2 #18 AWG for 3 or 4 conductors in a cable.

- .3 In no case shall the voltage drop to any signal exceed 10%.
- .7 Insulation 90 degrees C minimum.
- .8 Colour code wiring.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install main control panel and connect to ac power supply.
- .3 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .5 Connect alarm circuits to main control panel.
- .6 Locate and install all audible devices and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Install end-of-line devices.
- .9 Install remote annunciator panels and connect to annunciator circuit wiring.
- .10 Locate and install door releasing devices.
- .11 Locate and install remote relay units to control fan shut down. Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .12 Connect fire suppression systems to control panel.

**3.3 FIELD QUALITY CONTROL**

- .1 Site Tests:
  - .1 Fire alarm system:
    - .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, sprinkler system transmit alarm to control panel and actuate alarm.

- .2 Check annunciator panels to ensure zones are shown correctly.
  - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
- .2 Manufacturer's Field Services:
- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, type of equipment installed is that designated by the Engineers' specifications, wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements, equipment has been installed in accordance with the manufacturers' recommendations and that all signalling devices have been operated and tested and submit Manufacturer's Field Reports
  - .2 The supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the governmental regulations concerning such supervisory wiring have been met to the satisfaction of the inspecting officials.
  - .3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**END OF SECTION**

**Part 1    General ..... 2**  
    1.1    SYSTEM DESCRIPTION..... 2

**Part 2    Products..... 2**  
    2.1    MATERIAL..... 2

**Part 3    Execution ..... 2**  
    3.1    INSTALLATION ..... 2

**Part 1            General**

**1.1                SYSTEM DESCRIPTION**

- .1        Supply and install an empty conduit system for an all communication services as detailed on the drawings generally consisting of outlet boxes, fish wires, plywood backboards, pull boxes etc.

**Part 2            Products**

**2.1                MATERIAL**

- .1        Conduits: In accordance with Section 16 133.
- .2        Underground incoming buried telephone and cable ducts shall be rigid P.V.C.
- .3        Provide flush wall outlets complete with white decora style faceplates for telephone and cable TV system.
- .4        Junction boxes: in accordance with Section 16 131.
- .5        Outlet boxes, conduit boxes: in accordance with Section 16 132.
- .6        The systems shall generally consist of E.M.T. conduit risers and horizontal homeruns.
- .7        Fish wire shall be provided in all empty conduits/ducts.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install empty raceway system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cabletroughs, miscellaneous and positioning material to constitute complete system.
- .2        Prior to installing service ducts, confer with Bell Canada and Cable T.V. Company to confirm routing of service and method of termination.
- .3        Minimum conduit size shall be 19 mm, but not less than the size shown on the drawings.
- .4        All conduit ends shall be equipped with insulated bushings.
- .5        All conduits within buildings shall include pull boxes after every two 90 degree bends.
- .6        Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm below the floor and not less than 75 mm below the ceiling of the floor below.
- .7        Terminate conduit runs to/from a telephone backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter telephone closets next to the wall and be flush with the backboard.

- .8 Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- .9 All empty conduits located in telephone closets or on telephone backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- .10 Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards.
- .11 Supply and install 19 mm thick fire retardant plywood on the wall of telephone/television closets where shown on drawings. Mount the plywood with the bottom edge 300 mm above the finished floor.
- .12 Supply and pull wire in all empty conduits.

**END OF SECTION**



**Part 1    General ..... 2**  
    1.1    GENERAL..... 2

**Part 2    Products..... 2**  
    2.1    GENERAL..... 2  
    2.2    CONTROLS ..... 2

**Part 3    Execution ..... 3**  
    3.1    INSTALLATION ..... 3  
    3.2    MANUFACTURER'S INSTRUCTIONS..... 3  
    3.3    CONTROL ..... 4  
    3.4    FIELD QUALITY CONTROL..... 4

**Part 1           General**

**1.1           GENERAL**

- .1   Supply and install a complete snow melting system of specified heating cables, termination components, junction boxes, contactors and controls for snow melting in ramps, stairs, slabs etc as shown on drawings and specified herein.
- .2   “PYROTENAX” Installation Recommendation' shall be considered as an integral part of this specification.
- .3   Provide shop drawings in accordance with Section 16 000.

**Part 2           Products**

**2.1           GENERAL**

- .1   The heating cable and termination components shall be approved as Snow Melting and De-Icing Equipment to Canadian standards.
- .2   The heating cable shall be Pyrotenax brand copper-sheathed, type MI series heating cable manufactured by Tyco Thermal Controls or approved equal.
- .3   The heating cable shall be magnesium oxide insulated, with a copper or resistance alloy conductor and a seamless copper sheath. The heating cable shall be constructed in such a manner that no combustible materials are allowed between the resistance alloy conductor and outer metal sheath. All heating cable core materials shall be inorganic and will not deteriorate with age.
- .4   The heating cable shall be jacketed with high density polyethylene (HDPE) to resist corrosion.
- .5   Each heating cable shall be factory-fabricated to the length required and shall not be altered on site. The heated section shall be joined to a polymeric jacketed copper sheath cold lead section by a factory-made joint.
- .6   Heating cables will be designed for operation on supply voltages as shown on drawings

**2.2           CONTROLS**

- .1   Ramp Snow melting:
  - .1   System shall be operated by an automatic controller, snow sensor and thermostats.
  - .2   The system shall be protected against being left on by means of an internal timer and high temperature cut-out thermostat (Cat. #4688 WP, with capillary) mounted adjacent to the ramp.
  - .3   This system shall have an indication lamp at the Building monitoring panel to illuminate when the ramp snow melting system is running.

- .2 Stair Snow melting:
  - .1 System shall be controlled by a line sensing thermostat fixed at 40°F, located within the slab (4688 WP).
  - .2 A minimum of two cable runs shall be installed per step.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 The heating cable shall be installed according to local electrical codes, manufacturer's recommendations, information on the electrical drawings and the instructions supplied with the heating cable and components.
- .2 All circuits shall be ground-fault protected.
- .3 The installation shall be in accordance with the latest edition of the Pyrotex installation Bulletins.
- .4 Cable sheaths shall not touch or cross one another nor shall cables cross expansion or construction joints.
- .5 Where the lead-in emerges from slab, wrap polyethylene tape and protect against damage with conduit.
- .6 Heating cables shall be laid out equally at the specified areas on the drawings. Heating cables are generally installed in a two pour method held down by pre-punched straps. Straps are to be fastened to the first pour of concrete.
- .7 All junction boxes shall be located in accessible areas. Junction boxes shall not be located in the heated slab, but shall be located above grade level. Covers shall be kept on boxes at all times when not working therein.
- .8 All terminations shall be protected from the weather and from physical damage. The gland assembly shall be bonded to the system ground.
- .9 Any field alterations or deviations shall proceed only after authorization has been issued by the engineer. All changes shall be accurately recorded by the contractor.

**3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 The manufacturer shall site check and approve the cable mounting arrangement prior to pouring of the topping. All costs for this inspection shall be part of this Contractors' Contract

**3.3 CONTROL**

- .1 Ramp snow melting:
  - .1 The system shall be controlled by an automatic snow controller, snow sensor and high limit cut out.
  - .2 Where the rating of the controller would be exceeded, it shall be used in conjunction with a relay or contactor.
  - .3 Sensors shall be suitable for installation in exposed, elevated locations, or for flush installation in pavement and ramps.
  - .4 Control panel shall be microprocessor based to provide effective, economical automatic control.
  - .5 Control panel shall have an adjustable hold-on timer to provide up to 10 hours of system operation after snowfall ceases for complete melting.
  - .6 Control panel shall have individual LEDs to provide indication of power supply, sensor status and heating cable operation.
- .2 Stair snow melting:
  - .1 Each system shall be controlled by an individual tamperproof slab sensing thermostat.
  - .2 The thermostat shall be set at 40°F.

**3.4 FIELD QUALITY CONTROL**

- .1 The heating cable shall be tested for continuity with a meter, and for insulation resistance with a 500-Vdc Megger, when received on the job site, after installation, during and after the concrete pour.
- .2 A complete system test of controls shall be conducted to verify cable operation.

**END OF SECTION**

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**Part 1            General**

**1.1            GENERAL**

- .1    Supply and install a complete heat traced system, UL Listed, CSA Certified of heating cables, components, and controls to prevent pipes from freezing.
- .2    "TYCHO THERMAL" Installation Recommendation' shall be considered as an integral part of this specification.

**1.2            SUBMITTALS**

- .1    Product Data
  - .1    Heating cable data sheet
  - .2    c-CSA-us Certificate of Compliance for freeze protection of fire suppression systems including branch lines or UL Listing Certificate for freeze protection of fire standpipes and supply piping.
  - .3    Fire sprinkler freeze protection design guide
  - .4    System installation and operation manual
  - .5    System installation details
  - .6    Connection kits and accessories data sheet
  - .7    Controller data sheet
  - .8    Controller wiring diagram

**1.3            QUALITY ASSURANCE**

- .1    Manufacturers' Qualifications
  - .1    Manufacturer to show minimum of thirty (30) years experience in manufacturing electric self-regulating heating cables.
  - .2    Manufacturer will be ISO-9001 registered.
  - .3    Manufacturer to provide products consistent with IEEE 515.1 and CSA 22.2 No 130-03 requirements.
- .2    Installer Qualifications
  - .1    System installer shall have complete understanding of product and product literature from manufacturer or authorized representative prior to installation. Electrical connections shall be performed by a licensed electrician.
- .3    Regulatory Requirements and Approvals
  - .1    The system (heating cable, connection kits, and controller) shall meet NFPA-13 and NFPA-14 requirements by carrying c-CSA-us Certification for freeze protection of fire suppression branch lines.
- .4    Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, Article 100, by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended use.

**1.4 WARRANTY**

- .1 Extended Warranty
  - .1 Manufacturer shall provide ten (10) year warranty for all heating cables and components. Provide one (1) year warranty for all heat trace controllers.
  - .2 Contractor shall submit to owner results of installation tests required by the manufacturer.

**Part 2 Products**

**2.1 GENERAL**

- .1 Single Source Responsibility: Furnish heat tracing system for fire-suppression piping from a single manufacturer.
- .2 The system (heating cable, connection kits, and controller) shall meet NFPA-13 requirements by carrying a c-CSA-us system certification for freeze protection of fire suppression branch lines. No parts of the system may be substituted or exchanged.

**2.2 PRODUCTS**

- .1 Self-Regulating Heating Cable
  - .1 Heating cable shall be Raychem XL-Trace self-regulating heating cable manufactured by Tyco Thermal Controls or approved equal.
  - .2 Model Numbers (5XL1-CR/CT, 8XL1-CR/CT, 12XL2-CR/CT).
  - .3 The heating cable shall consist of a continuous core of conductive polymer that is radiation cross-linked, extruded between two (2) 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes.
  - .4 The heating cable shall have a modified polyolefin inner jacket and a tinned-copper braid to provide a ground path and enhance the cables ruggedness.
  - .5 The heating cable shall either have a modified polyolefin outer jacket (-CR).
  - .6 The heating cable shall have a self-regulating factor of at least 90 percent for 5/8XL or at least 70 percent for 12XL. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40°F pipe temperature to 150°F pipe temperature.
  - .7 The heating cable shall operate on line voltages of 120 volts without the use of transformers.
  - .8 The heating cable shall be part of a UL Listed or c-CSA-us Certified system.
  - .9 The heating cable shall be compatible CPVC sprinkler piping as verified by independent testing laboratory if required.
  - .10 The outer jacket of the heating cable shall have the following markings:
    - .11 Heating cable model number
    - .12 Agency listings
    - .13 Meter mark
    - .14 Lot/Batch ID
- .2 Heating Cable Connection Kits

- .1 Heating cable connection kits shall be Raychem RayClic connection kits.
  - .2 Manufacturer shall provide power connection, splice/tee and end seal kits compatible with selected heating cable.
  - .3 Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires.
  - .4 Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized.
  - .5 Connection kits shall be UL Listed and CSA Certified.
- .3 Heating Cable Installation Accessories
- .1 High temperature, glass filament tape for attachment of heating cable to fire sprinkler piping. Cable ties are not permitted. (TTC Catalog Number: GT-66)
  - .2 Plastic Piping – provide an aluminium self-adhesive tape over the heating cable on all plastic piping if required. (TTC Catalog Number: AT-180)
  - .3 Labels – Provide warning labels every 10 feet on exterior of insulation, opposite sides of pipe. (TTC Catalog Number: ETL)
- .4 Digital Temperature Controller with built-in Ground-Fault Protection Device (GFPD)
- .1 Multiple Circuit Distributed Digital Control System
    - .1 Distributed digital control system shall be DigiTrace ACCS-30 heat-trace control system.
    - .2 Heating cable manufacturer shall provide a distributed digital control system with pre-programmed parameters to provide concurrent control for heating cables used for pipe freeze protection, flow maintenance, hot water temperature maintenance, surface snow melting, roof and gutter de-icing, freezer frost heave prevention and floor heating applications.
    - .3 All programming shall be done through the central User Interface Terminal (ACCS-UIT2).
    - .4 The ACCS-UIT2 shall be a color LCD touch-screen display with password protection to prevent unauthorized access to the system.
    - .5 The ACCS-UIT2 shall communicate with up to fifty-two (52) ACCS Power Control Panels (ACCS-PCM2-5) where each panel can control up to five (5) circuits and accept up to five (5) temperature inputs.
    - .6 Digital control system shall be capable of assigning up to four (4) RTD temperature inputs per heat-tracing circuit.
    - .7 The ACCS-UIT2 shall communicate with up to sixteen (16) Remote Monitoring Modules (RMM2), where each module can accept up to 8 temperature inputs.
    - .8 The ACCS-UIT2 shall have a USB port to allow for quick and easy software update.
    - .9 The ACCS-UIT2 shall have three (3) programmable alarm contacts including an alarm light on the enclosure cover.
    - .10 A separate offline software tool shall be made available to allow users to pre-program the digital control system and transfer program via a USB drive or Ethernet.
-



- .11 The ACCS-UIT2 enclosure shall be NEMA 4 for indoor or outdoor locations.
  - .12 The ACCS-PCM2-5 panel shall be in a NEMA 4/12 enclosure approved for nonhazardous indoor and outdoor locations.
  - .13 The ACCS-PCM2-5 panel shall provide ground-fault and line current sensing, alarming, switching and temperature inputs for five (5) heat tracing circuits.
  - .14 Each ACCS-PCM2-5 panel shall have five (5) 3-pole, 30 A contactors (EMR type).
  - .15 The ACCS-PCM2-5 panel shall be capable of operating at 120 V to 277 V.
  - .16 The ACCS-PCM2-5 shall have an alarm contact including an alarm light on the panel cover.
  - .17 Digital controller shall have an integrated adjustable GFPD (10 – 200 mA).
  - .18 Digital control system can be configured for On/Off, ambient sensing, PASC and timed duty cycle control (HWAT only) modes based on the application. PASC control proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions.
  - .19 Digital control system will have a built-in self-test feature to verify proper functionality of heating cable system.
  - .20 Digital control system will also be able to communicate with BMS by one of the following protocols using the DigiTrace ProtoNode multi-protocol gateway.
  - .21 The following variables will be monitored by the digital controller and reported back to the BMS.
    - .1 Temperature
    - .2 Ground-fault
    - .3 Current draw
    - .4 Power consumption
    - .5 Associated alarms
  - .22 The ACCS-UIT2 shall be c-CSA-us Certified. The ACCS-PCM2-5 panel shall be c-UL-us Listed.
  - .2 This system shall connect to all wet sprinkler and wet fire line pipe tracing lines. Refer to the sprinkler and mechanical drawings for locations.**
  - .5 Thermal Pipe Insulation
    - .1 Pipes must be thermally insulated in accordance with the XL-Trace design guide requirements.
  - .6 For installation on plastic piping, the heating cable shall be applied using aluminum tape.
-

- .7 The heating cable for metal-pipe freeze protection shall be sized according to the table below. The required heating cable output rating is in watts per foot at 50°F. (Heating cable selection based on 1 inch fiberglass insulation on metal piping.)

<b>Pipe size</b>	<b>Wattage per foot</b>
76 mm or less	5 watts
101 mm	8 watts
152 mm	8 watts
203 mm	2 strips – 5 watts
254 mm	2 strips - 8 watts

- .8 All thermostats shall be identified with a Lamacoid Nameplate indicating power source.

### **2.3 CONTROLS**

- .1 Pipe tracing circuits shall be controlled by a line sensing thermostat fixed at 40°F. One thermostat shall be installed for each circuit.
- .2 Any dedicated panel serving only pipe tracing circuits shall be complete with an additional exterior ambient sensing thermostat fixed at 40°F to override the panel.

## **Part 3 Execution**

### **3.1 INSTALLERS**

- .1 Acceptable Installers
- .1 Subject to compliance with requirements of Contract Documents, installer shall be familiar with installing heat-trace cable and equipment.

### **3.2 INSTALLATION**

- .1 Comply with manufacturer's recommendations in the XL-Trace System Installation and Operation Manual, including technical bulletins, handling, storage, datasheets and installation instructions.
- .2 Apply the heating cable linearly on the pipe after piping has successfully completed any pressure tests. Secure the heating cable to piping with fiberglass tape.
- .3 Install electric heating cable according to the drawings and the manufacturer's instructions. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.
- .4 Grounding of controller shall be equipment according to Division 26 05 26 Section "Grounding and Bonding for Electrical Systems."
- .5 Connection of all electrical wiring shall be according to Division 26 05 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**3.3 FIELD QUALITY CONTROL**

- .1 Start-up of system shall be performed by factory technician or factory representative.
- .2 Field Testing and Inspections
  - .1 The system shall be commissioned in accordance to the XL-Trace Installation and Operation manual.
  - .2 The heating cable circuit integrity shall be tested using a 2500 Vdc megohmmeter at the following intervals below. Minimum acceptable insulation resistance shall be 1000 megohms or greater.
    - .1 Before installing the heating cable
    - .2 After heating cable has been installed onto the pipe
    - .3 After installing connection kits
    - .4 After the thermal insulation is installed onto the pipe
    - .5 Prior to initial start-up (commissioning)
    - .6 As part of the regular system maintenance
  - .3 The technician shall verify that the C910-485 or ACCS-30 control parameters are set to the application requirements.
  - .4 The technician shall verify that the C910-485 or ACCS-30 alarm contacts are connected to the fire alarm panel.
  - .5 The technician shall verify that the C910-485 or ACCS-30 and ProtoNode-RER/-LER are configured correctly with the BMS.
  - .6 All commissioning results will be recorded and presented to the owner.
- .3 Apply “Electric Traced” labels to the outside of the thermal insulation.

**3.4 MAINTENANCE**

- .1 Maintenance Service
  - .1 Comply with manufacturer’s recommendations in XL-Trace System Installation and Operation Manual.

**END OF SECTION**

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<b>Part 3</b>	<b>Execution.....</b>	<b>4</b>
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**Part 1            General**

**1.1                INTENT**

- .1        Provide all material, equipment and labour required for a complete and adequate installation of an Elevator communication system.
- .2        Provide a handsfree telephone in each elevator cab that will be interfaced to the telephone network and monitored by an off-site agency for the purpose of calling assistance in the event of any emergency such as a cab stuck between floors.
- .3        Provide an on-site rescue station adjacent to the fire panel that will allow emergency personnel to communicate with the handsfree telephones in the elevators.
- .4        Provide Shop Drawings in accordance with Section 16 000.

**1.2                WORK NOT INCLUDED.**

- .1        The arrangements and costs of the off-site monitoring and telephone line shall be by others.
- .2        Elevator contractor to provide communication cables from machine room to elevator cabs.

**1.3                OPERATION**

- .1        Pushing the call button in any of the elevator cab stations will cause the on-site rescue station to ring. If the rescue station handset is not picked up within 30 seconds, the call will be automatically forwarded to the concierge desk/lobby or a 24 hour off-site monitoring service. The elevator unit will alternate calls between the primary and secondary monitoring numbers until the call has been answered.
- .2        When the call is answered, the location feature will announce the caller location prior to the conversation beginning. For callers with a hearing disability, an LED shall begin flashing to alert them that their call has been received.
- .3        To call into any of the elevator cab stations, picking up the rescue station handset and entering the selected cab number will automatically connect the caller to the elevator.
- .4        The emergency elevator communication system shall require only a single telephone line. It shall also provide its own four hour backup power supply in case of a loss of regular AC power.

**Part 2            Products**

**2.1                ELEVATOR COMMUNICATION SYSTEM**

- .1    The Elevator Communications System shall be a Webb Electronics System consisting of:
  - .1    One Webbphone OEM-150 handsfree telephone in each elevator.
    - .1    The handsfree unit shall be mounted behind a perforated grill above the elevator's control panel. Dimensions and details for the mounting studs and speaker grill shall be coordinated between the elevator contractor and Webb Electronics.
    - .2    Each handsfree unit shall be capable of providing an operator-activated location message (audio format) and a computer-activated numeric location message (DTMF format).
    - .3    Each handsfree unit shall be provided with an indicator LED which begins to flash when the call has been answered by monitoring personnel.
    - .4    Each handsfree unit shall be provided with an adjustable call time which can be extended should the monitoring station choose to do so.
    - .5    Each handsfree unit shall be provided with self-diagnostic capability in order to automatically alert building personnel should an operational problem be detected
  - .2    One Webb Electronics LS-250 Rescue Station mounted adjacent to the fire alarm control panel.
    - .1    The faceplate of the Rescue Station shall be 13.5" high x 15" wide and made of 16 gauge steel with a white powder coated finish. It shall have a locking hinged door over the handset area, signage that says "Elevator Telephone" and a recognizable telephone icon no less than 3" in height.
    - .2    The Rescue Station back box shall be 3.6" deep and recessed in the wall as per equipment supplier's instructions.
    - .3    The Rescue Station shall provide an LCD operational display and LED visual indicators for alert conditions such as call waiting, low battery, loss of AC power and loss of telephone line.
    - .4    The Rescue Station shall provide parallel communication ports so that any remote handsets in the machine rooms or on-site security location may call into the elevators without requiring any additional communication equipment.
    - .5    The Rescue Station shall provide a network port so that external expansion circuitry may be added when more than 10 Webbphone handsfree units need to be connected to the rescue Station.

.2 Emergency telephone at the concierge desk or lobby, Webb Electronics LSL-250(D).

.3 Feature to automatically inform the building if any units are not working normally.

.4 Manufacturer:

**WEBB ELECTRONICS INC.**

106-12414 82 Ave.

Surrey, B.C. Canada

V3W 3E9

Phone: (604) 501-6652

Toll free: (877) 731-1010

www.webbelectronicinc.com

**Part 3 Execution**

**3.1 INSTALLATION**

.1 Emergency telephone to be located within Firemans room or as indicated on drawings.

.2 Supply and install conduit and cables between rescue Rescue Station and main telephone room as per equipment supplier's plans and recommendations.

.3 Supply and install conduit and cables between each elevator machine room and Rescue Station as per equipment supplier's plans and recommendations.

.4 Provide a 120V circuit with ground fault for Rescue Station power supply.

**END OF SECTION**

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**Part 1            General**

**1.1                SYSTEM DESCRIPTION**

- .1        Supply and install an empty conduit system for an Entry System as detailed on the drawings and specified herein.
- .2        Provide a separate price for the supply of the enterphone system as the owner may decide to have the equipment supplied by the security company.
- .3        Submit shop drawings in accordance with Section 16 000 for enterphone panels only if applicable.

**Part 2            Products**

**2.1                BUILDING ENTRANCE PANEL(S)**

- .1        Provide the following enterphone system:
  - .1        Building entrance enterphone panels:
    - .1        Caller pushes button on building entrance panel to sound tone signal in suite.
    - .2        Suite tenant may take handset off hook to converse with caller.
    - .3        Tenant may operate button to release building entrance door lock to admit caller.
    - .4        Enterphone panel(s) at building entrance location(s) as indicated on drawings, with the following minimum features:
      - .1        Enclosed, vandal resistant, flush mounting.
      - .2        Microprocessor control module.
      - .3        Handsfree Speaker and 80 second talk time.
      - .4        Superintendent calling.
      - .5        Adjustable volume control.
      - .6        Directory panel.
      - .7        Amplifier and Buzzer.
      - .8        Touch tone pad.
      - .9        Provision to install Postal Service lock.
      - .10      Door release switch with silencing relay and rectifier.
      - .11      Override to signal tenant of visitor.
      - .12      Panel finish: selected by Architect or Interior Designer.

**Part 3          Execution**

**3.1              INSTALLATION**

- .1      Install system in accordance with manufacturer's instructions.
- .2      Connect system to emergency power.

**END OF SECTION**

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**Part 1            General**

**1.1                INTENT**

- .1        Supply and install all labour, materials, products, equipment and service to provide a CO detection and control system as indicated on the drawings and specified in this section.
- .2        Submit shop drawings and product data in accordance with Section 16 000.

**1.2                REFERENCES**

- .1        Units shall be certified to ULC and CSA standards.
- .2        Manufacturer shall be certified ISO-9001-2000.

**1.3                CLOSEOUT SUBMITTALS**

- .1        Provide operation and maintenance data for detection system into manual specified in Section 16 000.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1        All equipment shall be interconnected and provided by the same manufacturer throughout.
- .2        Controller:
  - .1        Control panel must be capable of communicating digitally with the networked transmitters and relay modules. Each communication bus must be capable of accepting a combination of addressable transmitters, relay modules or annunciator panels at a maximum distance of 2,000 feet. One power supply (bringing either 17-27 Vac or 24-38 Vdc) will be sufficient to power the entire gas detection network (controller and sensors).
  - .2        Control panel will manage four internal DPDT relays at fully programmable alarm levels (and within programmable time delays) and be capable of activating multiple relay modules. The relay rating will be no lower than 5 A, 30 Vdc or 250Vac (resistive load).
  - .3        Control panel must include a self-test function that allows for the activation/deactivation of all the programmed outputs by simulating a continuous 5% increase/decrease value until the maximum/minimum value is reached.
  - .4        Control panel must include a real-time clock that enables operation of the outputs for a specific timeframe.
  - .5        Control panel must also include a Vulcain energy saving feature that allows for output operation on alarms set at the max, min or average value of a specific group of transmitters. This feature must also allow for the activation of outputs upon a certain number of a specific group ( $\frac{3}{4}$ ,  $\frac{1}{2}$ ,  $\frac{1}{3}$  and  $\frac{1}{4}$ ) of transmitters reaching their alarm levels. A total of 128 groups can be assigned.
  - .6        Control panel will be capable of communicating with an annunciator panel that can serve as a remote display panel in a secondary control room.

- .7 Control panel will indicate the exact concentration of gas, the gas detected, and the location of the sensor by sweeping through the network and displaying the detected levels at each point on a graphic LCD display.
  - .8 LLCD display will indicate multiple alarm levels for each sensing point. The LED will also provide visual feedback similar to the following:

Normal Operation:	Green LED
Alarm Level A:	Red LED
Alarm Level B:	Red LED
Alarm Level C:	Red LED
Failure:	Yellow LED
TX:	Yellow LED
RX:	Green LED
  - .9 The standard three high/low alarm levels will be complemented with multiple levels that can be programmed into the panel at a later date.
  - .10 The panel will have an audible alarm incorporated (rated at no less than 65 dBA at three feet), which will be activated at fully programmable levels.
  - .11 The control panel will leave the factory fully programmed and will be adjustable in the field by keying in instructions via the keypad. Programming must be saved on its Flash memory card.
  - .12 Suitable for operation between  $-4^{\circ}\text{F}$  and  $122^{\circ}\text{F}$  ( $-20\text{ C}$  and  $50\text{ C}$ ), the control panel must be housed in a NEMA 4X enclosure.
  - .13 The unit will be certified to UL and CSA standards. The controller must be manufactured within an ISO 9001 production environment.
  - .14 The system shall be complete with an override switch for testing of system.
  - .15 The control panel shall be a Vulcain model VA301C controller or approved equal.
- .3 Transmitter:
- .1 The transmitter will be powered by the control panel's power output rated at 17-27 Vac or by an external power supply rated at 17-27 Vac or 24-38 Vdc. Fully addressable, the gas transmitter must be capable of communicating digitally with the control panel through an RS-485 communication port. The gas transmitters must be installed in a true daisy chain with an end of line resistor on the last transmitter. Capable of remote sensing at distances of up to 300 feet, the gas transmitter will incorporate an electrochemical cell. The unit's sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy.
  - .2 Placed into a network configuration, the transmitter will be capable of transmitting gas concentrations through the control panel. For local activation of fans or louvers (or other equipment) an optional DPDT relay 5A, 30 Vdc or 250 Vac (resistive load) will be activated at programmable set points (and programmable time delays) through the control panel, if necessary. The transmitter will also have the capability of sending an analog 4-20mA signal to the BMS/DDC as an option.
  - .3 A 10-step LED display (with the possibility of adding an optional LCD) will provide gas concentration readings. A green LED will indicate normal operation and a yellow LED will indicate fault operation. The transmitter must also be capable of incorporating an audible alarm (rated at no less than 65Db at a distance

of three feet), which will be activated at fully programmable levels through the VA301C control panel.

- .4 The transmitter will be capable of operating within relative humidity ranges of 0-95% and temperature ranges of -40°F to 122°F (-20°C to 50°C). The transmitter must also have an optional capacity of operating at lower temperature ranges.
- .5 The unit will be manufactured to UL 1244 label and CSA 22.2. The transmitter must be manufactured within an ISO 9001-2000 production environment.
- .6 Transmitter alarm levels are to activate and the unit is to be installed in accordance with the following parameters:

TOXIC GASES	FIRST ALARM SET POINT	SECOND ALARM SET POINT	SENSOR LOCATION	RADIUS OF COVERAGE
Carbon Monoxide (CO)	25 PPM	75 PPM	3-4 ft above the floor (900-1200mm)	50 feet (15M)

- .7 A sustained CO level of 75 ppm beyond 5 minutes shall activate the trouble/emergency alarm.
  - .8 Transmitter shall be a VA201T-Q1-CO CO Transmitter or approved equal.
- .4 Strobe and Horn:
- .1 Strobe and horn will be activated by the Control panel or the relay module. Unit will be capable of being mounted directly onto conduit or onto a 100 mm junction box.
  - .2 Unit will be capable of operating within relative humidity ranges of 0-100% and temperature ranges of -35° C to 66° C.
  - .3 Unit shall be certified by CSA.
- .5 Approved Manufacturers: Enmet or Honeywell

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install equipment in accordance with manufacturer's instructions.
- .2 Interconnect equipment.

**3.2 FIELD QUALITY CONTROL**

- .1 Provide complete start up and commissioning service by the manufacturer's authorized representative
- .2 Manufacturer shall provide site inspections as required, operating instructions to the owner and a factory trained technician to perform initial calibration check and system verification.
- .3 Manufacturer shall be capable of providing optional maintenance contract for periodic recalibration of sensors for optimum operational efficiency.
- .4 All costs for these inspections shall be part of this contractor's contract.

**END OF SECTION**

<b>Part 1</b>	<b>General .....</b>	<b>2</b>
1.1	INTENT .....	2
<b>Part 2</b>	<b>Products.....</b>	<b>2</b>
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3.1	INSTALLATION .....	2



**Part 1            General**

**1.1                INTENT**

- .1        Supply and install a complete Building Monitoring System as shown on the drawings and specified herein.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1        The system shall generally consist of but not be limited to a monitoring panel complete with buzzer, connected with conduits and wiring to the appropriate equipment or system to be monitored.
- .2        Manufacturer: Mircom 9001, or approved equal.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install equipment in accordance with manufacturer's instructions and as per drawings.

**END OF SECTION**