

ELECTRICAL SPECIFICATIONS
FOR
FORESTSIDE ESTATES
ATTMAR & PALLESCHI DRIVE
BRAMPTON, ONTARIO

ENGINEER'S REFERENCE NO. 18-017

ISSUED FOR TENDER: AUGUST 02, 2019

ISSUED FOR PERMIT: SEPTEMBER 28, 2020



UNITED ENGINEERING INC

Mechanical and Electrical Consulting Engineers

3645 3645 Keele St. UNIT #105
Toronto, Ontario, M3J 1M6
Email: info@u-eng.ca
Tel: (416) 398-1999; Fax: (416) 398-1933

INDEX

DIV	SECTION	TITLE
26	26 00 10	ELECTRICAL WORK GENERAL REQUIREMENTS
26	26 05 00	BASIC ELECTRICAL MATERIALS & METHODS
26	26 05 44	FIRE STOPPING AND SMOKE SEAL MATERIALS
26	26 23 00	SERVICE AND DISTRIBUTION
26	26 32 00	EMERGENCY GENERATOR
26	26 33 43	ELECTRIC VEHICLE SUPPLY EQUIPMENT
26	26 50 00	LIGHTING
26	26 60 10	ELECTRIC PIPE TRACING CABLES
26	26 60 15	SNOW MELTING
26	26 60 17	FLOOR WARMING SYSTEMS
26	26 60 20	ELECTRIC HEATERS
27	27 30 00	VOICE COMMUNICATION SYSTEMS
27	27 40 00	CABLE TV SYSTEMS
28	28 00 00	SECURITY SYSTEM
28	28 42 00	GAS DETECTION AND ALARM
28	28 46 00	SINGLE STAGE ADDRESSABLE EVAC FIRE ALARM SYSTEM
28	28 46 01	SMOKE AND CO ALARM

1 GENERAL

1.01 GENERAL

- .1 General Conditions of Contract, Supplementary Conditions, Division 00 and Division 01, Section 14 21 23 Electric Traction Passenger Elevators apply to and are a part of this Section.
- .2 This Section specifies requirements that are common to Electrical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.
- .3 This subcontractor shall be familiar with the work of all other trades so that he can include for all work necessary under this contract to fulfil the intent of the drawings and specifications. Include all applicable taxes.

1.02 EXAMINATION OF SITE AND DRAWINGS

- .1 Before tendering, the Electrical Contractor shall examine the site, the local conditions affecting the work of this Contract and other trades and shall satisfy himself that the work may be carried out in the manner indicated on the plans and specifications. The contractor should report any conflicts or discrepancies prior to close of Tenders. Failure to do this will render this Contractor responsible for a complete job as intended.
- .2 In case of discrepancies or conflicts between Drawings and Specifications, Documents will govern in order specified in "General Conditions", however, when scale and date of Drawings are same, or when discrepancy exists within Documents, include most costly arrangement.

1.03 WORK INCLUDED

- .1 Include and supply all materials and labour required for the complete installation of all electrical work in the buildings and 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 work shall generally consist of the following:
 - .1 Provisions for incoming Hydro services. Use Hydro drawings for installation. Contact Hydro and arrange for services and pay required fees at start of work.
 - .2 Secondary distributions.
 - .3 Metering provisions suitable to the local utilities and as shown on the drawings.
 - .4 Panels and branch circuit wiring.
 - .5 Supply and installation of all wiring devices.
 - .6 Supply and installation and wiring of all lighting fixtures, both interior and exterior.
 - .7 Provisions for Bell Telephone systems. Coordinate with Bell.
 - .8 Reserved.
 - .9 Supply and installation of complete fire alarm system.
 - .10 Provisions for T.V. systems. Coordinate with supply authority.

-
- .11 Supply and installation of Emergency Power Systems.
 - .12 Supply and installation of Emergency Generator System.
 - .13 Supply and installation of all exterior convenience receptacles. (Ground fault).
 - .14 Supply and installation of all temporary power requirements.
 - .15 Wiring of all mechanical equipment supplied and installed under the Mechanical Division. Refer to mechanical Division 15000.
 - .16 Wiring of all miscellaneous equipment supplied by others (ranges, elevators, laundry appliances, etc.).
 - .17 Supply and installation of all miscellaneous electric heating.
 - .18 Supply and installation of ramp and stair snow melting system.
 - .19 Supply and installation of pipe tracing.
 - .20 Supply and installation of dry type transformers.
 - .21 Empty conduit systems (preferably in the slab) for security, access control, building automation (where indicated) and other systems as shown on the drawings.
 - .22 Supply and installation of emergency intercom systems.
 - .23 Provide coordination study and set breaker trips for all power distribution to suit same.
 - .24 #3/0 bare stranded copper grounding conductor from main cold water service to transformer vault.
 - .25 Digital metering system as noted on the drawings
 - .26 Wiring of the Dry sprinkler compressor determined from the shop drawings.
 - .27 If non-metallic water main is provided by mechanical division, provide separately min. of 4 – 10' x 3/4" copper clad ground rods as per OEC Section 10-700. Entire work to comply with Section 10 of O.E.C. Ground rods shall be installed under garage floor with lead being brought up into transformer vault.
 - .28 Provide all the electrical work related to the elevators specified in Section 14 21 23. The Section 14 21 23 are part of this section.

1.04 WORK EXCLUDED

- .1 Supply and installation of mechanical equipment listed under mechanical division.
- .2 Supply and installation of all equipment control wiring low or utilization voltage beyond main power connection to the terminals of motor or drive, except where line voltage switching is indicated, such as small fractional horsepower fans, unit heaters, etc.
- .3 Supply and installation of motor controls, starters, control panels, etc.

1.05 PHASING

- .1 Phasing and scheduling of Work is required in order to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit this project as specified in Division 01 and on drawings. Confirm exact phasing requirements with Consultant prior to start of Work.
- .2 Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, to approval of Owner and Consultant. Include for required premium time work to meet these requirements.
- .3 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times approved by Consultant and as agreed by Owner, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.
- .4 Project partial occupancy permits to be required throughout project. Provide for each partial permit a local governing electrical inspection authority certificate, a fire alarm system verification certificate and any other testing/verification certificates for systems.

1.06 PLANNING AND LAYOUT OF WORK

- .1 Base installation layout, design, terminations, and supply of accessories, on Documents with specific coordination with reviewed shop drawings.
- .2 Co-ordinate work with work of other trades to ensure a proper and complete installation. Notify trades concerned of requirements for openings, sleeves, inserts and other hardware necessary in their work for installation of your work.
- .3 Where work is to be integrated, or is to be installed in close proximity with work of other trades, co-ordinate work prior to and during installation.
- .4 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that they will clear each other as well as any other obstruction. Generally, order of right of way for services within ceiling spaces to be as follows:
 - .1 piping requiring pitch, including drains, steam, condensate etc.;
 - .2 large piping 100 mm (4") and above;
 - .3 large ducts main runs;
 - .4 cable tray and bus duct;
 - .5 large conduit 100 mm (4") and above;
 - .6 small piping less than 100 mm (4");
 - .7 small ducts branch runs;

-
- .8 small conduit less than 100 mm (4").
 - .5 Unless otherwise directed by Consultant, Mechanical Contractor is to determine final locations of major work within ceiling spaces.
 - .6 Do not use Contract Drawing measurements for prefabrication and layout of raceways, conduits, ducts, bus ducts, luminaires, and other such work. Locations and routing are to be generally in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.
 - .7 Prepare plan and interference drawings of work for submittal to General Contractor, who will then arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with Contractor's plan drawings so that trades may make use of section drawings. Section drawings indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Prints and/or disks of Contractors' interference drawings are to be distributed among other Trade Contractors and General Contractor. Submit interference drawings to Consultant for review.
 - .8 Carry out alterations in arrangement of work that has been installed without proper co-ordination, study, and review, even if in accordance with contract documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.
 - .9 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination by this Division.
 - .10 Whether shown on drawings or not, leave adequate space and provision for servicing of equipment, removal and re-installation of replaceable items. Comply with code requirements with regards to access space provision around electrical equipment.
 - .11 Where drawings indicate that acoustic tile ceiling is being suspended below existing plaster ceiling, coordinate with General Trades Contractor design of framework used to support suspended ceiling, lighting, diffusers, and other Electrical Divisions components that are mounted within or through ceiling. Do not mount devices to suspended ceiling. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.

1.07 COMPONENT FINAL LOCATIONS

- .1 Owner and Consultant reserve right to relocate electrical components such as receptacles, switches, communication system, outlets, hard wired outlet boxes and luminaires at a later date, but prior to installation, without additional cost to Owner, if relocation per components do not exceed 3 m (10') from original location. No credits will be anticipated where relocation per components of up to and including 3 m (10') reduces materials, products and labour. Should relocations exceed 3 m (10') from original location, adjust contract price for that portion beyond 3 m (10') in accordance with provisions for changes in Contract Documents.

1.08 SYSTEMS CO-ORDINATION

- .1 Be responsible for and perform specific coordination of various low voltage systems supplied by Electrical Divisions and also with systems supplied by other Divisions of Work. Include for but not be limited to provision of following, as applicable:
 - .1 coordinate with General Contractor and other Subcontractors, various systems of trades

which in any way are interfaced with or monitored by or integrated to, or need to be coordinated with;

- .2 prepare systems coordination drawings detailing related system coordination and integration points being monitored and/or controlled; submit coordination drawings as part of shop drawing submission;
- .3 coordinate security system requirements with successful door hardware supplier and prepare detailed coordination drawings of component installations, wiring and conduit layouts, division of responsibility between various trades, etc.; review security system requirements with associated door hardware (electromagnetic locks, electric strikes, etc., to ensure proper sequence of operation and door functionality is provided to suit each door configuration); prepare detailed door functionality of each door configuration and submit for review by Consultant;
- .4 review specifications of each trade/Division, i.e.AV equipment, BAS points, elevator requirements, electrical devices in millwork or prefabricated service consoles, etc., to ensure proper communications and power requirements;
- .5 review with manufacturers coordination and integration requirements of their systems;
- .6 review each systems communication protocols to ensure they are compatible and can communicate with each other as required;
- .7 review system shop drawings prior to submission to Consultant, to verify that each system has been coordinated with other systems and that required options and features are selected to meet coordination requirements;
- .8 be present at testing and commissioning functions of each system and provide technical assistance with regards to system operations;
- .9 be "on-site" coordinator of respective system trades with regards to respective system coordination of installation and testing;
- .10 liaise with Consultant with regards to ensuring that systems coordinate and integrate properly to satisfaction of Owner;
- .11 document coordination and integration requirements and maintain records for submission as part of shop drawings;
- .12 respond to coordination and integration requirements and be responsible for such work;
- .13 where a system integrator has been included for, coordinate integration requirements with system integrator.

1.09 PERMITS, CERTIFICATES, APPROVALS AND FEES

- .1 Comply with all applicable Codes and all local, municipal, provincial and federal by laws, rules and regulations. Obtain all permits required and pay permit fees.
- .2 The whole of the work shall comply with the requirements of the latest edition of the Canadian Electrical Code, Part I, and any Provincial or Local requirements that are applicable.
- .3 Pay Inspection Department fees as required. Submit the necessary copies of drawings to the local Cable TV (if applicable) and Bell Telephone Company, for their approval and information.
- .4 Arrange for inspection of work by the Inspection Authority having jurisdiction over the work and on

completion of the work present to the Owner the final certificate of approval.

- .5 Where electromagnetic locks are provided whether by this Division or by others, be responsible for obtaining and paying for required certificates of work with regards to such electromagnetic lock work.

1.10 CHANGES OR REVISIONS TO WORK

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity, or type of any work from that required by Contract Documents, prepare and submit to Consultant for approval, a quotation being proposed cost for executing change or revision.
- .2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 When change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work.
- .4 Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .5 If, in your opinion, changes or revisions to work should be made, inform Consultant in writing and, if Consultant agrees a Notice of Change will be issued.
- .6 Do not execute any change or revision until written authorization for change or revision has been obtained from Consultant.

1.11 TEMPORARY SITE SERVICES

- .1 Temporary light and power shall be provided on the job by the Electrical Contractor, but each Trade shall provide extension cords, etc., for their own use. Provide your own office, workshop, tools and materials storage and be responsible for any loss or damage thereto.
- .2 Temporary power shall be provided by the Electrical Contractor for the Crane and Manhoist.
- .3 Provide temporary power to trailers as required.
- .4 Supply and install temporary panels on each floor during construction.
- .5 Provide complete temporary incoming service to satisfy the needs of the owner.

1.12 COOPERATION WITH OTHER TRADES

- .1 Before tendering, examine the conditions at the site, the Architectural, Structural and Mechanical drawings and make yourself familiar with the building construction, architectural finishes, etc., in order that the price may include everything necessary for the complete installation of the work.
- .2 Confer with other Trade Contractors installing piping, other equipment, foundations, etc., which may affect the installation and arrange equipment in proper relation to other apparatus with the building construction and finish. Special care shall be taken in the installation of all piping, ducts, etc., where the same are to be concealed to see that they come within the finished lines of the floors, walls and ceilings.
- .3 Installation of conduits and other materials shall be coordinated with other trades work prior to actual installation. Failure to do this may necessitate relocation at the Contractor's cost, as directed

by the Consultant.

- .4 Notify the Partition Contractor of all openings, foundation work, anchors, hangers or other provision necessary for the installation of this work in ample time so that proper provision can be made for them. Failure to comply with these requirements on the part of the Electrical Contractor shall not relieve him of the cost of cutting for openings, etc., at a later period and the subsequent patching or other work required.

1.13 LIABILITY

- .1 Assume full responsibility for laying out this work and for any damage resulting from improper location of performance of this work.
- .2 Supply to other trades any equipment to be built-in by them or measurement to allow necessary openings to be left.
- .3 Protect all work from damage resulting from doing work of this Division. Cover floors and other work with tarpaulins, if necessary. Repair all damage to floor surfaces or other parts of the building resulting from doing the work of this Division, to the satisfaction of the Owner.
- .4 Be responsible for the condition of all materials under this Division and provide the necessary protection and maintenance of the work of this Division until the building has been completed and accepted.
- .5 Be solely responsible for loss or damage of materials or equipment supplied under this Division and delivered to the site from whatever source.
- .6 Maintain such insurance as will fully protect both the Owner and these Divisions from any claims under the Workman's Compensation Act, and insurance as noted in the General Conditions.

1.14 CONTRACT DRAWINGS

- .1 The drawings are in general small scale, and measurements shall not be scaled from these drawings. Where dimension figures are specifically shown, these are to provide a specific reference point for the installation of devices. Where there is a conflict that requires changes, refer the conflict to the Consultant for resolution before such installation is done incorrectly. Minor relocations shall be done at no extra cost. Check and verify all dimensions on the job.
- .2 In every place where a space is indicated as reserved for future equipment, for equipment to be supplied by another trade, or by the Owner, leave such space clean and install the conduit and other work in such a way that the necessary access and connections can be made to the future equipment.

1.15 RECORD AS-BUILT DRAWINGS

- .1 Obtain two sets of white prints. As the job progresses, mark these drawings to accurately indicate the location of installed work. The white prints shall be available for inspection at the site at all times. Incorporate all architectural and electrical changes made during construction. On completion of the job retain the Engineer to prepare as built drawings for the Owner.

1.16 SHOP DRAWINGS

- .1 Prior to ordering of any material or equipment provide shop drawings and/or descriptive data for review with the name of the project on each brochure or catalogue page.
- .2 Submit electrical shop drawings for review by the Consultant in accordance with Division 1 requirements. This review shall not relieve the contractor or supplier of responsibility for

compliance with the Contract Documents.

- .3 Assume responsibilities for accuracy of equipment dimensions and ensure that proper access is available for equipment maintenance.
- .4 Shop drawings are to be submitted in bound package format by category, and collated. Multiple Individual copies of single shop drawings are not acceptable.

1.17 HANGERS, INSERTS AND SLEEVES

- .1 Provide and install inserts, hangers anchors and supports required for work to be installed under this Section.
- .2 Locate and set sleeves. Sleeves shall provide adequate clearance around conduit and ducts to prevent metal surface touching sleeve. Pack sleeves with non-combustible material to prevent noise trans- mission as well as to act as a smoke and fire barrier.

1.18 CUTTING AND PATCHING

- .1 Cutting and patching for electrical work shall be done by this Section. Should any cutting and repairing of finished or existing surfaces be required, this Section shall employ the particular trade engaged on the site for this type of work to do such cutting and repairing and pay all expenses.
- .2 Holes in concrete walls and floors for conduits or ducts shall be core drilled where not sleeved.
- .3 All cutting and patching shall be laid out for the Consultant's review before being undertaken. The approval of the Structural Consultant will be required prior to the execution of any core drilling work.

1.19 PAINTING

- .1 All equipment supplied under this Contract shall be factory painted with prime coat and at least two coats of good quality finish paint.

1.20 ACCESS DOORS

- .1 Wherever any electrical equipment requiring maintenance or adjustment is "built in", advise the Partition Contractor that access doors are required. Be responsible for the location of the doors such that proper maintenance of the concealed work is possible. The cost of these doors shall be the responsibility of the Electrical trade. Fire rated access panels are required in rated partitions and assemblies.

1.21 IDENTIFICATION OF EQUIPMENT

-
- .1 All equipment supplied shall be identified with lamicoid plastic nameplates, black background with white etched letters 6mm high, (red nameplates on emergency power equipment). All panel directories shall be typewritten. All electrical boxes or different systems shall be identified with a different colour code. Provide warning labels on all insulated electrically traced pipes.

1.22 WORKMANSHIP

- .1 Only first-class workmanship will be accepted, not only with regards to safety, efficiency, durability etc., but also with regards to the neatness of detail. All conduit and wiring which is NOT ENCLOSED WITHIN FLOOR SLABS, must be lined up parallel, or at right angles to the building walls. Equipment must be accurately set, plumb and level. The hanger rods must be in similar, true, vertical alignment. In general, the entire work throughout shall be first-class and workmanlike, and shall present a neat and clean appearance upon completion.
- .2 It is to be clearly understood that any unsatisfactory work shall be rectified by this Division at its own expense. Pay the cost of all trades that may be affected by your work or correction.

1.23 CLEAN-UP

- .1 During the course of construction, keep work area clean and do not allow an accumulation of debris resulting from your work. Upon completion of the work, remove all debris and surplus material, leaving the premises in a broom-clean condition.

1.24 TESTS

- .1 All equipment and electrical systems provided under this Section shall be tested to ensure that they are functioning properly. Submit to the Consultant, giving all the necessary test data, a statement certifying that all equipment is functioning properly, and that the work specified and/or required has been completed.

1.25 WARRANTY

- .1 Systems shall be complete, tested and ready for use with all equipment operating satisfactorily and all fixtures lamped.
- .2 Provide a certificate of warranty of workmanship, materials and equipment for two (2) years after acceptance by the Consultant. This does not supersede warranties on specific items of equipment which may be for longer periods, and manufacturer's warranties shall begin on the date of this acceptance, not when the product was shipped or installed. All defects which appear during the warranty period shall be repaired at no cost to the owner.

1.26 CONCRETE WORK

- .1 Provide all concrete work for the electrical work as indicated on the drawings or in the

specification, unless otherwise noted.

1.27 BONDING AND GROUNDING OF ALL EQUIPMENT AND FEEDERS

- .1 All grounding and bonding shall conform to the Canadian Electric code, Ontario electrical safety code, and ESA requirements. All copper to copper and copper to steel connections shall be "Cadweld" or "Burndy Thermoweld" welded connections, unless specified otherwise. Contractor to size for in accordance with latest code tables and to inspectors approval.
- .2 The ground connection to the water pipe and the ground conductor shall be by means of a ground connector "Burndy" type "GAR" sized for the water pipe and the conductor. The size of grounding conductor shall be as required by the local Electrical Safety Code.
- .3 If incoming water main is PVC plastic, provide system of grounding rods as specified by O.E.C., service grounding resistance to meet approval of Ontario Hydro Inspection Department and ESA.

1.28 EXPANSION AND CONTRACTION

- .1 Proper allowance shall be made for thermal expansion and contraction of all bus ducts and conduits, etc., where applicable, and shall be installed in such a manner that the strain weight does not come upon connections and fittings, etc.

1.29 NOISE AND VIBRATION

- .1 All equipment supplied and/or installed by this Division shall operate without objectionable noise or vibration and to the satisfaction of the Owners.
- .2 Be responsible for changes and/or additions necessary to eliminate such objectionable noises and vibrations without extra cost to the Owners.

1.30 INFRA-RED SCANNING

- .1 Three months before expiry of the manufacturer's and contractor's warranty on the major electrical devices, provide an Infra-Red Scanning report.
- .2 The scanning shall be inspected with a Infra-Red Fast Scan Thermal Imaging camera with videotape capabilities as well as facilities for taking black and white Infra-Red Thermo-grams of all hot spots encountered, including temperature differences.
- .3 The Infra-Red inspection shall include equipments, joints and connections on the following equipment:
 - .1 Main switchboards.
 - .2 Distribution power panels.
 - .3 Bus ducts.
 - .4 Transfer switches.
- .4 An Infra-Red report, signed by a Professional Engineer, complete with 35mm colour photographs, black and white thermo-grams of all hot spots and suggested recommendations for repair, shall be

submitted within 10 days of the scanning.

- .5 This inspection shall be presented by BROSZ and Associates, ENERSCAN CONTROLS (793-4000) or other reputable firm.

1.31 MANUALS AND CERTIFICATES

- .1 On completion of this project, instruct the Owner's representative in the operation and function of all systems. Provide the Owner with three complete sets of approved shop drawings and operation manuals for all equipment requiring maintenance or operational instructions. These shall be issued in hard cover, 3-ring binders. One copy of the record drawings shall also be included. The manuals shall include:
 - .1 General arrangement shop drawings.
 - .2 Recommended maintenance practices and precautions.
 - .3 Complete wiring and connection diagrams.
 - .4 Complete list of parts.
 - .5 Fire alarm system verification and test report.
- .2 Before final payment is made, an unconditional electrical Provincial Inspection Department certificate shall be given to the Owner, indicating that all parts of the electrical system meet with Hydro approval.

1.32 WIRING FOR OTHER TRADES

- .1 Examine Architectural and Mechanical (plumbing, heating, ventilating and air conditioning) plans and specifications to determine extent of electrical work in connection with these Divisions, which is to be done under the work of the Electrical Division.
- .2 In general, all motor starters, contactors, relays, and associated controls for mechanical equipment supplied under Division 15, shall be done by Div. 15.
- .3 Co-ordinate the exact location and verify characteristics of electrical provisions for the work of the Mechanical Division.
- .4 The locations of starters, motors and associated equipment indicated on the drawings are approximate and diagrammatic only. Co-ordinate with the work of Division 15, Mechanical Trade Sections, to ensure proper location of equipment. The exact locations of conduit terminations at mechanical units shall be determined from equipment manufacturer's approved shop drawings. Conduits must be installed to enter only in the locations designated by equipment manufacturers.

ELECTRICAL WORK GENERAL REQUIREMENTS

- .5 Provide safety switches required for disconnection of remotely controlled motors, and where required at motors by the O.H.E.P.C. regulations, whether shown on the drawings or not. Where required at fan motors, they shall be concealed in the fan housing if possible.
- .6 Provide weatherproof un-fused safety disconnect switches, fastened to exterior of roof mounted units.
- .7 Co-ordinate the control scheme of all motor starters, contactors, and relays, with the requirements of the appropriate sections of Division 15 work. Division 15 shall do all control wiring in accordance with approved shop drawings to provide necessary operation sequences.
- .8 Thermal overload relays for starters shall be selected, and field adjusted to trip a maximum value of 115% of actual nameplate full load amperes. Selection of the relay element shall be based on starter manufacturer's recommendations. For this purpose, prepare a motor starter schedule listing the following for each motor:
 - .1 Actual full load amperes of motor and service factors.
 - .2 Temperature Class in degree centigrade rise of insulation class.
 - .3 Circuit breaker and proposed rating.
 - .4 Relay element section, trip range and settings.
- .9 Wiring for Mechanical Equipment:
 - .1 Electrical Contractor shall wire all line voltage loads and controls for the Division Mechanical with the exception of low voltage control wiring, which shall be done by Division 15.
 - .2 Supply, install and wire all ventilation fan timers.
 - .3 Wire sprinkler flow alarm switches.
 - .4 Provide 120 volt outlets for thermostatic controls.
- .10 Ensure that equipment supplied by other trades is of the proper capacity and voltage.
- .11 Provide, install and wire double voltage relays where required by the Electrical Code.

1 GENERAL

1.01 APPLICATION

- .1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more Sections of Electrical Divisions. It is intended as a supplement to each Section of Electrical Divisions and is to be read accordingly.

1.02 LOCAL ELECTRICAL UTILITY REQUIREMENTS

- .1 Comply with latest conditions of supply requirements of local governing electrical utility. Confirm exact requirements with local governing electrical utility and coordinate utility requirements with respective Divisions of Work providing such work. Provisions to accommodate local governing electrical utility requirements generally include but are not limited to following:
 - .1 preconstruction meeting;
 - .2 inspection: on site access for local governing electrical utility inspector to be on duty for duration of work;
 - .3 underground inspection: submission of approval drawings and application for inspection prior to any inspection of work;
 - .4 approval of work and materials by local governing electrical utility inspector prior to any backfilling work.
- .2 In case of discrepancies or conflicts between Drawings and Specifications and local governing authority standards, contact Consultant and obtain direction. If direction is not available prior to close of Bids, include for most costly arrangement, but ensure that direction is obtained prior to start of Work.

1.03 INCOMING ELECTRIC SERVICE WORK

- .1 Included in Division 01 is a cash allowance to cover costs for local governing electrical utility to extend their electrical system to service property. Local governing electrical utility work to include but not be limited to provision of following:
 - .1 primary conductors and secondary conductors installed in concrete encased ductbank;
 - .2 required primary and secondary connections to main power transformer;
 - .3 pad mounted main power transformer;
 - .4 testing of primary conductors, main power transformer and connections;
 - .5 required off site work to incoming system;
 - .6 low voltage metering components.

1.04 EQUIPMENT WITHSTAND RATINGS

- .1 Rate electrical equipment, circuit protective devices, bussing, and switches to interrupt and withstand short circuit faults greater than available fault current at its source of supply.

2 PRODUCTS

2.01 STANDARDS OF EQUIPMENT AND MATERIALS

- .1 Materials shall be new, of Canadian manufacturer where available, first quality and uniform throughout Submit tender based on the use of materials and equipment specified, and provide list of alternate equipment.
- .2 Electrical materials shall be C.S.A. approved and be so labelled. Material not C.S.A. approved, shall receive acceptance for installation by Ontario Hydro Special Inspections Branch before delivery, and modifications and charges required for such acceptance shall be included in work of this Section. Material shall not be installed or connected to the source of electrical power until approval is obtained.
- .3 Confirm capacity, ratings and characteristics of equipment items being provided to supply power to equipment provided under other Divisions of the work. Resolve discrepancies before such items are purchased.
- .4 Alternate equipment may be proposed, provided that the tender is based on the specified product or the approved equal listed, and that the cost difference is shown in the tender as an add/deduct from the base price. The acceptance of the proposed alternative is not automatic and the Consultant will be the sole judge of the acceptability.
- .5 The successful bidder shall tour the model suite for the purpose of establishing the standard of materials and workmanship.

2.02 MATERIAL ACCEPTANCE

- .1 Acceptance of materials installed presumes that materials have not been damaged or exposed to conditions that would be considered to adversely affect performance and life expectancy.
- .2 If, in the opinion of the Consultant, materials have sustained damage, or have been exposed to abnormal conditions, it shall be the responsibility of the contractor to have such tests performed as deemed necessary by the Consultant to establish condition and, therefore, acceptability of installed materials.
- .3 Tests shall be conducted by independent testing specialists acceptable to the Consultants, who shall provide written report of tests directly to the Engineer.

2.03 RACEWAYS

- .1 Rigid galvanized steel conduit shall comply with C.S.A. Specification C22.2 No. 45, Rigid Metal Conduit.
- .2 Electrical metallic tubing (EMT) shall comply with C.S.A. Specification C22.2 No. 83, Electrical Metallic Tubing. Connectors and couplings to be forged steel. Connectors to have factory installed insulated throats.
- .3 Rigid PVC conduit shall comply with C.S.A. Specification C22.2 No. 136, Rigid PVC (Unplasticized) Conduit.
- .4 Watertight flexible conduit, "Sealtite" PVC jacketed flexible steel with Hubbell-Kellum strain relief grips, shall comply with C.S.A. Standard C22.2 No. 56
- .5 Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .6 Rigid P.V.C. conduit shall be rigid non-metallic conduit of unplasticized polyvinyl chloride.

-
- .7 Rigid Type I conduit shall be a rigid non-metallic conduit of bitumenized fibre or asbestos cement requiring encasement in concrete.
 - .8 Rigid Type II shall be similar to Type I except of heavier construction and not requiring encasement in concrete.
 - .9 Cor-line electrical non-metallic tubing and fittings shall comply with C.S.A Standard C22.2 No 227.1. ENT shall be permitted for concrete encasement.

2.04 WIRE AND CABLE

- .1 Unless otherwise noted on the drawings, all wiring shall be copper conductor cables sized as noted, rated 75 degrees C, 600 volt minimum and C.S.A. approved for application. Aluminum corflex feeders may be used only where specified. Aluminum branch circuit will not be accepted. All wire sizes shown are based on the use of copper conductors unless noted otherwise. 100A feeders and larger will be allowed in aluminium if installed as per manufacturer's recommendations.
- .2 Wire and cable, unless noted, may be PVC insulated type TWH, complying with C.S.A. Specification C22.2 No. 75, Thermoplastic-Insulated Wire and Cables.
- .3 Low voltage wires and cables 250 MCM and larger shall, unless otherwise noted, have copper conductors with RW90 X-Link minus 40 degrees F, 1000 volt insulation. Aluminum allowed for 200A and larger.
- .4 Aluminum sheathed feeder cables shall, unless otherwise noted, have a corrugated seamless aluminum sheath, copper conductors, RA90 X-Link minus 40 degrees F, 1000 volt insulation with P.V.C. jacket. FT-4 rated.

Where PVC jackets are used PVC material shall meet CSA standards for flame spread rating as per O.B.C. Section 3. It shall be sole responsibility of Div. 16 if installed contrary to the O.B.C. requirements.

- .5 All aluminium feeder cables (#250MCM and above) shall have dual rated compression or mechanical type termination at both ends. Torque values to be as per lug supplier or equipment recommendations
- .6 Emergency feeders shall be as specified on the drawings and in accordance with O.B.C. Section 3.2.6.

The wiring cable shall be listed in the ULC Fire resistance Directory.

Polymer insulated cable shall have:

- Description: C22.1-02 Canadian Electrical Code, Part I Type R90
- Conductor: high conductivity copper Class "B" strand, designed to ensure tensile strength
- Insulation Voltage Rating: 600 volts
- Cable Temperature Rating: 90 degrees C dry
- Cable Temperature Rating: 75 degrees C wet per UL 44
- Termination Temperature Rating: 75 degrees C
- Insulation Material: silicone rubber

- Marking indicating that the cable is Type R90
 - Fire Rating: cable system shall have a 2-hour fire rating as listed by Underwriters Laboratories of Canada
 - Wet location approval per UL 44 and to be printed "UL RHW"
 - Complete system approval including pull box, vertical installation, pulling lubricant and minimum 1-hour splice
- .7 Use Electrovert "Z-Type" code markers for all conductors.
- .8 Underground and outdoor wiring shall be RW90 insulated cables in PVC conduit, complete with separate ground wire.
- .9 Wiring through or in all lighting fixtures shall be type GFT or rated at 75 degree per Code requirements.
- .10 Wiring for signal systems shall be as shown on the drawings and/or in strict accordance with the manufacturer's recommendations and specifications.
- .11 Feeders to chiller (where applicable) shall be copper and terminated with copper lugs. Aluminium will not be accepted.

2.05 OUTLET BOXES

- .1 Outlet boxes used with rigid steel conduit shall be 'FS' or 'FD' Feraloy condulets.
- .2 Outlet boxes used with EMT conduit shall be electro- galvanized and made of code gauge steel except when they are surface mounted on walls when they shall be 'FS' or 'FD' Feraloy condulets.
- .3 Outlet boxes installed outside the building shall be weatherproof type, with neoprene gasket.

2.06 SPECIAL BOXES AND CABINETS

- .1 Type 'C', 'C', 'T' and 'E' pull boxes, junction boxes and cabinets shall be made of code gauge steel with corners lapped and welded and shall be painted and identified as noted in this Specification.
- .2 Cabinets shall provide proper space for conduits, wires and connections and their size shall be in accordance with the requirements of the Authorities having jurisdiction.
- .3 The trim and cover shall be as required by the service and location.
- .4 Pull boxes, junction boxes and cabinets shall be independently supported from the conduit connected to them.
- .5 The metal cabinets shall be as manufactured by F.P.E., Square 'D', or equal.

2.07 DISCONNECT SWITCHES

- .1 The disconnect switches shall have the operating handle interlocked with the switch cover so that it can only be opened when the switch is in the "Off" position, and the handle cannot be put in the "On" position unless the cover is closed.
- .2 The fused switches shall have steel reinforced clips and fuses shall be easily removable when the switch is in the "Off" position.

- .3 Switches shall have ample gutter space for top or bottom wiring and must have fully visible blades when in the "Off" position, quick-make, quick-break mechanism and be horse-power rated.
- .4 Switches used outdoors shall be in a weatherproof enclosure.
- .5 Switches shall have provision for padlocking in the "Off" position and interlock defeat.
- .6 All motors shall be provided with a disconnect switch by this Division unless otherwise noted.
- .7 The disconnect switches shall be of the same manufacturer throughout.

2.08 FUSES

- .1 Fuses protecting motor circuits shall be HRC Form 1 class 'J'.
- .2 Other fuses up to 600A shall be Form I Class 'J'.
- .3 Other fuses above 600A shall be Form I Class 'L'.
- .4 All fuses and breakers to be coordinated to prevent unnecessary tripping and power disruption. Provide a complete coordination study as specified under "Scope of Work"
- .5 Fuses shall be of English Electric, CEFCO, Gould-Shawmut or Buss manufacture.
- .6 Provide a fuse cabinet in the Main Electrical Room housing 1 spare fuse of each type used in the project.

2.09 CONTACTORS

- .1 Contactors controlling lighting panels or branch circuits shall be Tungsten rated, electrically operated, mechanically held with coil clearing contacts of the size and rating specified, complete with control transformer, control circuit fuses, warning label and On/Off/Auto selector switch.
- .2 Contactor shall be in CEMA Type 2 enclosure unless otherwise noted.
- .3 The contactors ampere rating shown on the drawings is the minimum continuous enclosed derated rating of the contactor.
- .4 Contactors controlling branch circuits shall be mounted above the lighting panel from which they are fed, unless otherwise noted.
- .5 Contactors shall be of Allen Bradley, Asco or Square 'D' manufacture or equivalent as approved by the Engineer.

2.10 WIRING DEVICES

- .1 The supply of wiring devices shall be divided into three (3) different groups.
 - i) Apartment suites and corridors.
 - ii) Public areas ground floor – common amenities areas.
 - iii) Service areas, roof mechanical rooms, locker rooms and other secondary areas.
- .2 Apartment suites wiring devices shall be residential grade Decora style white complete with matching cover plates and rated to suit loads or approved alternate.
- .3 Public areas ground floor/common areas shall be specification grade, white:

-
- .4 Switches and receptacles in other areas shall be ivory of same quality. Switches by Leviton, Hubbell, Bryant shall be considered equal.
 - .5 Wherever construction permits, switches shall be located on the latch side of the door.
 - .6 Where two or more switches are shown adjacent, they shall be mounted with a common cover plate, except when serving two different source of supply and on 347 volt systems where dual phasing is used.
 - .7 All receptacles shall be flush mounted, except where otherwise shown. Where weatherproof receptacles are required, they shall be enclosed in boxes as specified. All receptacles shall be provided by this Division.
 - .8 Receptacles shall be located at a height as shown on the drawings. Where no heights are specified, consult the Engineer before installing any devices that may have to be relocated.
 - .9 All receptacles within a dwelling unit including those conforming to CSA 5-15R and 5-20R shall be tamper resistant type, excluding those for stationary appliances.
 - .10 Each branch circuit supplying 125V receptacles, rated 20A or less shall be protected by a combination type AFCI, exceptions as per OESC.

2.11 COVER PLATES

- .1 Each flush outlet shall be equipped with a stainless steel plate, satin finished, with screws, 0.040" thick or as directed by the interior designer. Plates shall have suitable openings to accommodate the mechanism they conceal. Plates shall be as manufactured by Leviton or other reputable supplier.
- .2 For exposed conduit work, plates shall be galvanized to match the fittings.
- .3 Where exposed to weather , weatherproof cover plates shall be provided for wet location regardless if a plug is inserted into the receptacle. Provide in-use cover plate. Conforming to Nema 3R.

3 EXECUTION

3.01 EQUIPMENT LOCATIONS

- .1 Approximate locations of electrical equipment, fixtures, switches, outlets, and the like, are given on the drawings. Refer to the Architectural Drawings and room elevations for application. In the absence of definite detail, exact location of outlets shall be determined on site as work progresses. Local switches for lighting shall generally be installed on the lock side of doors. Verify switch locations on the site.
- .2 Device plates shall cover opening left for outlet box, and plates shall be attached to boxes in an approved manner. Outlets and fixtures are to be located symmetrically (ie: centered in wall panels, ceiling panels or tiles, columns, between and above door, and the like).
- .3 The right is reserved to alter the location of equipment and outlets a distance of up to 3 meters without involving a change to the contract amount, providing notice is given prior to installation.

3.02 MOUNTING HEIGHTS

- .1 Mounting heights of outlets shall comply with OBC 3.8.1.5. Generally, the control shall be mounted from the finished floor to the operating point of the devices as:

-
- .1 Lighting Switches - 1100 mm;
 - .2 Receptacles - 304 mm A.F.F. or 150 mm above counter top splash backs;

In the barrier free units and common area-470mm A.F.F or 150 mm above counter top splash backs.

Kitchen island receptacle - directly under the counter top.
 - .3 Telephone Outlets - 304 mm;

In the barrier free units and common area-470mm A.F.F
 - .4 Manual Pull Stations – 1200 mm;
 - .5 Automatic Fire Alarm Detectors – highest point in ceilings.
 - .6 Fire Signals - 2440 mm AFF or 305 mm below ceiling.
 - .7 Panelboards - 1700 mm to top of the breaker.
 - .8 Thermostats - 1200 mm;
 - .9 Receptacles in Service Areas shall be 1220mm above the floor.
 - .10 Intercom – 1100 mm.
 - .11 Security Key pad - 1100 mm.
 - .12 Carder reader – 900mm.
 - .13 Carbon Monoxide detectors within garage space shall be 900-1800mm.
 - .14 Other controls-not lower than 900mm and not higher than 1100mm A.F.F.

3.03 HOLES AND DRILLING

- .1 Pneumatic hammers and percussion drills are prohibited.
- .2 Where not sleeved, make holes through concrete walls and floors by core-drill only.
- .3 Seal holes and sleeves through floors to serve as water dam.
- .4 Comply with requirements of C.S.A. Standard No. A23.3

Code for the Design of Concrete Structures for Buildings, paragraph 5-17.

3.04 WATERTIGHT SEAL AT FLOORS AND WALLS

- .1 Supply and set sleeves for all pipes, conduits through walls or floors, and pack openings after installation of conduits. Sleeves shall be sched. 40 steel pipe for passing through masonry walls and # 22 gauge galvanized iron for conduits passing through partitions, and shall be large enough for packing with fire rated material.
- .2 Packing and sealing of sleeves and openings shall be the responsibility of this Division. Pack with approved firestopping material and make waterproof.

3.05 HANGERS AND INSERTS

- .1 Provide necessary hangers and inserts for work of this division.
- .2 Fasten to cast-in-place concrete by suitable drilled or cast-in-inserts.
- .3 Fasten to structural steel using bolts or welded fasteners.
- .4 Do not use wood, chain, wire lashing, strap or grappler bar hangers except where noted or detailed.
- .5 Support fixtures to comply with Ontario Electric Code requirements. Provide additional supports as required, which shall be fastened to building structure steel members, joists, beams, etc., but not metal pan or roof decking. Material for additional supports and their installation shall comply with requirements of U.L.C.
- .6 Support outlet and junction boxes independently of the conduits running to them where required by Electrical Code, and where deemed necessary by the Engineer, using steel angle brackets or steel rods to support outlets or fixtures due to weight, to the building structure.
- .7 Drilled fastenings to concrete shall be self-drilling concrete anchors, Phillips "Red-Head" or approved equal. The maximum weight per fastening shall not exceed 24% of manufacturer's pull-out load data.
- .8 Chain, where permitted and specified for the installation of fluorescent lighting fixtures shall be No. 4 (2 mm) Tenso Pattern coil steel chain, plated with a strength of 82 Kg, as manufactured by Dominion Chain Co. Ltd., or approved equal. Where "S" hooks are used with chain, they shall be No. 6 type with open strength of 83 Kg minimum. Attachment of chain at both ends of support shall develop.

3.06 PAINTING

- .1 Hangers, support framing and all equipment fabricated from ferrous metals which are not protected with zinc or other suitable corrosion-resistant finish shall have at least one (1) coat of a corrosion-resistant paint applied before shipment or immediately on arrival at the site.
- .2 After installation, touch up all scratches, chips, other damage and defects in paint, using zinc chromate or primer or paint or special enamels as necessary to match the original.
- .3 Finish and colour of all equipment shall be coordinated to provide uniform appearance.
- .4 Painting of conduits and supports and other exposed surface work will be done under Painting Section, except as noted. Install materials in time to be painted together with mounting surfaces.
- .5 Do not paint over nameplates.

3.07 NAMEPLATES AND SCHEDULES

- .1 Identify electrical equipment supplied under this Division with 3 mm thick black laminated plastic nameplates to indicate equipment controlled to provide instruction or warning. Fasten each plate with two (2) chrome plated screws. Lettering shall be 6 mm high for small devices such as control stations, and at least 13 mm high for all other equipment. Submit a list of proposed nameplates for approval before manufacture.
- .2 Provide panelboards with typewritten schedules identifying outlets and equipment controlled by

each branch circuit. Protect schedules with non-flammable clear plastic.

- .3 Identify junction boxes, pull boxes, coverplates, conduits and the like, provided for future extension, indicating their function (ie: power, fire alarm, communication).
- .4 Verify room names and numbers prior to listing on nameplates and schedules.

3.08 EXCAVATION AND BACKFILL

- .1 Provide necessary excavating and backfilling inside and outside building, required for work of this Division in accordance with Division 1 Sections.

3.09 SUPPORT FOR UNDERGROUND SERVICES

- .1 Provide suitable solid support to comply with requirements of authorities having jurisdiction, where solid, undisturbed earth stratum is not available for support of underground services. Minimum requirements where services pass through backfill or exterior foundation walls shall be 20 MPa concrete fill, full depth to undisturbed earth.

3.10 CONCRETE WORK

- .1 Provide concrete work where required for work of this Division in accordance with applicable Division 1 Sections.

3.11 BRANCH CIRCUIT WIRING AND FEEDER CABLES

- .1 Provide branch circuit wiring, conduits and feeders as required for lighting, power and auxiliary systems.
- .2 Separate conduit systems shall be provided for feeder, lighting and power systems, for exit light system and auxiliary communication systems (ie: Fire Alarm/EVC System, Bell Telephone, Sound Systems and the like).
- .3 For the supply of exit signs in building, provide separate wiring and conduit to special circuits as designated. Separate wiring by panel.

3.12 CONDUIT, RACEWAYS AND WIREWAYS

- .1 Wire and cable shall be installed in conduit (or tubing) as follows:
 - .1 Rigid galvanized steel conduit with threaded IPS fittings to be used where required by regulations.
 - .2 Electrical metallic tubing (EMT) may be used concealed in place of rigid conduit in dry locations subject to governing regulations. Connectors shall be provided with factory installed insulated throats. Connectors and couplings to be concrete tight set screw.
 - .3 Use Bx for connections to chain suspended and recessed fixture drops, transformers, and similar equipment of prevent transmission of vibration. A code-gauge green grounding conductor shall be provided for all such connections. Use "Sealtite" conduit and Hubbell-Kellems Sealtite conduit strain relief grips (if required) for all such connections at motors.
 - .4 Conduit installed below grade and below concrete grade slabs shall be rigid PVC type, C.S.A. approved as Electrical Raceway.
 - .5 Conduit and cables for electrical work in demountable type and drywall type partitions shall enter from above, from a junction box concealed in the ceiling above, and shall comprise a flexible

BASIC ELECTRICAL MATERIAL AND METHODS

conduit connection.

- .6 Conceal conduits and wiring except where noted. Run exposed conduits parallel to building lines and to other conduits. Provide every empty conduit with a fish wire (3 mm polypropylene rope) and identify to designate its functions (ie: power, P.A., telephone, fire alarm and the like).
- .7 Fasten every conduit to structure by means of approved conduit clamps or clips. Wire lashing is not acceptable.
- .8 Where conduit is installed in concrete slabs, obtain general approval, prior to commencing the work, on both maximum dimension and cross-overs which may be used therein. Provide approved expansion couplings.
- .9 Install conduits in such a manner as to conserve head room and interfere as little as possible with free use of space through which they pass. Obtain approval for routing of same. Keep conduits at least 150 mm clear of heating pipes, flues and other high temperature work.
- .10 Run conduit exposed in mechanical equipment rooms, electrical rooms, fan rooms and the like, and in- stalled after mechanical and other equipment is completed. Install fixtures, outlets, starters, etc., to clear and to suit application.
- .11 Electrical non-metallic tubing (ENT) with kwikon fittings may be used where embedded in poured-in-place concrete provided proper grounding is maintained.

3.13 WIRE AND CABLE

- .1 Wire and cable shall not be installed at temperatures below -7 degrees C unless "minus 40" type is used. Wiring to heating and cooling equipment shall be rated 90 degrees C minimum, the ampacity of which shall be limited to 75 degrees C value.
- .2 Include supplementary ground conductor in each conduit, tubing or raceway.
- .3 Conductors used for all auxiliary systems (ie: fire alarm, EVC and the like) shall be tagged and/or colour coded, and where applicable shall agree with manufacturer's wiring diagrams. Conductors in underfloor raceways and cable duct systems shall be stranded type.
- .4 All wiring shall be copper unless otherwise noted. Minimum wire size shall be copper 14 AWG gauge unless specified otherwise. Control wiring shall be No. 18 AWG red insulation. Maximum voltage drop between furthest outlet of any circuit, when fully energized, and the panel to which it is connected, shall not exceed three percent (3%) except for electric heating circuits which shall not exceed one percent (1%).
- .5 Number of wires indicated for lighting and power, motor and motor control, alarm, signal, communication and auxiliary systems is intended to show general scheme only. The required number and types of wires shall be installed in accordance with equipment manufacturer's diagrams and requirements, and with requirements of the installation, except that specification standards shall not be reduced.
- .6 Solderless connectors with screw-on wire connectors rated 600 Volts shall be used for joints in branch wiring.
- .7 Use compression joints and terminals for all conductors No. 4 AWG and larger. Mechanical connections are acceptable at panelboards and circuit breakers where these are part of factory assembly.
- .8 Wire or cables in feeders, sub-feeders and branch circuits shall be colour coded in accordance

BASIC ELECTRICAL MATERIAL AND METHODS

with Ontario Safety Code. Each end of feeder terminations (ie: in switchboard, panelboards, switches, splitters and the like),

- .9 Armoured or sheathed cables may be used only for wiring within demountable and drywall type partitions and if additionally specified or detailed. However, it shall not be directly buried in or below concrete slabs.
- .10 Cables with PVC jackets shall be FT4 fire rated PVC jackets.
- .11 Where single conductor aluminum corflex sheathed or interlocked armour cables are specified for feeders, they must be installed in strict accordance with the manufacturer's recommendations and instructions, the Hydro Electric Power Commission's requirements and as follows:
 - No sheath currents shall be allowed to flow where cables exceed 250 M.C.M., in a three phase, four wire system. 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.
 - Cables shall not be allowed to come into contact with each other or ground and must be spaced a minimum of one(1) cable diameter from each other throughout the entire run.
 - All aluminum sheathed or interlocked armour cables must be neatly and securely fastened by means of approved aluminum cable clips, spaced at intervals of NOT MORE THAN 1.2m. Use cable clips approved for the type of cable. Install cables on Unistruts.
 - The sheath of aluminum sheathed cables shall not be used for bonding or a wiring system, separate ground conductors shall be installed in accordance with Table 16 of the current edition of the Ontario Electrical Code.
 - Corflex cables, exposed in parking garage shall be PVC jacketed.

3.14 OUTLET, JUNCTION AND PULL BOXES

- .1 Use suitable electrical boxes for terminations and junctions on conduit work. Install pull boxes where necessary to permit installation of conductors. Support pull boxes, outlet boxes, panels and other cabinets independently of conduit.
- .2 Provide each light switch, wall receptacle and other device with an outlet box of suitable dimensions and a faceplate. Outlet boxes shall be adapted to their respective locations. Use "Masonry Type" outlet boxes for flush installation in masonry walls. (Standard sectional boxes #1004, #1104 and the like, shall not be used).

Outlet boxes provided to carry a lighting fixture shall be of a design capable of supporting the fixture, and shall be equipped with suitable fixture studs.

- .3 "Thruwall" and "Utility" type boxes shall not be used.
- .4 Electrical boxes and panels shall be C.S.A. approved, code gauge sheet metal, galvanized or with suitable protective treatment. Secure covers with screws or bolts.
- .5 No outlet boxes shall be installed back to back in fire rated walls - always stagger. Through wall boxes may be used within apartment interval walks.
- .6 Outlet boxes in boiler, mechanical rooms etc., where used with exposed conduit, shall be cast type.
- .7 The exact height and position of all outlets must conform with other work in the area and it is this

BASIC ELECTRICAL MATERIAL AND METHODS

Division's responsibility to mount outlets in such a manner to avoid interference with all piping, ducts, conduits, etc. Outlets for local switches near single doors shall be on the strike side of the door, as finally hung.

- .8 Lighting outlet boxes shall be standard 100mm octagonal or square boxes as required.
- .9 Outlets for plug shall be standard switch boxes, single or ganged, as required.
- .10 Outlets for plug receptacles shall be standard switch boxes.
- .11 Where standard make boxes are not suitable for a particular device, conduit or junction, provide boxes of special design to fit space and other requirements.
- .12 Ceiling outlet boxes in concrete slabs shall be 75mm deep to avoid bends in conduit connection to outlets.
- .13 Outlets mounted in garage slabs shall be PVC or galvanized metal outlets epoxy or bituminous base painted.
- .14 Outlet boxes shall be accessible at all times. They shall not be buried or enclosed.

3.15 SWITCHES

- .1 Provide circuit breaker and non-fusible switches of one (1) manufacturer, NEMA Type "HD", with quick-make, quick-break contacts, horsepower rated where required, to match the motor protection. Switches to include mechanical cover interlocks and line side barriers.
- .2 Provide safety disconnect switches adjacent to motors and other equipment when required by regulations. Use switches of one (1) manufacturer throughout.

3.16 FUSES

- .1 Provide fuse holders in fusible equipment with a complete set of proper size Form 1. HRC NEMA "J" or "L" current limiting fuses, except as noted. Fuses shall be of one (1) manufacturer throughout.
- .2 Apply Thomas & Betts "Koper/Shield" conductive anti-seize compound to all fuse ferrules and holders.

3.17 DEVICE IDENTIFICATION

- .1 Nameplate for special service receptacles shall be black "Dymo" tape with 3 mm white embossed letters.

3.18 PANELBOARDS

- .1 Provide handle locking devices on circuit breakers feeding plumbing, heating, ventilating equipment and controls, and all auxiliary systems, time switches, and others as noted. Paint handles white to permanently identify location and function. Provide thirty (30) spare handle locking devices for future use.
- .2 Provide empty conduits from flush panel-boards and others as noted, terminating accessible ceiling spaces, sized to accommodate spare and space breaker provisions. One (1) 25mm conduit for each three (3) spare breakers or spaces.

BASIC ELECTRICAL MATERIAL AND METHODS

- .3 Circuit numbers on drawings do not necessarily correspond to the numbers on the lighting panels. Circuits sharing a common neutral shall not be connected to the same main. Panel circuit breakers, which are used directly for the switching of lighting fixtures, shall be grouped in consecutive numbers commencing at breaker number one.

3.19 ELECTRICAL SERVICE

- .1 Provide complete new electrical service as shown on the drawings and as described herein.
- .2 The Supply Authority will supply and install primary cables, pad mounted transformers and terminations. This contractor is to supply and install grounding, secondary cables, primary and secondary concrete encased ducts and transformer pad to suit Hydro requirements.

When an Owner Substation is specified the Supply Authority will supply and install the primary cables and terminations.

Slope ducts away from the building. Where this is not possible, provide a low point outside the building and connect to a mechanical drain or approved gravel pit.

Carry cash allowance or as specified for Hydro services.

- .3 Grounding service, equipment, feeders, and the like shall be performed in accordance with O.H.E.P.C. regulations and the Supply Authority's requirements.
- .4 The neutral conductor of the wiring system together with the conduit system and service equipment shall be bonded to the water service as near as practical to the service entrance.
- .5 Provide compression lug connections suitable for connection to transformer secondary.
- .6 Provide a metering cabinet where noted with dimensions of 1200 mm square x 300 mm deep, and provide with removable sub-base and locking provisions, all to approval of Supply Authority, connected to switchboard with an empty 38 mm rigid conduit.

3.20 GROUNDING

- .1 Ground all electrical systems in accordance with provisions of the Ontario Electrical Code. The ground installation should follow the local utility standard. When the installation doesn't fall into the utility standard, the required calculation has to submit to the Utility for approval prior to the installation.
- .2 Install ground conductors to permit the direct path from equipment to ground. Install concealed or embedded grounding conductors within the building in rigid galvanized conduit with both conductor and conduit bonded at both ends. Provide bonding numbers with approved clamps to maintain ground continuity of metallic raceway systems and at all expansion joints.
- .3 Ground connections to grounding conductors shall be accessible for inspection and made with approved solderless connectors bolted to the equipment of structure to be grounded. Clean contact surfaces prior to making connections to ensure proper metal to metal contact. Connections shall be of the type that grounds both conduit and conductor; and cap screws, bolts, nuts and washers shall be silicon bronze.
- .4 If incoming water main is PVC plastic, provide system of grounding rods as specified by O.E.C. Service grounding resistance to meet approval of Ontario Hydro Inspection Department.
- .5 The swimming pool, hot tub and spa should be properly grounded. The grounding and bonding shall be installed as per OESC-Bulletin 68-7-9.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide fire stopping in accordance with front end documents and as describe herein. This Contractor coordinates fire stopping with General Contractor.

2 PRODUCTS

2.01 MATERIALS

- .1 Fire stopping and smoke seal systems: In accordance with CAN4 S115 latest edition:
 - .1 Asbestos free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CANS4 S115 and not to exceed opening sizes for which they are intended.
 - .2 Fire stop system rating for service penetrations: to suit Ontario Building Code 2012, 3.1.9.1 latest edition Fire Stopping of Service Penetrations.
 - .3 Fire stop system rating for sealing junction of rated walls to rated floors and ceilings: to suit Ontario Building Code.
- .2 Service penetration assemblies: certified by ULC in accordance with CAN4 S115 latest edition and listed in ULC Guide No. 40 U19 latest editions.
- .3 Service penetration fire stop components: certified by ULC in accordance with CAN4 S115 latest edition and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.
- .4 Fire resistance rating of installed fire stopping assembly not less than the fire resistance rating of surrounding floor and wall assembly, and in accordance with Ontario Building Code.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non sagging.
- .11 Colour: if range available to Consultant's choice of standard colours, generally to match background colour where visible in finished spaces.
- .12 Through non-fire or non-smoke separations or where waterproof membrane is field applied, where pipes are insulated, sleeves shall be sized to accommodate the insulation and vapor barrier.

-
- .13 Where holes are core drilled in existing structures, sleeves shall be provided as specified complete with fire stopping as noted above.
 - .14 Submit a complete fire stopping system shop drawing package, identifying the products that may be used on the project. Prior to submitting data, review with Authority having Jurisdiction to confirm acceptability of proposed materials and assemblies.

3 EXECUTION

3.01 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.
- .2 Seal holes or voids made by through penetrations, poke through termination devices, and up-penetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to a neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

1 GENERAL

1.01 GENERAL

- .1 Electrical work general requirements 26 00 10, Basic electrical materials and Methods 256 05 00, Division 00 and Division 01 apply to and are a part of this Section.

2 PRODUCTS

2.01 MAIN SWITCHBOARD

- .1 The main switchboard shall be of the free standing totally enclosed design and shall consist of individual dead front type cells bolted together to form a complete switchgear assembly as shown on the drawings. Construction shall be of sprinkler proof type, where in sprinklered area.
- .2 The main switches shall be manually operated, fixed mounted, system service circuit breaker. Provide when shown on the drawings, within the main switch enclosure a zero sequence digital ground fault protection relay, adjustable from 20% to 100% of pick-up of the main switch rating adjustable from .1 to .5 seconds, factory set at maximum.
- .3 Bussing shall be aluminium alloy of the current rating shown on the drawings and shall be braced to withstand 100,000 Amp. RMS symmetrical short circuit stresses unless otherwise shown.
- .4 Provisions shall be made metering CT's and PT's to suit the local P.U.C.
- .5 The distribution switches shall be manually operated fixed mounted, system service switches with fuses or circuit breakers as shown.
- .6 Provision shall be made for the incoming feeders as shown.
- .7 Bussing in switchboard shall be extended for the full length of the board with provision for future extension.
- .8 The switchgear shall be shipped, if necessary, in sections for re assembly on site.
- .9 Each switch instrument, meter, etc., shall be identified on the cover with an engraved lamaroid nameplate.
- .10 For all feeders the associated switch shall have compression lugs.
- .11 The switchboard finish shall be two coats of primer and two finish coats of ASA 61 light grey paint except for the emergency power switch which shall be painted red.
- .12 The switchboard shall be as manufactured by Federal Pioneer Limited, Square 'D', Siemens, Westinghouse, Commander or approved equal.
- .13 The equipment layouts shown on the drawings are based on equipment of Federal Pioneer manufacture. Should other manufacturers be submitted, their equipment must fit the allocated space and equipment dimensions.
- .14 All joints for buses and interconnections shall be silver-to-silver, high pressure contacts. Insulated bus supports shall be of the flame retardant type.
- .15 Clamp type terminals shall be provided for all incoming and outgoing cables unless bus duct connections are indicated.

-
- .16 A 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.
 - .17 Compartments for future fused switch assemblies shall be completely equipped for the addition of assemblies.
 - .18 Where indicating instruments are required, in general, they shall be of the long scale type with convex glass to limit reflection.
 - .19 Switches and instruments and control shall be of the rotary operating type with positive means of maintaining contact positions. Provisions shall be made in the bus duct for mounting all Hydro metering current transformers.
 - .20 Small wiring, nameplates and terminal blocks with numbering strips shall be provided as required.
 - .21 Switchboards utilizing circuit breakers are an acceptable equivalent provided the short circuit ratings and co-ordination are maintained throughout.

2.02 DISTRIBUTION AND POWER PANELS

- .1 Distribution and power panels shall be factory assembled, sprinkler-proof, free standing, dead front type, suitable for use on the system as specified on the drawings. Sprinkler-proof or drip proof, if required.
- .2 Fusible panels shall be of the "QMQB" type consisting of a fully convertible chassis to permit assembly of units in any desired arrangement. The fusible units shall have visible blades, integral handle mechanism, cover interlock, quick make, quick break mechanism, front operation, high pressure fuse holders and recessed live parts. The units shall be floor mounted and shall, unless otherwise noted, be not more than 2350mm in height.
- .3 Breaker panels shall be of the "CDP" type with the sizes and type of breakers as shown on the drawings. The panels shall be wall mounted, surface or flush as specified on the drawings.
- .4 Splitter troughs shall be complete with copper bus bars the length of the trough. The covers shall be bottom hinged with retainer securing screws at the top.
- .5 Distribution metering panels shall be fusible panels with meter socket suitable for Hydro meters.
- .6 Bussing in each panel shall be aluminium alloy and shall extend the full length of the panel.
- .7 Panels shall be provided with the non-ferrous plates for aluminium sheathed cables.
- .8 Panels, including tubs, connected to the normal power supply shall have two coats of primer and two finish coats of ASA 61 grey paint.
- .9 Distribution and power panels shall be of the same manufacturer as the main switchboard.

2.03 LIGHTING AND RECEPTACLE PANELS

- .1 Lighting panels shall be of the size, capacity and type as shown on the drawings.
- .2 Lighting panels shall be of dead front type enclosed in code gauge steel for surface or flush mounting and be equipped with door, lock and directory.
- .3 Bussing in each panel shall be standard aluminium alloy and shall extend the full length of the panel.

-
- .4 Breakers shall be ambient compensated type, calibrated at 40 degrees C, and be of the bolt on type. Multiple breakers shall have common trip.
 - .5 Lighting panels for use on 208 volt system shall, unless otherwise noted, be of the "NBLP" type with NB breakers.
 - .6 Lighting panels for use on 600 volt system shall, unless otherwise noted, be of the "NHDP" type with NEG breakers.
 - .7 Panels, including tubs, connected to the normal and emergency power supply shall have two coats of primer and two finish coats of ASA 61 grey paint and those connected to the emergency power supply shall have two coats of red paint.
 - .8 Lighting panels shall be of the same manufacturer as the switchboard.
 - .9 Suite load centres shall be flush mounted, plug-in breaker type as indicated on the drawings, rated at 240 volts, single phase, and three wire system and shall contain the number of circuits as shown on the drawings. Panels shall be complete with hinged doors and vandal resistant cover screws. Branch circuits that supply receptacles in sleeping facilities of a dwelling unit shall be protected by an arc-fault circuit interrupter.

2.04 DRY TYPE TRANSFORMERS

- .1 Dry type transformers shall, unless otherwise noted, be of the indoor air cooled dry type of the size, rating and capacities as shown on the drawings. Transformers shall conform to CSA-C9-M, NEMA TR-1 and ANSI C57.12.51 current standards and shall be approved to CSA C22.2 No. 47 where applicable. Scott T winding configuration shall not be accepted.
- .2 Transformers shall be of the 1.2 KV Class aluminium windings with 200°C insulation system and 130°C rise for 15kVA and 30kVA transformers or with 220°C insulation system and 150°C temperature rise for transformers 45kVA and larger with a maximum ambient temperature of 40°C. Transformers shall conform to **CSA C802.2 (Energy Efficient transformer)**.
- .3 Transformers shall have 4 taps at 2 1/2% full capacities, 2 above and 2 below nominal voltage.
- .4 Enclosures shall be sprinkler proof and constructed in accordance with NEMA 250, CSA-C9 and C22.2 No.47.
- .5 Transformers 15kVA to 75kVA shall be equipped as required with eye bolts, braces, etc., to enable them to be wall mounted, floor mounted or suspended.
- .6 Sound levels shall be in accordance with NEMA ST-20.
- .7 Floor mounted transformers shall have Vibro-Acoustic vibration isolators installed between case and floor. Wall mounted transformers shall have wall mounting angle iron platforms with appropriate vibration isolating hangers and/or brackets.
- .8 All transformers shall be identified with lamicoid plastic nameplates, black background with white etched letters 6mm high, (red nameplates on emergency power equipment).
- .9 All transformers shall be supplied with the manufacture's Installation, Operation and Maintenance Guide.
- .10 Transformers shall be CSA type ANN as manufactured by Federal Pioneer Limited, Westinghouse, Bemag, REX Ltd., Hammond Power Solutions Inc. or approved equal.

-
- .11 Transformers shall be wired with 1 metre flexible conduit on primary and secondary side for sound isolation.

2.05 SPRINKLER PROOF EQUIPMENT

- .1 The equipment shall be sprinkler proof. Drip proof is not acceptable.

3 EXECUTION

3.01 GENERAL REQUIREMENT

- .1 The equipment is to be installed strictly in accordance with the manufacturer's requirements and recommendations and the requirements of the authorities having jurisdiction.
- .2 Inspect and test the electrical installation to ensure safety to building occupants, operating personnel, conformity to Authorities having jurisdiction and Contract documents.
- .3 Supply all testing equipment, instruments, materials and labour for all intermediate and final testing and commissioning described hereinafter or necessary to provide compliance with the Specification.
- .4 Tests shall be performed using all recognized safety procedures and techniques during energizing and de energizing of all equipment to ensure employee safety and protect all work.
- .5 After the systems have been fully inspected and tested they shall be thoroughly cleaned prior to energizing and commissioning.

3.02 MAIN SWITCHBOARD

- .1 Install the main switchboard in accordance with the manufacturer's requirements and recommendations and the requirements of the Authorities having jurisdiction.
- .2 Prior to energizing or commissioning the switchboard it shall be fully inspected, tested, checked and adjusted to include, but not limited to the following:
 - .1 Grounding.
 - .2 Bus torque, supports, clearance, general mechanical conditions and insulation resistance.
 - .3 Breaker and switches operation.
 - .4 Trip units tested and calibrated to the settings provided by the Co-ordination Study.
 - .5 Breaker settings and fuses.
 - .6 Ground fault system operation.
 - .7 Continuity of feeder cables.
 - .8 Phase resistance of feeder cables.
 - .9 Insulation resistance of feeder cables.
 - .10 Proper phasing of incoming service and feeder cables.
 - .11 Equal division of load between parallel conductors.

.12 Balanced load on system.

.13 Where switches have been shipped in sections of re-assembly in the field, they shall be re-assembled with the utmost care. All bus connections shall be tightened with a torque wrench to the manufacturer's recommendations. Finally, the whole assembly shall be tested for its insulation resistance (values as set out in the Electrical Code), using a reliable and accurate megger. Voltohm meter tests are not acceptable.

3.03 DISTRIBUTION AND POWER PANELS

- .1 Locate distribution and power panels where indicated and mount securely and plumb true and square to adjoining surfaces.
- .2 All panels less than 1530mm are to be wall mounted so that the top of the panel is 1980mm above finished floor.
- .3 Connect loads to the circuits as shown on the drawings.
- .4 Openings in panels shall be cut or punched. Burning of holes shall not be permitted.
- .5 Each panel and switches or breakers mounted in them, shall be identified.
- .6 Test and inspect the panels in accordance with the requirements of the switchboard.

3.04 DISTRIBUTION AND POWER PANELS

- .1 Locate lighting panels where indicated and mount securely and plum true and square to adjoining surfaces.
- .2 Panels are to be mounted so that the top of the panels are 1980mm above finished door.
- .3 Provide 2 32mm empty conduits from each flush mounted panel to the ceiling spaces above and below for future installation (except for suite panels).
- .4 Provide wireways above multi section panels to avoid cross wiring.
- .5 Numbering of breakers in multi panel assemblies shall be consecutive. If necessary provide narrow Dymomite strips with the required numbering.
- .6 Test and inspect the panels in accordance with the requirements of the switchboard.
- .7 Note that this Division will be fully responsible for ensuring that all connected loads are accurately balanced across the phases of each panel.
- .8 All circuit wiring in panelboards shall be laced in a neat and workmanlike manner.
- .9 One identified, grounded, neutral conductor shall be provided for each three branch circuits, connected to different phases of a three phase main at the panels. Circuit numbers on the drawings do not necessarily correspond to the numbers on the panels.

3.05 DRY TYPE TRANSFORMERS

- .1 Locate the dry type transformers where shown on the drawings and ensure that there is adequate ventilation so that they operate as specified and that there is no transfer to adjacent surfaces or equipment of heat.

-
- .2 Prior to energizing or commissioning any transformer it shall be fully inspected, tested, checked and adjusted to include, but not limited to the following:
 - .1 Grounding.
 - .2 Ratio.
 - .3 Polarity.
 - .4 Insulation resistance.
 - .5 Taps adjusted to give rated voltage specified at 50% of rated capacity during normal working hours.
 - .3 Terminal contacts shall be rated for a min of 90° C temperature.

3.06 FEEDER AND BUSDUCTS

- .1 Prior to energizing or commissioning any feeder it shall be fully inspected, tested, checked and adjusted to include, but not limited to the following:
 - .1 Grounding.
 - .2 Continuity.
 - .3 Phase resistance.
 - .4 Insulation resistance.
 - .5 Proper phasing.
 - .6 Equal division of load between parallel conductors.

1 GENERAL

1.01 RELATED WORK

- .1 Installation of anchor devices, setting templates: specified in other Sections of Specification.
- .2 Concrete pad: specified in other Sections of Specification. Floating slab c/w isolation, plywood forming.
- .3 Seal concrete pad with concrete sealer. Add oil resistive paint.

1.02 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 set and installation must conform to all applicable OBC, OESC, CSA and TSSA requirements, including CSA C282, CSA B149.1 latest editions at time of tender.
- .3 The generator set must be available with the Underwriters Laboratories listing (UL2200) for a stationary engine generator assembly.
- .4 The generator set must be pre-certified to meet U.S. EPA federal emission requirements for stationary standby. On-site emission testing & certification will not be acceptable for standby applications.

1.03 DESCRIPTION OF SYSTEM GENERAL

- .1 Generator set consists of:
 - .1 Natural gas engine.
 - .2 Alternator.
 - .3 Generator 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 Structural steel mounting base.
 - .10 Automatic transfer and manual by pass switch.
- .2 Set designed to operate as emergency standby, unattended in remote location compliance with CSA standard number C282: current edition

1.04 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 00, 01.

Include:

- .1 Engine: make and model, with HP and air requirements.
- .2 Alternator: make and model, ratings including temp rise and kW output.
- .3 Voltage regulator: make, model and type, performance.
- .4 Automatic transfer and bypass switch: make, model, dimensions, features.
- .5 Engine silencer: make, model, orientation, dimensions, insertion loss.
- .6 Battery: make, type and capacity.
- .7 Battery charger: make, type and model, output performance.
- .8 Alternator control panel: make and type of meters and controls
- .9 Governor: type and model, performance.
- .10 Automatic engine room ventilation system.
- .11 Cooling air requirements in cubic meters per minute.
- .12 British standard or DIN rating of drawing.
- .13 Flow diagram for:
 - .1 gas fuel
 - .2 Lubricating oil
 - .3 Cooling air
- .14 Dimensions drawing showing complete generating set, mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
- .15 Dimensions and structural specifications of engine generator foundation.
- .16 Continuous full load output of set at 0.8 of lagging.
- .17 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/manual by pass.
 - .3 Automatic shut down on:
 - .1 Over cranking
 - .2 Over speed
 - .3 High engine temp
 - .4 Low lube oil pressure.

-
- .5 Short circuit
 - .6 Alternator overvoltage
 - .7 Lube oil high temperature
 - .8 Low coolant level
 - .4 Manual remote emergency stop
 - .18 Manufacturer's standard two year warranty statement

1.05 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into maintenance manual specified in Section 16010.
- .2 Operation and Maintenance Manual to include 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 switches, 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 Systems
 - .2 Lubricating Oil
 - .3 Cooling System
 - .4 Certified copy of factory test results.

1.06 DESCRIPTION OF SYSTEM

- .1 Emergency Power System, to provide illumination and power supply.
- .2 Engine Driven Emergency Standby Generator Set:

These specifications cover the supply and installation of a complete standby generator set rated for continuous standby service at 0.8 PF, connected for 3 phase, 4 wire. The system shall be of a package of new and current equipment consisting of:

 - .1 A natural gas engine driven electric generating set to provide emergency standby power. The fuel system is to be supplied independently of building supply, and in accordance with latest applicable CAN/CSA-C282 edition
 - .2 An engine start-stop control system mounted on the generating set.
 - .3 Mounted accessories as specified.

- .3 The performance of this specific generating set shall be certified by the manufacturer as to the set's full power rating, stability, and voltage and frequency regulation.
- .4 For purposes of this specification, standby duty means the load which may be carried for 24 hours continuously without exceeding 130oC temperature rise on generator windings (ambient 40oC) and without overloading the engine at rated generator RPM, when equipped with all necessary operating accessories including AC generator and all engine-driven components.

2 PRODUCTS

2.01 ENGINE:

- .1 The engine shall be natural gas fueled, or as shown, four cycle, water cooled with mounted radiator, fan and water pump. Intake and exhaust valves shall be heat resisting alloy steel, stellite faced. Stellite exhaust valve seat inserts shall be provided. Full pressure lubrication shall be supplied by a gear oil pump. Engine speed shall be governed to alternator frequency within 0.5% from no-load to full-load alternator output. The engine shall have a DC battery charging alternator with transistorized voltage regulator. Starting shall be by a 12/24 volt, solenoid shift starter. The engine shall include a thermostatically controlled water jacket heater.
- .2 The system shall be sized and sequenced to allow emergency system loads as defined by CSA C282 latest edition to be transferred onto the generator(s) within 15 seconds. Non-emergency system loads will be sequenced onto the generator(s) as generator capacity comes on-line.
- .3 The minimum HP of the engine shall be as determined by the following:
- .4 $1.34 \times \text{kW}$ plus HP required for engine driven gen. efficiency and accessories.

2.02 ENGINE INSTRUMENTS:

- .1 The engine instrument panel shall contain an oil pressure gauge, water temperature gauge and battery charge rate ammeter, in scrolling digital or analog format and to suit authorities having jurisdiction.

2.03 ENGINE CONTROLS:

- .1 The generating set shall contain a complete engine start-stop control which starts engine on closing contact and stops engine on opening contact. A cranking limiter shall be provided to open the starting circuit in approximately 45 to 90 seconds (crank time), if the engine is not started within that time. The engine controls shall also include a 3 position selector switch with the following positions: RUN-OFF-AUTO.
- .2 High engine temperature, low oil pressure, low coolant level, and over speed shutdown with individual annunciation and common alarm terminals shall also be provided. The control panel shall display all of the alarms and shutdowns visually, either by individual lights or by scrolling digital display. Comply with latest edition of CAN/CSA-C282.

2.04 BRUSHLESS ALTERNATOR:

- .1 The alternator shall be a 4 pole, revolving field design with temperature compensated solid state voltage regulator and brushless rotating rectifier exciter system. Units over 100kW shall also have a permanent magnet exciter. No brushes shall be allowed. The stator shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semi-flexible driving flange to insure permanent alignment. The insulation system shall be Class H as defined by NEMA MG1-1.65. Temperature rise shall not exceed 130oC at the full load rating specified.

2.05 AC INSTRUMENT PANEL:

- .1 The generator set instrument panel shall be wired, tested and shock mounted on the electric plant by the manufacturer of the alternator. It shall contain running meter, frequency meter, AC voltmeter, voltage adjusting rheostat, AC ammeter with phase selector switch and panel lights. It may be of analog or digital type with scrolling display.
- .2 Provide a unit-mounted main line circuit breaker, rating as shown on the drawings. The main line circuit breaker shall have auxiliary contacts, wired to the generator set controller, to provide an alarm when the breaker is not closed. The circuit breaker shall be mounted in a sprinkler proof enclosure on the generator set.
- .3 The circuit breaker panels, Automatic Transfer Switch, and control panels should be sprinkler proof equipment.

2.06 UNIT PERFORMANCE:

- .1 Frequency regulation shall not exceed 3 hertz from no load to rated load. Voltage regulation shall be within plus or minus 1 percent of rated voltage, from no load to full rated load. The instantaneous voltage dip shall be less than 25 percent of rated voltage when full, 3 phase load and rated power factor is applied to the alternator. Provide manufacturer's data to support this in the shop drawings. Recovery to stable operation shall occur within 3 seconds. Stable or steady state operating is defined as operation with terminal voltage remaining constant within plus or minus one percent of rated voltage. A rheostat shall provide a minimum of plus or minus 5 percent voltage adjustment from rated value. Temperature rise shall be within NEMA MG1-22.40 definition. The sequencing of the building loads shall be such that any overloads which occur during motor starting, even though they may exceed the steady-state capability of the prime mover, shall not cause stalling.

2.07 STARTING BATTERIES:

- .1 Supply 12/24 volts lead acid heavy duty starting batteries complete with metal rack and all necessary cables and jumpers.

2.08 BATTERY CHARGER

- .1 Provide a battery charger to maintain starting batteries in peak condition. The charger shall be mounted on the generator set. There shall be meters to show charging current and voltage, and it shall be capable of recharging the batteries to full charge within the time limits specified in CSA C282. Provide alarms to the generator control panel for low and high battery voltage, if not inherent in the control panel.

2.09 AUTOMATIC TRANSFER SWITCH / MANUAL BY-PASS - CSA STANDARD C22.2 NO. 178 (LATEST EDITION)

- .1 The complete automatic load transfer control with manual emergency by-pass switch shall be supplied by the generator set supplier. This switch must be the product of one manufacturer. The load transfer control shall be rated for continuous duty and for all classes of load. The ampere rating of the transfer switch shall be sufficient to handle the capacity of the loads being transferred. The control components shall be compatible with the electrical requirements of the standby set and provide the following functions.
- .2 Upon power line outage, automatically start the generating set and when the set comes up to rated speed and voltage, disconnect the load circuits from the power line and transfer them to the standby set's output.

Additional Items:

- .1 Voltage sensitive relays to initiate transfer to standby power at 70% of normal line voltage

and back to line at 90%.

- .2 Time delay on plant starting 3 - 5 seconds.
- .3 Adjustable time delay on retransfer to normal 0 - 10 minutes.
- .4 Time delay on plant shutdown (cooldown) after retransfer - 5 minutes.
- .5 Simulated power failure test switch (plant assumes load) to comply with CSA C282-09, Clause 11.4, for monthly exercising of the emergency power system.
- .6 Advanced warning signal from the transfer switch to the elevator controller on transfer from emergency back to normal power (pre-transfer contacts).
- .7 In-phase monitor or time delay in neutral (adjustable), to prevent a transfer of heavy motor loads in an out-of-phase condition in either direction, before the voltage in the motor(s) can decay to a safe level.
- .8 Indicator light for "ATS in bypass mode" position, and contacts for remote indication wired to the generator controller, as per C282-09, Table 1 item #22.
- .9 Approved products: Asco 3AABA series, Cutler-Hammer 4BIH series, Thomson Technology TSBG series, Cummins BTPC series

2.10 BID REQUIREMENTS:

- .1 The generator set shall be as distributed by Total Power Limited, Cummins/Onan, Caterpillar, GAL Power, or approved equal.

2.11 STRUCTURAL STEEL MOUNTING BASE

- .1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators and control console resiliently mounted.
- .3 Spring type isolators with adjustable side snubbers.

2.12 EXHAUST SYSTEM

- .1 Heavy-duty, hospital plus grade type, horizontally mounted exhaust silencer, with condensate drain, plug and flanged couplings, as indicated. Pipe muffler drains to nearest floor drain. Approved manufacturers: Stealth-Malvern, Silex Innovations.
- .2 Submit detailed specifications showing insertion loss and dimensions. Provide adequate support when mounting silencer to reduce issues of deformation caused by high temperatures associated with gas engines, usually in excess of 1200 °F.
- .3 Suitable length of heavy duty flexible stainless steel exhaust hose with flanged couplings as required, to connect to silencer and engine manifold flange.
- .4 Fittings and accessories as required. Allow for extra size of exhaust pipe to accommodate run to grade c/w rain cap. Insulate to CSA Standards, in accordance with exhaust temperatures mentioned above in 2.12.1.
- .5 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal

expansion.

Note: Electrical Divisions to provide basic equipment. Installation by Mechanical Divisions.

2.13 FUEL SYSTEM

- .1 Fuel system will be done by Division 15.
- .2 Division 16 to provide:
 - .1 Suitable gas pressure switch mounted inline with incoming gas supply to generator set, wired for alarm on "Low gas pressure" to the generator controller.
 - .2 Remote indication of "Low gas pressure" level at fire alarm annunciator.
 - .3 Solenoid valve(s), fuel line filters, and other items normally mounted on the engine, in accordance with CSA B149-10 Section 7.2.
 - .4 Alarm from position-indicating ball valve at incoming gas station utility supply, wired to generator control panel for "valve closed" as per C282-09, Clause 7.3.6 (a) (iii).
- .3 Provide suitable gas pressure at generator set in accordance with manufacturer's requirements.

2.14 COOLING AIR SYSTEM

- .1 Cooling air system will be done by Div. 15.
- .2 Engine ventilating system:
 - .1 Cold air inlet damper assembly, with motorized damper as indicated.
 - .2 Air discharge and intake grilles as indicated.
 - .3 Max. 0.5" W.C. external static pressure on radiator fan

2.15 FINISHES

- .1 Apply finishes in accordance with Section 16010.
- .2 Generator set control cubicle: exterior to match engine and alternator.
- .3 Other ducts and racks, grey.
- .4 Supply 0.25 L of appropriate colour touch-up enamel (or as approved).

2.16 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 16100.

2.17 EQUIPMENT

- .1 Shop assemble generating unit including:
 - .1 Base
 - .2 Engine and radiator
 - .3 Alternator

.4 Control panel

.5 Battery and charger

- .2 To be classified as a manufacturer, the builder of the generator set must manufacture, at minimum, engines or alternators. On request, provide a copy of prototype test certificate from generator set manufacturer, including torsional analysis.

3 EXECUTION

3.01 INSTALLATION

- .1 Locate generating unit and install as indicated.
- .2 Install fuel supply system as indicated.
- .3 Install ventilating air duct system as indicated. (Part of work under Div. 15).
- .4 Complete wiring and interconnections as indicated.
- .5 Start generating set and test to ensure correct performance of components.
- .6 Installations to be in compliance with CSA C282 latest edition.

3.02 SITE TESTING

- .1 Perform tests in accordance with Section 16100.
- .2 Notify Engineer 10 working days in advance of test date.
- .3 Demonstrate:
 - .1 Unit start, transfer to load, re-transfer to normal power, unit shut down, on "Automatic" control.
 - .2 Unit start and shut down on "Manual" control.
 - .3 Unit start and transfer on "Test" control from transfer switch(es).
 - .4 Unit start on "Engine start" control.
 - .5 Operation of manual bypass switch.
 - .6 Operation of automatic alarms and shut down devices.
 - .7 Alternator winding temperature rise during test period.
- .4 Run unit on load for minimum period of 4 h at 100% full load (As per C282-09, Clause 10.3) to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling. Use artificial load banks as required to provide full rated load.
- .5 At end of test run check battery voltage to demonstrate battery charger has returned battery to fully charged state.
- .6 Provide a copy of all site testing for the engineer's approval, at completion of commissioning services. Replace any components of system which do not comply with this specification.

-
- .7 Coordinate with noise and emissions Consultant and provide necessary technical data and assistance for application of Ministry of Environment (MOE) Certificate of Air and Noise Approval for this project.

3.03 SERVICE AND WARRANTY

- .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. Service contracts shall also be available.
- .2 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. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge. Travel and labor shall be included for the first 12 months. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. 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 GENERAL

1.01 GENERAL REQUIREMENT

- .1 Electric Vehicle Supply Equipment (EVSE).
- .2 Electrical Contractor to provide CSA approved and UL tested products.
- .3 Electrical Contractor to supply and install a fully operational EV Charging Station in accordance with ESA, OBC, TGS requirements and as per the latest requirements of the Ontario Electrical Safety Code.
- .4 Client approved system to be installed as outlined by a manufacturer and equipment supplier.

1.02 BASIC MATERIALS AND METHODS

- .1 The equipment and components in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted).
 - .1 SAE J1772 – Electric Vehicle Conductive Charge Coupler.
 - .2 cUL 2594 Electric Vehicle Supply Equipment
 - .3 UL 2231-1&2 - Personnel Protection Systems for Electric Vehicle Supply Circuits.
 - .4 NEMA 3R outdoor/indoor and NIST
 - .5 UL 1998 – Software in Programmable Components
 - .6 UL 991 – Tests for Safety-Related Controls Employing Solid-State Devices
 - .7 Canadian Electrical Code – Section 86 – Electric Vehicle Charging Systems
 - .8 Latest Ontario Electrical Code

1.03 SUBMITTALS

- .1 Manufacturer shall provide [3] copies of the following documents to owner for review and evaluation in accordance with general requirements of Division 16:
 - .1 Product Data on the specified product
 - .2 Shop Drawings on the specified product
 - .3 Installation Guides on the specified product
 - .4 User Manual on the specified product
 - .5 EVSE is to be networked unless specified otherwise by engineer

1.04 SYSTEM DEFINATION

- .1 CHARGING CIRCUIT INTERRUPTING DEVICE (CCID) – A device that continuously monitors the differential current among all of the current-carrying line conductors in a grounded system and rapidly interrupts the circuit under conditions where the differential current exceeds the rating of the charging circuit interrupting device. The device is identified by the letters CCID followed by the differential trip current rating of either 5 or 20 mA.

- .2 LEVEL 2 CHARGING – A method that utilizes dedicated AC Electric Vehicle Supply Equipment in either private or public locations. The vehicle shall be fitted with an on-board charger capable of accepting energy from alternating current electric vehicle supply equipment. Level 2 charging permits the vehicle to be charged by connecting to a voltage of either 240 or 208 VAC.
- .3 GROUNDING MONITOR/INTERRUPTER – A device that monitors equipment grounding continuity in a charging system, and either prevents the circuitry from becoming energized under conditions where the grounding is not available or interrupts the circuit under conditions where the grounding is lost during operation.

1.05 SYSTEM DESCRIPTION

- .1 Electric Vehicle Supply Equipment (EVSE) for SAE J1772 Level 2 charging, rated a maximum of 240V AC, with a frequency of 60 Hz, and intended to provide power to an Electric Vehicle with an on-board charging system. This specification covers Electric Vehicle Supply Equipment intended for use where ventilation is not required.
- .2 EVSE shall be suitable for use on a solidly grounded power distribution system.

1.06 INSTALLATION, OPERATION AND MAINTENANCE DATA

- .1 Manufacturer shall provide [3] copies of Installation, Operation and Maintenance procedures to owner in accordance with general requirements of Division 16.
- .2 Circuit shall supply no load other than the EVSE and the over current protection sized for 125% (Rule 86-300).
- .3 Voltage drop to not exceed 5% from the supply side of the consumer service to point of utilization and not to exceed 3% in a feeder or branch circuit (Rule 8-102b and Rule 8-102c).
- .4 EV Charging Station is considered a continuous load.
- .5 All wiring methods should follow Section 12 of the OEC.

1.07 DELIVERY, STORAGE, AND HANDLING

- .1 Electrical Contractor shall store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.
- .2 Electrical Contractor shall inspect and report concealed damage to carrier within 48 hours.
- .3 Electrical Contractor shall store in a clean, dry space. Cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heated enclosures to prevent condensation.
- .4 Electrical Contractor shall handle in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish.
- .5 Service Conditions to be followed before, during and after EVSE installation.

1.08 FIELD MEASUREMENTS

- .1 Electrical Contractor shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in Ontario Electrical Code.

2 PRODUCTS

2.01 GENERAL

.1 Multi-Use Residential

- Networked Units with connected access

.1 Wall-mount

.2 Pedestal

.3 Integrated Service Platform

.4 Web Client for EVSE owners

.5 Mobile App for EV drivers

.6 Mobile App for Licensed Installers

.2 Commercial

- Networked Units with connected access

.1 Wall-mount

.2 Pedestal

.3 Integrated Service Platform

.4 Web Client for EVSE owners

.5 Mobile App for EV drivers

.6 Mobile App for Licensed Installers

.3 Public

- Networked Units with connected access

.1 Wall-mount

.2 Pedestal

.3 Integrated Service Platform

.4 Web Client for EVSE owners

.5 Mobile App for EV drivers

.6 Mobile App for Licensed Installers

.4 Corporate Fleet (Internal)

- Private Network with RFID access

.1 Wall-mount

-
- .2 Pole Mount
 - .3 Single/Double Pedestal
 - .4 Charging Station Manager Application
 - .5 EVSE Back End Safety Infrastructure - EV Smart Distribution Panel (Or similar system provisions):
 - Modular based Computerized EV Distribution Panel
 - .1 Real-Time Control/Monitoring at individual breaker level
 - .2 Supports Level II charging
 - .3 Allows for renewable energy integration
 - .4 Built in Smart Meter
 - .5 On board CPU
 - .6 Communication via Ethernet Cat5/6, Wireless, GPRS Modem
 - .7 Built in protection for Overload, Spark, Short Circuit, Lack of Phase, Temperature, and Theft, Damage and Accident
 - .8 Built in AFT (Appliance Fault Test)
 - .9 Built in overload setting and delay
 - .10 Built in Lightning protection
 - .11 Built in Surge protection
 - .12 Integration port for 4 IP based cameras
 - .13 Single Phase or Three Phase, selectable
 - .14 Payload: 30A continuous load 2-Pole charging load
 - .15 Remote Control
 - .16 External mounting available – NEMA rated external enclosure
 - .17 Minimizes conduit run for individual charger
 - .6 Where smart panel is not utilized, electrical contractor to provide for the following provisions :
 - .1 A fully operational and inclusive separate enclosure of adequate size adjacent to the power supply panel can facilitate metering CTs and any other required interconnections and systems to provide for fully operational system.

2.02 EQUIPMENT

- .1 Furnish the EV Charging Station to be
 - .1 Level 2 charging

-
- .2 Enclosure: NEMA 3R per NEMA 250-1997, sun and heat resistant, free standing bollard mount unless otherwise indicated.
 - .3 Free standing cUL Certified Level 2 Only Electric Vehicle Charging Station. The EV charging station shall comply with the applicable requirements of all codes and standards listed in Article 1.2 of this specification and has a CCID with auto re-closure (i.e. GFCI breakers not required in the service panel)

2.03 COMPONENTS

- .1 Input Power per Charging Port: 7.2 kW.
- .2 Input Voltage per Charging Port: 208/240 VAC
- .3 Input Current per Charging Port: 30A
- .4 Input Power Connections: Independent 2-Pole 40A branch circuits per Charging Port, each providing Line 1, Line 2 & a single Ground
- .5 Recommended Service Panel Breakers per Charging Port: 40A 2-Pole (non-GFCI type) on dedicated circuit. Standby Power: 5W typical (Single Port) or 7W typical (Dual Port)
- .6 Output Charging Power per Charging Port: 7.2 kW
- .7 Output Voltage per Charging Port: 240 VAC
- .8 Output Current per Charging Port: 30A
- .9 Output Charging Connector per Charging Port: SAE J1772TM EV Connector not less than 15' for Single Port or 20' for Dual Port
- .10 Locking Holster: Electromechanically locks the SAE J1772 connector to the EV Charger between charging sessions
- .11 RFID Card Reader: ISO 15693 & 14443 for contactless credit cards, QR Code and Mobile App accessible.
- .12 Ground Fault Protection: 20 mA CCID with auto retry (15 minute delay, 3 tries)
- .13 Plug-Out Detection:
 - .1 Power terminated per SAE J1772TM specifications
 - .2 Algorithm to disengage power and notify the driver when a plug is removed
- .14 Option for Hard Wire version for Wall-Mount unit
- .15 Option for Plug-in version for Wall-Mount unit
- .16 Illuminated on charger to indicate status of operation
- .17 Manufacturer/Distributor to provide mounting plates for wall mount and pedestal EVSE to be used for wall applications and concrete footing applications.
- .18 Surge Protection: 6 kV at 3,000A
- .19 EMC Compliance: FCC Part 15 Class A

-
- .20 Operating Temperature: -300C to +500C
 - .21 Operating Humidity: 95% non-condensing
 - .22 Terminal Block Temperature Rating: 1000C.
 - .23 Access control and Payment options via secure web application
 - .24 Integrated service platform for remote diagnosis.
 - .25 Commercial/Public Station Hardware features the following:
 - .1 To be available in pedestal or wall mount.
 - .2 Pedestal Unit with lockable retractable SAE J1772 cable for prevention of tripping hazards.
 - .3 QR Code capable, Mobile App capable and with Integrated RFID Smart Card Readers.
 - .4 Intelligent Power Control – Algorithms ensure power is delivered only when a driver is authorized and the SAE J1772 is properly seated in the vehicles mating inlet.
 - .5 Bright, easy-to-read display for user instructions, station status and Mobile App communication.
 - .6 Utility Grade Energy Meter – Integrated power metering circuitry provides accurate bi-directional energy measurement.
 - .7 Integrated Fault Detection for Ground Fault and Over-Current Detection.
 - a. Ground Fault Detection circuitry with Auto Re-Try and Driver Notification to ChargePass card users.
 - b. Over-Current Detection disconnects power prevent nuisance breaker trips at the service panel. Unit will Auto Re-Try and notify all users, whether via QR Code, RFID, Mobile APP or manual engagement.
 - .8 Network Interface: Wireless mesh and cellular network interfaces allow seamless integration with back office business systems or utility AMI's (Advanced Metering Infrastructure).
 - .9 Smart Grid Compatible: Utility grade meter and smart-grid interfaces to enable demand response and Time-Of-Use (TOU) pricing.
 - .10 BAS compliant

2.04 WARRANTY

- .1 The manufacturer warrants equipment to be free from defects in materials and workmanship for 2 years from date of commission.

3 EXECUTION

3.01 INSTALLATION

- .1 Installation shall be performed by the Electrical Contractor.
- .2 Provide concrete base (if required) and install the unit as per manufacturer instructions.

-
- .3 Connect the unit to branch circuit panel board as shown on drawings.
 - .4 Connect appropriate communications raceway according to EVSE installation location. (communications option must be identified on EVSE order)
 - .1 EVSE located in underground facility
 - a. Hardwired Ethernet Cat5/6 cable (recommended- a conduit to be provided)
 - .2 EVSE located outdoors
 - Hardwired Ethernet Cat5/6 cable or,
 - Wireless modem or,
 - GSM cellular modem
 - .5 Hardwired Ethernet Cat5.
 - .6 Wireless
 - .7 Start-up, test and configure the EVSE as per manufacturer instructions.
 - .8 Provision the EVSE as per client's requirements according to software platform, if applicable.
 - .9 Install protective bollards (if required) where applicable.
 - .10 Provide a permanent sign to read ELECTRIC VEHICLE CHARGING STATION. To be installed as indicated on the drawings.
 - .11 Provide parking space pictograms (if required) where applicable
 - .12 Option for Corporate Branding of EVSE utilizing clients graphic according to corporate sustainability protocol/program. Custom application can be applied prior to EVSE delivery if ordered in advance.
 - .13 The EVSE should be mounted at a height in conformance with ESA and OBC requirements

3.02 FIELD QUALITY CONTROL (ALL UNITS REQUIRE PROVISIONING)

- .1 Provisioning shall be provided by the Electrical Contractor or a Factory Certified Technician employed by either the manufacturer or a manufacturer certified company. Provisioning shall include one visit to perform all procedures, tests and verifications as specified by the manufacturer within the unit's installation, testing and verification manuals.
- .2 The following procedures and tests shall be performed during the provisioning process:
 - .1 Visual Inspection:
 - a. All equipment for signs of damage or foreign materials as well as cleanliness of the installed system.
 - b. All equipment for any other safety related matters.
 - .2 Mechanical Inspections:
 - a. Check all power connections for tightness.

-
- b. Check all control wiring terminations and plugs for proper seating.
- .3 EV Charging Station Tests:
- a. Demonstrate the functions of both Level 1 and Level 2 to ensure;
 - b. Proper functioning of the unit;
 - c. Proper functioning of the power metering system;
 - d. Proper operation of the driver notification
- .3 Tests shall be performed during the substantial completion field review by the electrical field reviewer, and witnessed by him or her if such witnessing is requested.
- .4 Notify persons witnessing at least 15 working days in advance of test date and time.
- .5 Arrange for facility's maintenance representative to be present during tests.
- .6 Operational Training: Before leaving the site, the Electrical Contractor or the Factory Certified Technician shall familiarize responsible personnel with the operation of the EV charging station. The training shall include at least one 1 hour session.

1 GENERAL

1.01 SUBMITALS

- .1 Submit shop drawings for products of this Section and as identified on Schedule of Luminaires.
- .2 Include photometric data, lamp, and ballast information for each luminaire. Include ballast data identifying maximum circuit loading limitations.
- .3 Photometric data to include: total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures.
- .4 Include copy of certification that lenses and louvers comply with local governing building code requirements for flame spread ratings.
- .5 For poles, submit documentation that poles supplied are suitable for steady wind velocity and gust velocity of area of installation, and suitable for total effective projected area of mounted lighting equipment.
- .6 For exterior site areas or parking areas, where luminaires are proposed that are not from based specified manufacturer, provide luminaire manufacturer's computer prepared detailed photometric layout drawings with complete photometry showing performance levels of proposed luminaires. Clearly identify lighting levels, quantity, locations, mounting heights, etc. Identify variances from base design.
- .7 Refer to Section entitled Electrical Work General Requirements, for general submission requirements.

1.02 WORK INCLUDED

- .1 Supply and Install electrical lighting fixtures and systems as scheduled, complete with lamps, ballasts and necessary accessories required for their installation and performance. Refer to Lighting Fixture Schedule on Drawings.
- .2 Fixtures Supplier/Manufacturer shall provide a point by point, photometric study (horizontal lighting levels) under both normal power and emergency power conditions for the following areas:
 - .1 Pool area, including water surface and pool surrounding deck.
 - .2 Common suite corridors, including pot lights and sconces layout.
 - .3 Exterior parking areas.

Calculations to be graphic in nature and in DXF file format. Unit of measurements shall be in Foot Candles or lx.

1.03 CALALOGUE REFERENCE

- .1 Catalogue reference numbers given for individual fixture types are intended as a guide when read with the description and the fixture as finally applied. Verify catalogue references with description and coordinated with installation conditions, with particular regard to ceiling construction details, type and finish, before ordering fixtures.

1.04 LAMP AND BALLAST CONDITIONS

- .1 Upon first energizing all fluorescent and H.I.D. fixtures, these shall remain energized for a stabilizing period of 100 hours.

2 PRODUCTS

2.01 BALLAST

- .1 Fluorescent lamp ballasts shall comply with ASA Specification C82 1, and meet current C.S.A. Standard C22.2 No. 74, Lamp holders and Control Equipment for use with Electric Discharge Lamps.
- .2 Two (2) lamp 32 watt rapid start ballasts shall have an average noise level not exceeding 30 dB when tested in a 24 dB weighted network.
- .3 Light output shall be minimum of 95% of rated lamp lumens. Power factor to be a 95% minimum. Ballasts shall operate satisfactorily with fluctuation of plus or minus 10% of nominal system voltage.
- .4 Ballast protection shall be of the automatic reset type, affording both coil and capacitor protection.
- .5 H.I.D. lamp ballasts (Metal Halide, Mercury Vapour, etc.) shall comply with C.S.A. Specification No. C22.2 No. 66, Specialty Transformers, including amendments for indoor operation where applicable, and shall be compatible with fixture and lamp assembly which they serve.
- .6 Acceptable BALLASTS manufacturers are:
 - .1 General Electric;
 - .2 OSRAM Sylvania;
 - .3 Advance.

2.02 PLASTIC LENSES

- .1 Plastic lenses in lighting fixtures shall be virgin acrylic with minimum thickness of 3 mm and providing flame spread and smoke density ratings, complying with applicable Federal and Provincial Codes.

2.03 LAMPS

- .1 T-8 fluorescent lamps in climate controlled applications to be Philips Lighting, "Advantage - ALTOS II" Series, as follows:
 - .1 phosphor coated;
 - .2 reduced mercury content;
 - .3 energy saving, high efficiency, extended life;
 - .4 rapid start, lamps with colour temperature of 3500 K (for pricing purposes); confirm colour temperature requirements with Owner / Consultant prior to ordering;
 - .5 colour rendering index (CRI) of at least 85;
 - .6 for 32 watt nominal 4' lamps: Rated average life of a minimum 36,000 hours (using programmed start ballasts and 12 hour cycling per start) and initial lumens of at least 2950;

-
- .7 for 28 watt nominal 4' lamps: Rated average life of a minimum 36,000 hours (using programmed start ballasts and 12 hour cycling per start) and initial lumens of at least 2600.
 - .2 T5 and T5-H0 Fluorescent Lamps in climate controlled areas to be – Philips "Alto-Silhouette" series, as follows:
 - .1 energy efficient, low mercury content;
 - .2 high output programmed rapid start;
 - .3 miniature bipin;
 - .4 colour temperature 3500K, unless otherwise scheduled;
 - .5 colour rendering index (CRI) minimum 85;
 - .6 average life of 24,000 hours for T5;
 - .7 average life of 25,000 hours for T5-HO;
 - .8 approximate initial lumens of 5000 at 54 watts T5 HO;
 - .9 approximate initial lumens of 3000 at 28 watts T5.
 - .3 Pin based compact fluorescent lamps to have a rated average life of a minimum 12,000 hours, colour temperature of 3500 K, minimum colour rendering index of 80 and complete with electronic energy saving programmed start ballasts compatible with lamps.
 - .4 For non-climate controlled areas provide high output lamps suitable for reliable starting and operation at low temperatures below freezing (-29°C) (-20°F) and supplied with proper low temperature operating ballasts.
 - .5 Fluorescent lamps for luminaires connected to dimmers are to be suitable in all respects for application. Lamps, ballasts and dimmers must be approved by respective manufacturer for connection and use together.
 - .6 Metal halide lamps to be based on Osram Sylvania "Metalarc" series with following features:
 - .1 pulse start, coated type;
 - .2 apparent colour temperature of approximately 3900K;
 - .3 minimum lamp life of 15,000 hours and colour rendering index (CRI) of at least 65;
 - .4 compatible lamp and ballast combination that meets ANSI specifications;
 - .5 of same manufacturer and production batch.
 - .7 High intensity discharge (HID) lamps to be of wattage rating indicated on Schedule of Luminaires. Unless otherwise noted HID lamps to be coated types.
 - .8 High pressure sodium lamps to be coated type with apparent colour temperature of 2100K, minimum lamp life of 24,000 burning hours and colour rendering index of at least 21.
 - .9 Low voltage MR 16 halogen lamps to be based on Osram Sylvania "Titan-IR" series with following features:

-
- .1 hard coated dichroic reflector providing consistent colours throughout life of lamp and using IR technology for energy savings and reduced heat;
 - .2 transmits heat through back of lamp;
 - .3 UV filter capsule to reduce fading of UV sensitive materials;
 - .4 beam spreads from narrow spot, spot, narrow flood, flood and wide flood;
 - .5 minimum 5000 hours lamp life without sacrificing full rated light output;
 - .6 transformers with regulation to maintain voltage between 11.5 to 12.5 volts.
- .10 Confirm exact colour temperature of lamps with Owner, prior to ordering.
 - .11 Supply lamp kit consisting of various lamps with different beam spreads, for accent type luminaires. Utilize lamp kit during adjusting and aiming to determine final selection of lamps.
 - .12 Acceptable lamp manufacturers are:
 - .1 Philips Lighting;
 - .2 OSRAM Sylvania;
 - .3 GE Lighting.

2.04 LEDS

- .1 Light emitting diodes (LEDs): with rapid and changing development of LED technology, provide most technically proven and most advanced and successfully tested LED technology at time of installation.
- .2 Generally, colour temperature range to be from 2700 K to 6500 K with minimum CRI of 80 and rated life (based on 70% lumen depreciation level) from 50,000 to 70,000 hours.
- .3 Heat sinks to adequately remove heat from bottom of semiconductor.
- .4 LED specification standards to comply with IES LM 79 and LM-80.

2.05 EMERGENCY LIGHTING BATTERY UNITS

- .1 Battery units shall be Square 'D' Lumacell Model or approved equal of the types noted, long life sealed lead, with design life of ten (10) years, 6 or 12 Volt. The unit shall be performance certified and carry C.S.A. Specification No. C22.2 No. 141, Unit Equipment for Emergency Lighting, approval for the wattage shown. The unit shall have a published five (5) year guarantee on the charger, and a five (5) year complete guarantee on the battery followed by a five (5) year pro rata guarantee.
- .2 Provide a 120 Volt input circuit for each battery unit wired to un-switched circuit indicated. Wire to exit signs from battery units. Size conductors to all remote lamps to provide maximum voltage drop of five percent (5%).
- .3 Provide emergency lighting battery units and wiring systems as noted in Electrical Rooms and Generator Room only.
- .4 Emergency battery units shall be designed to provide emergency lighting for at least 2 hours automatically upon failure of normal power source.

- .5 Upon restoration of the normal power, the battery unit shall be restored automatically to a charging condition. The charging cycle shall raise the battery to an equalized voltage, and then electronically sense the full state of charge in the battery, and return the battery to a lower float voltage. The charger shall be regulated to a plus or minus 20 mV output for plus or minus 10% voltage fluctuation.
- .6 In order to extend battery life at ambients other than room temperature, the charger shall reduce the battery voltage by 4 mV per cell per degree C rise in temperature, and shall raise the battery voltage by 4 mV per cell per degree C reduction in temperature from a 20 degree C reference temperature.
- .7 The unit shall be equipped with a phase loss and brown out protection circuit which shall turn on emergency lights when input voltage to the unit falls below 90 volts or 75% full voltage.
- .8 The unit shall include a test switch, charge and "ON" pilot lights, which shall be light emitting diodes. The unit shall include a low voltage disconnect circuit and circuit distribution panel.

2.06 EXIT SIGN

- .1 Exit signs shall comply with OBC 2012. The manufacturers are Beghelli, Stanpros, Lumacell or equal with five years warranty.
- .2 The exit sign to be used in the amenity area and the residential corridors shall be:
 - .1 Edge lit type, either single face recessed wall mounted, or recessed single or double faced ceiling mounted.
 - .2 Faceplate shall have green running man pictogram on clear or mirrored background with or without directional indicators as required.
 - .3 Lamps are high output LED. They are fully contained and not be visible or protruding
- .3 The exit sign to be used in the parking garages, service rooms or similar shall be:
 - .1 Thin line or universal type, surface, single or double face, back wall or ceiling mounted.
 - .2 Faceplate shall have green running man pictogram with or without directional indicators as required.
 - .3 Lamps are high output LED. They are fully contained and not be visible or protruding.

2.07 FIXTURE SCHEDULE

- .1 Lighting fixtures shall be as scheduled on drawings.

3 EXECUTION

3.01 INSTALTION

- .1 Provide luminaires as scheduled.
- .2 Before placing luminaire orders:
 - .1 verify quantity requirements;
 - .2 thoroughly review ceiling types, finishes and construction details; verify ceiling types with latest Architectural Drawings; order luminaires to suit correct ceiling type;

-
- .3 ensure that required mounting assemblies, frames, rings and similar features are included;
 - .4 confirm colours and finishes with Consultant.
 - .3 Include for assembly and mounting of luminaires and lamps, complete with:
 - .1 wiring and connections;
 - .2 fittings and hangers;
 - .3 aligners;
 - .4 box covers;
 - .5 other accessories required for a complete, safe and fully operational assembly.
 - .4 Where outlet boxes locations are shown on drawings, they are diagrammatic only. Position outlet boxes to coincide with suspension hangers and knockouts.
 - .5 Install ceiling fixtures in centre of tiles unless dimensioned otherwise on Reflected Ceiling Plans. Locate hangers on tile centres or intersections. Mount recessed downlights, troffers, and surface mounted luminaires in or on full tiles. Install fixtures in and on acoustical tile ceilings in alignment with tile joints. Where holes are cut for luminaires,
 - .6 Cut holes for recessed luminaires to exact size so that gaps are not visible or luminaire trims cover gaps.
 - .7 Mount surface ceiling luminaires perfectly level or plumb, tightly to ceiling without showing a space or light leak between frame and ceiling.
 - .8 Carefully align linear luminaires shown in continuous lines or rows, so that rows appear as straight lines. Variation in alignment not to exceed 6 mm (1/4") for any 5 m (16') run.
 - .9 Provide spacers for fixtures mounted on low density ceiling material.
 - .10 Provide plaster frames for recessed fixtures in plaster or gypsum board ceilings.
 - .11 Prepare fixtures, trim and poles and standards required to be painted.
 - .12 Wiring between fluorescent lamp holders and associated operating and starting equipment to be of similar or heavier gauge than leads furnished with approved types of ballasts with equal or better insulating and heat-resistant characteristics.
 - .13 Protect wiring with tape or tubing at all points where abrasion may occur. Conceal wiring within fixture construction except where design or mounting dictates otherwise.
 - .14 Splices:
 - .1 Minimize number of splices.
 - .2 Make with approved mechanical insulated steel spring type connectors, suitable for temperature and voltage conditions to which splices are to be subjected.
 - .3 Splices are not to be made unless properly terminated in accessible identified junction boxes.

-
- .15 Support luminaires directly by ceiling slab structure and not to formed steel decking, ceiling hangers, ductwork, piping, cable trays, etc.
 - .16 Do not tighten wing nuts, bolts, or screws that allow fixture adjustment for recessed adjustable fixtures.
 - .17 Install spread lenses only where called out on Schedule of Luminaires and Specifications.
 - .18 Use cloth gloves when handling reflector cones, louvers, halogen lamps, glass, sconces and all exposed surfaces of fixtures.
 - .19 Co-ordinate luminaire installation with work of other trades to ensure that necessary recessing depths and mounting spaces are provided.
 - .20 Install luminaires in accordance with applicable architectural drawing reflected ceiling plans and/or wall elevations and/or field instructions issued by Consultant. Confirm luminaire locations prior to roughing-in. In equipment rooms, shafts and similar secondary areas, install luminaires after mechanical and other major work is roughed in and adjust luminaire locations as required.
 - .21 Align and position all adjustable luminaires, and ensure that luminaires with adjustable lamp holders are properly positioned to correspond to lamps specified.
 - .22 Comply with requirements of local governing electrical code regarding support of luminaires in suspended ceilings.
 - .23 Independently suspend fluorescent luminaires in suspended ceilings from ceiling slab. For each luminaire, provide minimum two (2) cable supports secured to ceiling slab and to luminaire.
 - .24 Locate exit signs in final locations confirmed with Consultant and approved by local building code authority. Relocate exit sign and re-direct direction arrows to suit local building code authority requirements and Consultant's directions.
 - .25 Notify Consultant immediately if:
 - .1 fixture placement is in conflict with a structural beam, mechanical duct, plumbing pipe, etc.;
 - .2 space above ceiling is not sufficient;
 - .3 any reason that a fixture cannot be located where it is dimensioned or shown on construction documents.Relocate fixture, if necessary, where Consultant decides.
 - .26 Lamps to be new and intact when project is complete and ready for acceptance.
 - .27 Include a full lamp listing in Operating and Maintenance Instruction Manuals.
 - .28 Concrete Bases:
 - .1 Secure poles for pole mounted, exterior type luminaires to concrete bases as detailed.
 - .2 Co-ordinate required work including excavation/backfilling/concrete work to provide bases as shown.
 - .3 Provide anchor bolt covers and anchor bolt templates for proper positioning of anchor bolts in concrete.

-
- .4 Refer to concrete base detail found on drawings; this detail is for general requirements only.
 - .5 Include costs for and engage Professional Structural Engineer licensed in Place of Work and with liability insurance, to review and endorse final base design work; confirm exact details with Consultant; grade levels may be different in various areas.
 - .29 Extend ground conductors from metal parts of poles to building grounding provisions. Generally locate devices in locations on drawings, but base exact locations on approvals of Consultant and governing authorities. Confirm luminaires and pole finishes with Consultant prior to ordering. Run wiring in conduit.
 - .30 Secure grade mounted building floodlighting luminaires to concrete pads set flush with finished grade level.

1 GENERAL

1.01 DESCRIPTION OF WORK

- .1 Provide and install complete system of electric pipe tracing sets to provide protection of water piping from freezing under subnormal winter conditions. Protection shall be extended, but not limited, to the following systems:
 - Horizontal fire lines and FHC
 - Sprinkler Mains, Risers, and Branch Lines
 - Sump pumps risers.
 - Drum drips
 - Drain traps
 - Test inspection stations.

(Note: Drain traps are not usually shown on the electrical drawings. Coordinate from the mechanical drawings and on site)
- .2 Field measure all piping and pre-order all cable sets from manufacturer complete with cold leads, thermostats, relays and contactors. Cable sets shall be as manufactured by Tyco Thermal Controls or approved equivalent.
- .3 Where applicable, freeze protection cable and controls shall comply with current NFPA13, edition as outlined below. This includes any sprinkler piping (mains, risers, branches) normally filled with water, in environments subject to ambient temperatures below freezing.
- .4 Heat Tracing Cables installed on fire suppression piping shall be specifically listed for use on fire suppression piping. Manufacturer's certificates of compliance shall make reference to this.

2 PRODUCTS

2.01 WATER PIPE TRACING

- .1 Heating cable sets directly connected for indoor use under 1" of mineral insulation provided by Mechanical Divisions. Cable heat output shall offset heat loss under ambient conditions down to -30 degrees Celsius.

Cable voltages shall be 120V/208 Volts as indicated on construction plans. Provide GFEP breakers with 30mA trip for tracing cables unless ground-fault protection is integral to controls components.
- .2 Heating cable sets directly connected for indoor use under 1" of mineral insulation provided by Division 15. Cable heat output shall offset heat loss under ambient conditions down to -30 degrees Celsius.
- .3 Controls – ambient sensing thermostats, remote bulb or electronic thermistor type to suit voltage and cable size, in tamperproof enclosure, watertight construction.
- .4 Sprinkler Pipe tracing circuits shall be controlled using an ambient temperature sensor so as to energize upon air temperatures below 4 degrees C. In addition, the controller shall measure pipe temperature and the controller shall monitor and alarm on all of the following conditions:
 - Loss of Power

-
- Switch failure
 - Low pipe temperature
 - Ground Fault

Sprinkler Pipe Tracing alarm contacts shall be connected to the fire alarm panel to signal trouble. Pipe tracing addresses shall be clearly identified at the fire alarm panel. Controller shall be Tyco Thermal Controls type C910 or approved equivalent.

3 EXECUTION

3.01 INSTALLATION

- .1 Prior to submission of Bid, engage system manufacturer to review documents to ensure that requirements are included for proper operation and functionality of system for specific application in compliance with drawing and parameters and specification. Confirm type of piping and insulation, and design temperature parameters with Mechanical Divisions and include in design and selection of system. Provide required components suitable for operation at voltages and for connection to breakers as noted on drawings and as required.
- .2 Provide system power distribution panels for applications of multiple heating cables that provide centralized operation of system with thermostat connection and use of ground fault type breakers, relays and contactors.
- .3 Heating cable to be applied linearly (without spiralling) on pipe after pipe has been successfully pressure tested. Secure heating cable to pipe. After installation, test cable with a 2500 VDC megger. Minimum insulation resistance would be 1000 megohms regardless of length.
- .4 Install cable in accordance with manufacturer's recommendations and in accordance with manufacturer's installation chart.
- .5 Provide double line of tracing on all pipes located within 10m of intake air shafts in parking garages.
- .6 Provide identification labels at start and end of each run, every 4.5 m (15'), at bends, branches, risers both sides of wall and floor penetrations and at access doors.
- .7 Connect pipe tracing power feeders to ground fault type breakers with 30 mA trip as per local governing electrical code requirements.
- .8 Provide contactors to connect to thermostats and cables to energize/de-energize heating cable circuits through thermostat operations.
- .9 Install controls, sensors, and thermostats in strict accordance with system manufacturer's installation recommendations. Ensure that each control unit, sensor, and thermostat is clearly identified with nameplate. Thermostats to be set at manufacturer's recommended upper limit temperature to ensure that heating cable is totally de-energized above set point. Provide thermostat as shown or if not shown, provide one (1) for each commonly grouped cables (i.e. in same area and performing similar application).
- .10 Test, adjust, and verify operations.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide and install a complete system of specified heating cables, terminations, junction boxes, and controls c/w distribution for snow melting in ramp(s), trench drain(s) including 1.5m min. beyond trench drain or extend more as specified on the drawing, roof and gutter and exposed stair(s).
- .2 Provide and install a complete pre-wired power distribution and control panel for snow melting.
- .3 Provide all work as indicated on plans and diagrams.

2 PRODUCTS

2.01 SNOW MELTING

- .1 Tyco "Pyrotenax", CSA certified, factory assembled and tested mineral insulated "MI" heating cable as shown on drawings, consisting of heating cable, control components, and required installation and connection accessories.
- .2 MI Heating Cable:
 - .1 Magnesium oxide insulated, with copper or resistance alloy conductor and a seamless copper sheath.
 - .2 Constructed in a manner that no combustible materials are allowed between resistance alloy conductor and outer metal sheath.
 - .3 Heater core materials are inorganic and will not deteriorate with age.
 - .4 Heated section joined to a PVC jacketed copper sheath cold lead section by a factory-made joint.
 - .5 Complete heater assembly to have a protective high density polyethylene jacket.
 - .6 Designed for operation on supply voltages up to 600 VAC;
 - .7 Heat output to not decrease as temperature of slab increases.
 - .8 Factory-fabricated to length required and not be altered on site.
- .3 Mounting Hardware:
 - .1 Corrosion resistant mesh or stainless steel pre-punched strapping to hold snow melting cables in place and to maintain desired spacing for application.
- .4 Junction Boxes:
 - .1 Cast aluminum flush and surface mounting junction boxes complete with gasketed lid and entries suitable for entries required at each location. Junction boxes to not be in heated surface or below grade or in a location where moisture will enter box.
- .5 Warning Signage:
 - .1 Anodized aluminum plaque that identifies an embedded heating cable system.
- .6 System Testing and Verification:

-
- .1 Include for manufacturer's authorized representative to inspect system installation, test system, and verify system.
 - .2 Manufacturer's authorized technician to prepare and sign verification report letter that states system has passed manufacturer's testing and performs to manufacturer's requirements for application.
 - .7 Acceptable Manufacturers are:
 - .1 Tyco (Pyrotenax);
 - .2 TRM Heating Cables.

2.02 ROOF AND GUTTER DE-ICING

- .1 Tyco - Raychem, "Ice Stop", ULC listed and labelled, CSA approved, UV stabilized, self-regulating electric heat tracing cable as follows:
 - .1 consisting of two (2) No. 16 AWG nickel copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature along its length allowing cable to be crossed over itself without overheating;
 - .2 to be used with various building materials and to be cut-to-length in field;
 - .3 overall jacket to be an abrasion resistant fluoropolymer;
 - .4 impact resistance to be minimum 7.5 joules (10 ft-lb) at 0°C (32°F), and crush resistance of 8900 N (2000 lbs);
 - .5 UV resistant - qualified for prolonged exposure to sun per IEEE 515.1-1995, Section 4.3.2, and UL1588-1993;
 - .6 qualified to withstand continuous submersion in water for 2000 hours per IEEE 515.1-1995, Section 4.3.1;
 - .7 nominal power output of 12 W per 300 mm (foot) in snow and ice and 5 W per 300 mm (foot) in air.
- .2 System to be controlled by automatic controllers and sensors, as specified later in this Section. Include for manual override switch.
- .3 Accessories to also include as required, following:
 - .1 No. C75-100-A heating cable gland kit;
 - .2 power connection and end seal kits;
 - .3 splice, end seal and tee kits;
 - .4 junction boxes;
 - .5 hanger clips and gutter clips;
 - .6 cable ties, cable markers, etc.;
 - .7 contactors and relays as required.

.4 System Testing and Verification:

- .1 Include for manufacturer's authorized representative to inspect system installation, test system and verify system.
 - .2 Manufacturer's authorized technician to prepare and sign verification report letter that states system has passed manufacturer's testing and performs to manufacturer's requirements for application.
- .5 Acceptable manufacturers are:
- .1 Tyco – Raychem;
 - .2 TRM Heating Cables.

2.03 AUTOMATIC CONTROLLER

- .1 Environmental Technology Inc., model APS-4C, CSA approved automatic controller for heat tracing cable. Features include:
 - .1 microprocessor based controller unit:
 - .2 operating at line voltage as noted;
 - .3 operating temperature between minus 40 °C to 71 °C (-40 °F to 160 °F);
 - .4 complete with adjustable heater hold-on timer up to 10 hours after snow stops;
 - .5 heater test switch;
 - .6 sensor inputs for up to 6 sensors;
 - .7 automatic self-testing ground fault equipment protection; selectable settings for ground fault tripping;
 - .8 high limit temperature sensor adjustable from 4 °C to 32 °C (40 °F to 90 °);
 - .9 energy management computer interfaces:
 - .1 inputs for Override ON and Off;
 - .2 outputs for Supply, Snow, Heat, Hi Temp and Remote.;
 - .10 weatherproof NEMA 3R polycarbonate enclosure with hinged impact resistant locking clear lid cover;
 - .11 remote control unit RCU with duplicate annunciation and controls, where required.

2.04 SENSORS

- .1 Environmental Technology Inc., model CIT-1 snow/precipitation sensor as follows:
 - .1 moisture and temperature sensors for connection to automatic controllers;
 - .2 solid state design combined with a rugged aluminum housing and epoxy potting;
 - .3 detects falling or blowing snow as precipitation at temperatures below 3.3 °C (38 °F);

-
- .4 mast or roof mounting with suitable corrosion resistant hardware;
 - .5 connection wiring of per manufacturer's requirements, of required length wiring.
 - .2 Environmental Technology Inc., model GIT-1 gutter mounted precipitation sensor as follows:
 - .1 moisture and temperature sensors for connection to automatic controllers;
 - .2 solid state design combined with a rugged aluminum housing and epoxy potting;
 - .3 detects falling or blowing snow as precipitation at temperatures below 3.3 °C (38 °F);
 - .4 mounts in gutters and downspouts to sense actual environmental conditions;
 - .5 corrosion resistant mounting hardware;
 - .6 connection wiring of per manufacturer's requirements, of required length wiring.
 - .3 Environmental Technology Inc., model SIT-6E pavement sensor as follows:
 - .1 moisture and temperature sensors for connection to automatic controllers;
 - .2 solid state design combined with a rugged aluminum housing and epoxy potting;
 - .3 detects falling or blowing snow as precipitation at temperatures below 3.3 °C (38 °F);
 - .4 integral hold-on timer keeps heater on for an hour after snow stops falling;
 - .5 adjustable mounting system mounts in pavement to sense actual environmental conditions; sub-assembly allows for field replacement of sensor without disturbing pavement;
 - .6 corrosion resistant mounting hardware;
 - .7 connection wiring of per manufacturer's requirements, of required length wiring.
 - .4 Acceptable manufacturers include Environmental Technology Inc. Other manufacturers may be acceptable subject to product being equal to base specified product and be recommended by heating cable manufacturers.

2.05 POWER DISTRIBUTION & CONTROL PANEL

- .1 The panel shall be cULus Listed to Std. 508a and CSA Std. C22.2 No. 14.
- .2 The panel shall be available with a NEMA 3R enclosure. The panel shall incorporate a door in door design, isolating the branch circuit breakers from the snow melting controller.
- .3 The panel shall incorporate 1-pole or 2-pole (SMPG 1) ground fault protected circuit breakers or 3-pole (SMPG 3) shunt trip circuit breakers in conformance with CEC Section 62-300 .4 and all other applicable codes. All panels shall be designed for operation on 208 or 277 volts single phase (SMPG 1) or at 208, 480 or 600 volts 3 phase (SMPG 3).
- .4 An optional main circuit breaker shall be available (if required by code) to allow for upstream protection outside the snow melting power distribution and control panel.

When the control and distribution panel is not installed in a secured electrical room, the contractor shall provide a vandal proof security cage around the panel.

3 EXECUTION

3.01 INSTALLATION OF SNOW/ICE MELTING

- .1 Prior to submission of Bid, engage system manufacturer to review documents to ensure that requirements are included for proper operation and functionality of system for specific application. Provide electric heating cables for snow/ice melting as shown on drawings and as required to heat surfaces. Provide contactors as required for connected load. Verify drawing dimensions of areas to be heated, prior to ordering cables. As per local electrical code requirements, connect cables to feeders with approved ground fault protection devices, unless controller unit has integral ground fault protection.
- .2 Coordinate work with General Trades Contractor preparing surfaces to receive heating cable installation.
- .3 Install electric heating cables in strict accordance with manufacturer's requirements and installation instructions. Perform manufacturer's recommended cable testing, including field testing of insulation, 500 VDC meggering of cables and testing for continuity of cables.
- .4 Cable sheaths to not touch or cross one another nor are cables to cross expansion joints. Cross concrete crack control joints in accordance with manufacturer's recommendations.
- .5 Lay cables out at spacing as per system manufacturer's recommendations, but not greater than 225 mm (9") in concrete, 150 mm (6") in asphalt and for pavers, to ensure reasonably uniform distribution of heat.
- .6 Locate junction boxes in accessible areas. Locate junction boxes above grade level, not in heated slab. Covers boxes at all times when not working therein.
- .7 Protect terminations from weather and from physical damage. Bond gland assembly to system ground.
- .8 Do not proceed with any field alterations or deviations unless approved in writing by Consultant. Record changes accurately on as-builts.
- .9 Coordinate cable installation with type of surface toppings and with trades installing same. Supervise installation of toppings to ensure against cable damage. Replace damaged cables. Conduct recommended tests under supervision of a manufacturer's representative. Do not permit cables to be covered until tests are complete and accepted by Consultant. Engage manufacturer's technician to inspect installation, verify test, approve test results, and prepare an installation report.
- .10 Fasten cables with proper straps supplied by cable manufacturer.
- .11 Install main controllers, aerial sensors and slab sensors in strict accordance with manufacturer's installation recommendations. Ensure that each device is clearly identified with nameplate.
- .12 Ground and bond system components and cabling as per system manufacturer's instructions.
- .13 Provide identification labels at start and end of each run and as recommended by cable manufacturer.
- .14 Provide warning signage on surface being heated.
- .15 Provide copies of test report, signed by testing technician, to Consultant for review.
- .16 Test, adjust, and verify operations.

3.02 INSTALLATION OF AUTOMATIC CONTROLS

- .1 Prior to submission of Bid, engage system manufacturer to review system controls to ensure that all requirements are included for proper operation of complete system and cables for each specific application. Provide specified control panel and snow/ice sensors in locations as shown on drawings and as required. Mount devices and connect complete to control heating cables.
- .2 Install devices in accordance with manufacturer's instructions and requirements.
- .3 If controller does not have ground fault detection protection, ensure that power to system is ground fault protected as per local governing code requirements.
- .4 Sensors to be suitable for installation in exposed, elevated locations, or for flush installation in pavement and ramps.
- .5 Pavement sensors controlling pavement snow/ice melting to function to incrementally ramp pavement temperature to minimize thermal stresses that may contribute to concrete cracking and maintain a maximum slab temperature of 3.3 °C (38°F).
- .6 Where ambient sensors are not included with control panel, provide high limit thermostats with capillary end bulbs inserted into a metal conduit under surface being heated, to prevent operation of system in warm weather or over-heating of panels. Include for means of manual override switch to power ON/OFF system.
- .7 Provide precipitation sensors in locations and of type to suit application, drawing requirements and site conditions, as per system manufacturer's recommendations.
- .8 Ground and bond system components as per system manufacturer's instructions.
- .9 Provide for system manufacturer to program controller and to test and verify that automatic control system, in conjunction with snow melting cable is functioning in proper operation.
- .10 Ensure that each control unit, sensor, and thermostat is clearly identified with nameplate.

3.03 INSTALLATION OF GUTTER DE-ICING

- .1 Provide electric heating cables for gutter de-icing as shown on drawings and as required to heat trace gutters, down spouts and roofing areas. Engage system manufacturer to review documents prior to Bid submission to ensure that requirements are included. Provide contactors as required for connected load. Verify drawing dimensions of areas to be heated, prior to ordering cables. Verify with cable manufacturer that cable is suitable for type of surface being heated. As per local electrical code requirements, connect cables to feeders with approved ground fault protection devices, unless controller unit has integral ground fault protection.
- .2 Install electric heating cables in strict accordance with manufacturer's installation and operation manual. Fasten cables with proper fasteners supplied by cable manufacturer.
- .3 Coordinate cable installation with type of gutters, eaves, and roofing materials and with trades installing same.
- .4 Conduct recommended tests under supervision of cable manufacturer's representative. Test cable insulation resistance with 2500 VDC megger. Perform continuity test as recommended by manufacturer. Engage manufacturer to inspect installation, verify test, approve test results, and provide written signed report.

-
- .5 Install controls, sensors, and thermostats in strict accordance with system manufacturer's installation recommendations. Provide manual override switch in electrical room for de-energization during summer months.
 - .6 Provide identification labels at start and end of each run and as recommended by cable manufacturer.
 - .7 Test, adjust and verify operations.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide all work as indicated on plans and diagrams.

2 PRODUCTS

2.01 FLOOR WARMING CABLING SYSTEM

- .1 Tyco - Raychem, "RaySol", ULC listed and labelled, CSA approved, self-regulating electric heat tracing cable as follows:
 - .1 consisting of two (2) nickel-copper bus wires embedded in parallel in a radiation-crosslinked polymer core that varies its power output in response to temperature all along its length, allowing heating cable to be installed in conduit without overheating;
 - .2 to be cut to length in field, and to have no heating-cable-to-cold-lead connections buried in slab;
 - .3 covered with a radiation-crosslinked modified polyolefin dielectric jacket and protected by a tinned-copper braid and a fluoropolymer outer jacket;
 - .4 a maximum thermal output at 4°C (40°F) of 54.4 watts/m (16.5 watts/ft); (for floor warming typical minimum temperature of 27°C (±3C°) [80°F(±5F°)] or 0.186 watts/m² (6 watts/ft²);
- .2 Heating cable spacing to be determined by an application-specific, steady-state, finite-difference, thermal analysis of floor to be warmed.
- .3 System to be controlled by controllers as specified later in this Section. Ground fault protection to be provided as per local governing code requirements.
- .4 Accessories also include as required, following:
 - .1 power connection and end seal kits;
 - .2 splice and end seal kits;
 - .3 junction boxes;
 - .4 plastic cable ties, cable markers, labels, etc.
- .5 System Testing and Verification:
 - .1 Include costs for manufacturer's authorized representative to inspect system installation, test system, and verify system.
 - .2 Manufacturer's authorized technician to prepare and sign verification report letter that states system has passed manufacturer's testing and performs to manufacturer's requirements for application.
- .6 Acceptable manufacturers are:
 - .1 Tyco – Raychem;
 - .2 Thermon – 3M.

2.02 FLOOR WARMING MAT SYSTEM

- .1 Tyco-Raychem "QuickNet ", CSA certified, factory assembled and tested, floor warming system with heating mat, control components, required installation and connection accessories.
- .2 Heating Mat Features:
 - .1 Consists of a heating cable woven into an adhesive-backed fiberglass mesh.
 - .2 Rated to produce 129 watts per m² (12 watts per ft²) at 120 or 240 volts.
 - .3 Incorporates two copper alloy heating elements encapsulated in an inner fluoropolymer layer that is surrounded by an aluminum/Mylar foil to provide a ground path with 100% coverage.
 - .4 Fluoropolymer outer jacket extruded over the ground foil for abrasion and chemical resistance.
 - .5 End termination splice with a diameter of 9 mm (3/8") which is environmentally sealed.
 - .6 Power leads of sufficient length to reach junction boxes, minimum 3m (10') long, and colour coded.
- .3 Thermostats:
 - .1 Raychem QuickStat, 7 day programmable electronic thermostat that incorporate a thermistor-type floor sensor to monitor floor temperatures, an integral 5mA Class A Ground Fault Circuit Interrupter (GFCI), a temperature set-back option to reduce energy consumption, a digital readout and ON/OFF control.
- .4 System Testing and Verification:
 - .1 Include costs for manufacturer's authorized representative to inspect system installation, test system and verify system.
 - .2 Manufacturer's authorized technician to prepare and sign verification report letter that states system has passed manufacturer's testing and performs to manufacturer's requirements for application.
- .5 Acceptable Manufacturers are:
 - .1 Tyco Raychem;
 - .2 Thermon.

2.03 ELECTRONIC CONTROLLERS

- .1 Tyco "FWT-3" series, CSA approved automatic controls for floor warming systems with following features:
 - .1 microprocessor based controller unit with knob control and indicators mounted to single gang faceplate;
 - .2 automatic control and monitoring of one heat tracing circuit;
 - .3 analogue adjustment for setting floor temperature with range of 10 to 35 °C (50 to 95 °F);
 - .4 LEDs identifying power on and heater on;

- .5 operating at line voltage as noted;
- .6 weatherproof NEMA 4X enclosure with hinged impact resistant locking clear lid cover;
- .7 temperature sensor cable, 7.6 m (25') long;
- .8 mounting hardware as required.

3 EXECUTION

3.01 INSTALLATION OF SELF REGULATING HEATING CABLING

- .1 Provide electric heating cables for floor warming. Refer to drawing details and notes. Engage system manufacturer to review documents prior to Bid submission to ensure that requirements are included. Provide contactors as required for connected load. Verify drawing dimensions of areas to be heated, prior to ordering cables. Verify with cable manufacturer that cable is suitable for type of surface being heated. As per local electrical code requirements, connect cables to feeders with approved ground fault protection devices, unless controller unit has integral ground fault protection.
- .2 Install electric heating cables in strict accordance with manufacturer's recommendations and installation and operation manual. Fasten cables with proper fasteners supplied by cable manufacturer.
- .3 If in conduit, install heating cable at least 38 mm (1-1/2") below finished surface of floor at required spacing.
- .4 Protect heating cable from damage during installation. Heating cable repairs and splices to be made using a splice kit provided by system manufacturer.
- .5 After installation, prior to concrete pour, megger cable at 2500 Vdc, from conductor to braid. Resistance readings to be 20 megohms to infinity. After concrete pour, retest cables. Submit test record to Consultant.
- .6 Engage manufacturer to inspect installation, verify test, approve test results, and provide written signed report.
- .7 Install controls, sensors, and thermostats in strict accordance with system manufacturer's installation recommendations.
- .8 Test, adjust, and verify operations.
- .9 Provide copies of test report, signed by testing technician, to Consultant for review.

3.02 INSTALLATION OF HEATING MATS

- .1 Prior to submission of Bid, engage system manufacturer to review documents to ensure that requirements are included for proper operation and functionality of system for specific application. Comply with manufacturer's recommendations with regards to selecting appropriate size mat to suit floor space being heated. Verify drawing dimensions of areas to be heated, prior to ordering mats. As per local electrical code requirements, connect cables to feeders with approved ground fault protection devices.
- .2 Install electric heating mat in strict accordance with manufacturer's requirements and installation instructions. Perform manufacturer's recommended commissioning tests to be performed and recorded before heating mat is embedded in mortar, after heating mat is embedded in mortar and after tile or natural stone is set

-
- .3 Coordinate mat installation with trades installing floor. Supervise installation of toppings to ensure against mat damage. Replace damaged mats. Do not permit mats to be covered until tests are complete and accepted by Consultant. Engage manufacturer's technician to inspect installation, verify test, approve test results, and prepare an installation report.
 - .4 Install controllers/thermostats in strict accordance with manufacturer's installation recommendations. When instructed by Consultant, provide engraved nameplate identifying control unit, sensor, and thermostat.
 - .5 Provide identification labels at start and end of each run and as recommended by cable manufacturer.
 - .6 Program controller and test, adjust as required and verify that automatic control system, in conjunction with heating cable is functioning in proper operation.
 - .7 Provide copies of test report, signed by testing technician, to Consultant for review.

3.03 INSTALLATION OF ELECTRONIC CONTROLS

- .1 Prior to submission of Bid, engage system manufacturer to review system controls to ensure that all requirements are included for proper operation of complete system and cables for each specific application. Provide specified control panel and snow/ice sensors in locations as shown on drawings and as required. Mount devices where shown and connect complete to control heating cables.
- .2 Install devices in accordance with manufacturer's instructions and requirements.
- .3 Install devices in locations as confirmed with Consultant prior to rough-in.
- .4 Program controller and test, adjust as required and verify that automatic control system, in conjunction with heating cable is functioning in proper operation.
- .5 When instructed by Consultant, provide engraved nameplate identifying control unit, sensor, and thermostat.
- .6 Provide copies of test report, signed by testing technician, to Consultant for review.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide electric heating fixtures, associated wiring, controls and necessary accessories required for the installation and performance as shown on drawings.

2 PRODUCTS

2.01 ELECTRIC HEATING UNITS

- .1 Baseboard heaters shall be "Stelpro" B series or equal. Baseboard front panels shall be 22 gauge steel construction. Casings shall be 22 gauge and have full front access and shall be provided with an epoxy-polyester powder coat finish. Junction boxes on each end of the unit shall be 16 gauge. Heating element shall be metal sheathed tubular with boxed aluminium fins. Baseboards noted shall be protected by means of a built in high temperature cut out. Controls are to be determined by engineer.
- .2 Force flow units shall be "Stelpro" WF series or equal, flush mounted where possible. Unit casings shall be 20 gauge steel construction. Front grills shall be 18 gauge steel construction with an epoxy-polyester powder coat finish. Air intake shall be at the top of the unit with bottom air discharge. Airflow shall be 160CFM for single units, 2x 160CFM for double units and 3x 160CFM for triple units. Heating elements shall be nickel-chrome. Units shall be protected by means of a built in high temperature cut out. Controls are to be determined by engineer.
- .3 Unit heaters shall be "Stelpro" SHU series or equal. Unit casings shall be 18 gauge steel construction with an epoxy-polyester powdercoat finish. Louvers on front of unit shall be adjustable. Screens shall protect the intake as well as the discharge. Heating elements shall be nickel-chrome. Units shall be protected by means of a built in high temperature cut out. Controls are to be determined by engineer.
- .4 Ceiling force flow heaters shall be "Stelpro" DRII series or equal. Unit casings shall be 20 gauge steel construction with an epoxy-polyester powdercoat finish. The motor shall be totally enclosed and permanently lubricated. Unit shall have a 'fan only' mode for continuous air circulation. Heating elements shall be nickel-chrome. Units shall be protected by means of a built in high temperature cut out. Controls are to be determined by engineer.
- .5 Kick space heaters shall be "Stelpro" SKS series or equal. Unit casings shall be 22 gauge steel construction. Front grills shall be 16 gauge with an epoxy-polyester powder coat finish. Units shall generate airflow of 50 CFM. Heating element shall be metal sheathed tubular with spiral-wound fins. Units shall be protected by means of a built in high temperature cut out. Units shall also have a fuse link as additional protection. Controls are to be determined by engineer.
- .6 Patio door heaters shall be "Stelpro" PDH series or equal. Unit casings shall be 18 gauge steel construction with an epoxy-polyester powder coat finish and may be used as a step. Units shall have a compact 4" x 4" profile and a full-length wireway. Heating element shall be metal sheathed tubular with boxed aluminium fins. Units shall be protected by means of a built in high temperature cut out. Controls are to be determined by engineer.
- .7 Draft barriers shall be "Stelpro" DBI series or equal. Extruded aluminium grills shall be a thickness equivalent to 11 gauge. Unit casings shall be 18 gauge steel construction and will have a full-length wireway. Heating element shall be metal sheathed tubular with boxed aluminium fins. Units shall have front air intake and top air discharge. Units shall be protected by means of a built in high temperature cut out. Controls are to be determined by engineer.

-
- .8 Convection heaters shall be "Stelpro" SIL series or equal. Unit casings shall be 20 gauge steel construction with an epoxy-polyester powder coat finish. Units shall have bottom air intake and front air discharge. Heating element shall be an X-shaped one-piece aluminium extrusion. Units shall be protected by means of a built in high temperature cut out. Controls are to be determined by engineer.
 - .9 Acceptable manufacturers are:
 - .1 Stelpro;
 - .2 Dimplex (Chromalox);
 - .3 Ouellet.

2.02 THERMOSTATS

- .1 thermostat shall be adjustable, integral, tamperproof, 7 °C - 30 °C (45 °F - 85 °F) range;
- .2 relays and transformer kit of rating shall be provided to suit remote thermostat.

3 EXECUTION

3.01 INSTALLATION OF ELECTRIC HEATING UNITS

- .1 Provide electric heating units where required and connect with required power wiring. Provide contactors as required for connected loads and relays suitable for connection to remote thermostats, where applicable. Install in accordance with manufacturer's instructions and local governing electrical code requirements.
- .2 Sizing of heating units to be scheduled or detailed on drawings. Confirm finishes with Consultant prior to ordering.
- .3 Provide required hardware and accessories for mounting heaters. Ensure that mounting provisions are suitable in respect for particular construction on which heaters are to be mounted. Generally, in finished areas, units ceiling or wall mounted to be flush mounted and complete with flush trim. Refer to drawing notes. Where required, provide ceiling brackets for ceiling mounted unit heater. Comply with heater manufacturer's installation recommendations.
- .4 When installation is complete, check and test operation of each heater and adjust as required.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide and install new telephone service ducts from the property line to the communication room as shown.
- .2 Coordinate with telephone authority to ensure avail ability of service and connection point.
- .3 Complete empty telephone raceways system consists of outlet boxes, cover plates, terminal cabinets, conduits, cable troughs, pull boxes, sleeves and caps, fish wires, and service fittings.
- .4 Supply and installation of all communication wiring unless otherwise contracted with the Owner..

2 PRODUCTS

2.01 MATERIALS

- .1 Plywood backboard.
- .2 Grounding in accordance with Section 26 00 10.
- .3 Conduits: ENT, PVC, EMT type, to Section 26 05 00.
- .4 Cable troughs: to Section 26 05 00.
- .5 Junction boxes, cabinets to Section 26 05 00.
- .6 Fish wire: polypropylene type.
- .7 Outlet boxes, conduit boxes, size and fittings: to Section 26 05 00.
- .8 Telephone conductors as shown on drawings.

3 EXECUTION

3.01 INSTALLATION

- .1 Install telephone service facilities as indicated.
- .2 Install 19 mm thick plywood backboards in each terminal location c/w cabinets. Plywood shall be fire rated.
- .3 Install grounding facilities and make connections.
- .4 Install empty raceway system, including fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute complete system.
- .5 Install all communication wiring from the utility termination point in the electrical or communication room to each telephone outlet as shown. Note that, unless otherwise contracted with the Owner, the supply and installation of communication riser wiring and all other communication wiring is to be carried out under this contract.
- .6 Install grounding facilities and make connections.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide and install new cable TV service ducts from the property line to the communication room as shown.
- .2 Coordinate with cable TV authority to ensure availability of service and connection point.
- .3 Complete empty cable TV raceways system consists of outlet boxes, cover plates, terminal cabinets, conduits, cable troughs, pull boxes, sleeves and caps, fish wires, and service fittings.
- .4 Supply and installation of all TV wiring unless otherwise contracted with the Owner.

2 PRODUCTS

2.01 MATERIALS

- .1 Plywood backboard.
- .2 Grounding in accordance with Section 26 00 10.
- .3 Conduits: ENT, PVC, EMT type, to Section 26 05 00.
- .4 Cable troughs: to Section 26 05 00.
- .5 Junction boxes, cabinets to Section 26 05 00.
- .6 Fish wire: polypropylene type.
- .7 Outlet boxes, conduit boxes, size and fittings: to Section 26 05 00.

3 EXECUTION

3.01 INSTALLATION

- .1 Install cable TV service facilities as indicated.
- .2 Install 19 mm thick plywood backboards in each terminal location c/w cabinets. Plywood shall be fire rated.
- .3 Install grounding facilities and make connections.
- .4 Install empty raceway system, including fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute complete system.
- .5 Install all TV wiring from the utility termination point in the electrical or communication room to each TV outlet as shown. Note that, unless otherwise contracted with the Owner, the supply and installation of TV riser wiring and all other TV wiring is to be carried out under this contract.
- .6 Install grounding facilities and make connections.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide and install a complete system of empty conduits and outlet boxes only for security system as shown.
- .2 The system shall be supplied and installed under separate contract between System Supplier and the Owner.

2 PRODUCTS

2.01 MATERIALS

- .1 Plywood backboard.
- .2 Grounding in accordance with Section 26 00 10.
- .3 Conduits: ENT, PVC, EMT type, to Section 26 05 00.
- .4 Cable troughs: to Section 26 05 00.
- .5 Junction boxes, cabinets to Section 26 05 00.
- .6 Fish wire: polypropylene type.
- .7 Outlet boxes, conduit boxes, size and fittings: to Section 26 05 00.

3 EXECUTION

3.01 INSTALLATION

- .1 Install conduits roughing-in only. The conduit size shall be coordinated with the security contractor prior rough in.
- .2 Installation of equipment and devices shall be done by Security Contractor.
- .3 Install grounding wires as required.

1 GENERAL

1.01 WORK INCLUDED

- .1 Provide all labour, materials, product, equipment and service to install complete gas detection and control system as indicated on the drawings and specified in this section.
- .2 Provide and install complete networked gas detection and control system where the ventilation system will be hooked up directly to the gas detection system. The main control panel shall be as the PG-2000/EC-Gold manufactured by Enmet Canada.
- .3 Provide all work as indicated on plans and diagrams.
- .4 Vulcain, Enmet are an approved manufacturer.

1.02 REFERENCE STANDARD

- .1 All products shall be certified to UL and CSA standards.
- .2 Manufacturer shall be certified to ISO-9001-2000.

2 PRODUCTS

2.01 CONTROLLER HARDWARE

- .1 The Central Controller shall be Enmet Canada (or approved equal). The control panel must be capable of communicating digitally with the networked transmitters and relay modules through a RS-485 Modbus communication bus. The communication bus must be capable of accepting a combination of addressable transmitters, relay modules or annunciator panels of at least 2,000 feet wire length. One or more power supplies (bringing either 17-27 Vac or 24-38 Vdc) will be used to suit the power requirements of the entire gas detection network (controller and sensors).
- .2 The control panel must include a self-diagnostic function.
- .3 The control panel must be capable of grouping sensors into zones for common fan relay control and allow cross zoning to control multiple fan relays from one zone or different alarm levels.
- .4 The 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 of eight relays each.
 - .1 The 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.
- .5 The LCD display will indicate multiple alarm levels for each sensing point. The LED will also provide visual feedback in the following manner:

Normal Operation:

Alarm Level A:

Alarm Level B:

Alarm Level C:

Failure:

- .6 The standard three high/low alarm levels will be complimented with multiple levels that can be programmed into the panel at a later date.
- .7 The panel will have an audible alarm with silence ability (rated at no less than 65 dB at three feet), which will be activated at fully programmable levels. The buzzer and silence will reset when concentration levels return to normal.
- .8 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 in the event of power loss.
- .9 Table for operation between -40F and 1220F (-20 C and 50 C), the control panel must be housed in a NEMA 1 enclosure.
- .10 Typical controller accessories to be made available if required:
 - .1 Controller Accessories
 - .1 BACnet option if required:
 - .2 HOA switches
 - .3 remote audio and visual alarms
 - .2 Data logging option:
 - .1 An optional output should be available for a data logging capability to provide long-term data logging to determine trends.

2.02 SENSORA AND TRANSMITTERS

- .1 The sensor transmitters will be powered by the control panel's power output or by an external power supply rated at 17-27 Vac or 24-38 Vdc.
 - .1 Fully addressable, the gas transmitter must be capable of communicating digitally with the control panel through an RS-485 communication port.
 - .2 The gas transmitters must be installed in a true daisy chain.
 - .3 The gas transmitter will incorporate an electrochemical cell.
 - .4 The unit's sensing cell must maintain high levels of accuracy.
 - .5 The sensor must have a minimum 2 year cell life guarantee.
 - .6 The sensor must have an automatic routine internal self-gas test to verify the sensor is active, with a fault indication in the event of inactivity.
 - .7 Where sensors are used within locker/utility area's they are to be 120v, and c/w relay for interconnections to room exhaust fan(s).

-
- .2 Placed into a network configuration, the transmitter will be capable of transmitting concentrations through the control panel and may include:
 - .1 Optional relays 5A, 30 Vdc or 250 Vac (resistive load) for local activation of fans or louvers (or other equipment) to be activated at programmable set points and programmable time delays.
 - .2 The capability of sending an analog 4-20mA signal to the BMS/DDC will be an option.
 - .3 The transmitter must also be capable of incorporating an optional audible alarm rated at no less than 65Db at a distance of three feet.
 - .3 A LED status will provide gas concentration indication.
 - .1 A green LED will indicate normal operation and a separate LED will indicate fault operation.
 - .4 Protective Shield or Cage.
 - .1 Provide each sensor/transmitter with a heavy gauge fabricated metal protective shield or cage.
 - .2 The shield/cage shall enclose the sensor/transmitter to provide protection against accidental damage without affecting unit operation and allowing the unit visual display to be clearly displayed.
 - .3 Include Tamper Proof screws.
 - .5 The transmitter will be capable of operating within:
 - .1 Relative humidity ranges of 0-95% and temperature ranges of -4oF to 122oF (-20oC to 50oC).
 - .2 The transmitter must also have an optional capacity of operating at lower temperature ranges.
 - .3 The unit will be manufactured to UL and CSA 22.2 standards. 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 unless otherwise specified:

TOXIC GASES	FIRST ALARM SET POINT (TLV-TWA)	SECOND ALARM SET POINT (TLV-STEL)	THIRD ALARM SETOINT	SENSOR CELL LOCATION	RADIUS OF COVERAGE
Carbon Monoxide (CO)	25 PPM	50 PPM	100 PPM	2'11"-3'11" above the floor (900-1200mm)	Approx.40 feet (80 feet sensor to sensor) (12 meters radius)

2.03 OPTIONAL SYSTEM ACCESSORIES

.1 Audio/Visual:

- .1 Audio and/or visual alarms to be made available as required for remote alarm status on high/high alarm. Power is supplied from main controller. Include additional relays as required.

.2 Relay Module

- .1 Relay module will be powered by the controller power output or by power transformer rated at 17-27 Vac or 24-38 Vdc. Module must be capable of communicating digitally with control panel through an RS-485 communication port.
- .1 Relay module will have a possibility of 8 relays rated at no lower than 5A, 30 Vdc or 250 Vac (resistive load).
- .2 Unit will be manufactured to UL and CSA 22.2 standards. Unit will also be manufactured within an ISO 9002 production environment.

.3 Splash Guard:

- .1 Provide as required in areas that may be subject to wash down or exposure to water or water spray a protective device for the sensors/transmitters.

3 EXECUTION

3.01 INSTALLATION

- .1 The Installing contractor shall meet all requirements as per the drawings and specifications and as per the manufacturer's installation guidelines.
- .2 The installing contractor shall review with supplier the required number of control relay contacts to effectively interface the gas monitoring panel with fans, Fire Alarm Panels, HOAs and/or remote devices that may not be indicated within this scope.
- .3 Provide complete start up and commissioning service by the manufacturers authorized representative.
- .4 Provide a certificate of calibration from the manufacturer indicating sensors are calibrated as per specifications and code requirements.

3.02 WARRANTIES

- .1 The Installing contractor shall meet all requirements as per the drawings and specifications and as per the manufacturer's installation guidelines.

1 GENERAL

1.01 SUBMITTALS

- .1 Submit shop drawings for products specified in this Section.
- .2 Refer to Section entitled Electrical Work General Instructions, for general submission requirements.
- .3 The Contractor shall furnish, in all and place in operating condition all Fire Alarm and Communication equipment, accessories and material necessary to provide a single stage, fully supervised, fully addressable, zoned, non-coded, indicating, fully integrated and field programmable system complete with emergency voice communications (EVC) and fire-fighters' communications. Entire system is designed as a centralized data communication and processing system.

2 PRODUCTS

2.01 FIRE ALARM SYSTEM GENERAL FEATURES:

- .1 All equipment shall be listed by Underwriters Laboratories of Canada and shall include, but not be limited to, a central equipment Control Unit, Central Alarm Control Facility (CACF), Alarm Initiating Devices, Alarm Sounding Devices, Auxiliary Devices and Telephone Devices, all located as shown on the plans and wired in accordance with the manufacturer's recommendations, to form a complete and workable system as hereinafter specified.
- .2 System components to be listed as products of a single manufacturer under appropriate category, by Underwriter's Laboratories of Canada and bear ULC label. System components and work in conjunction with system installation to meet specific application requirements of local governing authorities, codes, standards, regulations and requirements of following:

CAN/ULC-S524, Standard For Installation Of Fire Alarm Systems;

CAN/ULC-S527, Control Units For Fire Alarm Systems;

CAN/ULC-S537, Standard For Verification Of Fire Alarm Systems;

local governing building code;

local governing electrical code;

local governing building permit applications for approvals;

other requirements of local governing authorities.
- .3 All equipment furnished under this Specification shall be "Solid State", programmable system as manufactured by Mircom, Chubb Edwards, Siemens, Notifier, Simplex, or approved equal. System shall operate as described in the manufacturer's operations manual.
- .4 The Fire Alarm Control unit(s) shall be of Modular construction for ease of expansion and servicing and shall be of solid state design. It shall supervise all wiring to alarm initiating devices, annunciator lamps and filaments, and battery connections for breaks or grounds. 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.
- .5 The Fire Alarm Control unit shall contain all common function controls, including "LAMP TEST",

"TROUBLE SILENCE" and "AUXILIARY DISCONNECT" switches and "AC ON", "TROUBLE", "LAMP FAIL", "GROUND FAULT", "AUXILIARY OPERATED DISCONNECTED" lamps.

- .6 A momentary signal silence pushbutton shall be provided so that the alarm signals may be silenced before actuating device has been restored to normal (this 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). The silencing of alarm signals from one zone shall not prevent subsequent alarms from being received from any other zone.
- .7 The amplifiers 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. A standby amplifier per channel shall automatically provide power to ensure uninterrupted system operation. All amplifiers shall remain fully supervised during 'AC' power loss. All amplifiers shall use computer grade solid state components, and shall be fully integrated with the system
- .8 Should power failure occur, standby power for the fire alarm and complete audio system shall be provided by connection to the Emergency Generator Main Distributor Panel and to rechargeable batteries capable of maintaining the total audio load for thirty minutes. The batteries shall be maintained fully charged by a supervised variable rate charger capable of recharging the batteries to 70% of rated capacity in 12 hours.
- .9 System to include but not be limited to following components:
 - .1 Central Alarm and Control Facility (CACF) (also known as Fire Command Centre (FCC));
 - .2 central processing units (CPU);
 - .3 EVC and paging system components;
 - .4 2-way supervised fire fighters' communication system;
 - .5 transponders/data gathering panels (DGP);
 - .6 initiating devices (pull stations, heat/smoke/flame detectors);
 - .7 alarm indicating devices (speakers, horns, strobes);
 - .8 smoke control;
 - .9 interfaces and interconnections to auxiliary building systems;
 - .10 Wiring in conduit and/or fire rated cables.

2.02 CENTROL ALARM CONTROL FACILITY (CACF)

- .1 CACF is a dedicated location or room within facility, for centralized control and monitoring of system. Equipment provided to include but not be limited to:
 - .1 main control panel/transponder;
 - .2 active annunciators and passive graphic displays;
 - .3 system printer;
 - .4 evacuation annunciation and communication (EVAC) facilities for relocation of building occupants and fire fighter deployment during an emergency condition;

-
- .5 general paging components;
 - .6 controls for air handling equipment, master electromagnetic locks, and other interconnected equipment.
- .2 Controls and indicators for integrated system are provided in wall mounted panels. Controls and LED indicators include but are not limited to following:
- .1 operators annunciator panel/LCD display unit;
 - .2 emergency voice communication;
 - .3 fire-fighters' telephone communication;
 - .4 bypass switches;
 - .5 sprinkler system annunciation;
 - .6 electromagnetic lock control consisting of master reset switch and release switch;
 - .7 elevator control switches;
 - .8 smoke control;
 - .9 system printer.
- .3 Operators display unit to be LED/LCD type annunciator panels interconnected with controls. Controls are mounted in cabinet with a door and clear glass viewing window, such that indications and operating instructions are clearly visible. Door to be complete with a lock and two (2) keys. Operator's interface panel includes:
- .1 multi-character (8 lines X 21 characters) alphanumeric back-lit LCD display;
 - .2 common alarm led and push-button acknowledge switch;
 - .3 common supervisory led and push-button acknowledge switch;
 - .4 common trouble led and push-button acknowledge switch;
 - .5 signal silence switch;
 - .6 system reset switch;
 - .7 power on indicator;
 - .8 minimum five (5) password protected programmable function keys/LEDs.
- .4 Control Switches and LEDs to be included for following functions:
- .1 one (1) switch for each speaker circuit zone to allow emergency voice communication selection;
 - .2 one (1) green LED for each speaker circuit zone to indicate voice communication ready-to-talk;
 - .3 one (1) amber LED for each speaker zone to indicate a trouble condition on either of speaker circuits on that zone;

-
- .4 one (1) switch to allow for manual evacuation;
 - .5 one (1) switch to allow for all talk;
 - .6 system master handset microphone;
 - .7 one (1) switch for each EMERGENCY TELEPHONE CIRCUIT to allow 2 way communication selection;
 - .8 one (1) green LED for each emergency telephone circuit to flash on a call in condition, and to remain on steady when zone is selected;
 - .9 one (1) amber LED for each emergency telephone circuit to indicate a trouble condition on circuit;
 - .10 one EVAC switch for each floor;
 - .11 one EVAC switch for each building; (as applicable);
 - .12 complex wide EVAC switch;
 - .13 system reset switch;
 - .14 signal silence switch;
 - .15 fan bypass switches and LEDs;
 - .16 elevators bypass switches and LEDs;
 - .17 electromagnetic lock release/reset switches.
- .5 Common control indicators include but not be limited to:
 - .1 trouble buzzer;
 - .2 trouble LED;
 - .3 trouble silencing switch;
 - .4 power ON indicator.
 - .6 System controls to include circuitry to transmit an alarm signal to device(s) provided by others (Owner's arranged monitoring company) to send alarm signal to Fire Department or to an outside private protection company, in accordance with CAN/ULC-S561.
 - .7 It shall be completely modular in construction and shall include:
 - .1 A supervised hand held dynamic microphone with two pre-amplifiers, with "Press to Talk" switch, which when operated shall send a preannounce tone over selected speakers (subsequent to the mandatory alarm sound period). The press to talk switch shall momentarily interrupt any alarm sounding tone to allow voice transmission to selected alarm zones. The microphone module shall include L.E.D. indicators to visually display the sound output level (up to eight audio busses may be employed in the system), and a lamp to indicate when alarm tone is selected and an All Call, Page and General Evac switches.
 - .2 Paging Zone selector with "Individual Zone" page selection switches. The selection switches shall be of the momentary contact type with an LED indicator to provide a visual

indication of operation. Each zone shall have a fault indication.

- .3 A supervised master handset with "Call In" buzzer and "Busy Signal" tone generator for use in communication with Remote Handsets.
- .4 Handset zone selector modules with momentary contact type selection switches having visual indicators. Each zone shall be equipped with a flashing "Call-In" lamp which changes to steady when answered and a separate fault indication.
- .5 The handset shall be moulded of high impact red ABS plastic and shall have retractable cord, supervised against tampering. The handset shall be installed in a heavy gauge steel enclosure flush-mounted in finished areas, with both key lock and break-glass access, and shall have an enclosed raceway to separate the wiring from operating areas. The hinged faceplate shall be finished in baked red enamel and clearly labelled.
- .6 Fire alarm 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.
- .7 A common "Trouble" annunciator module with a solid state sounding device and automatically restoring silencing button. Individual fault lamps shall be provided for the "Amplifier System", "speaker Lines", "Microphone", "Master Handset", "Handset Lines", "Tone Generator", "Fire Master Handset", "Handset Lines", "Tone Generator" "Fire Alarm System" ("Battery Charger"). A 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.
- .8 A Fan Control module(s) containing electronic 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.

2.03 STANDBY BATTERY AND CHARGER

- .1 The standby battery and charger shall be an automatic rate compensated unit capable of recharging the batteries to 70% capacity within 12 hours. The unit shall be of sufficient capacity to operate the entire system for 24 hours with power remaining to sound the alarms for 30 minutes. The batteries shall be sealed lead acid or as approved, enclosed in a steel cabinet.

2.04 WATERFLOW ALARM SWITCH

- .1 Waterflow switches shall be Potter type. Units shall have pneumatic retards adjustable from 0 to two (2) minutes, provided by Div. 15 Sprinkler Contractor.

2.05 SPRINKLER SHUT-OFF VALVES - SUPERVISORY SWITCHES

- .1 The O. S. & Y. valves as indicated shall be monitored by Potter type valve supervisory switches, provided by Sprinkler Contractor.

2.06 MANUAL PULL STATION

- .1 Addressable manual pull stations. They shall be red metal, with clearly visible break-glass. One required at each exit door

2.07 AUTOMATIC HEAT DETECTORS

- .1 Addressable automatic heat detectors shall be of the combination rate of rise and fixed temperature type. When actuated they shall give visual evidence of such operation. Heat

detectors shall be 135oF. and 190oF. as shown on drawings.

2.08 AUTOMATIC SMOKE DETECTORS:

- .1 The products of combustion area detectors shall operate on the photoelectric principle and shall be activated by the presence of products of combustion. The detector shall be listed by ULC.
- .2 A visual indication of an alarm shall be provided by a latching light emitting diode (LED) on the detector, which may be seen at ground level. A visible alarm signal shall be capable of remote LED annunciation.

2.09 FIRE SIGNS

- .1 "FIRE DO NOT ENTER" custom nomenclature, illuminated, flashing, 24 volt D.C., ULC listed and labelled warning sign with slim line satin aluminium housing and with black face and red letters. Signs to be equipped with upper and lower rows of long life LED illuminators rated for at least 100,000 hour life, flasher, and Lexan guard. Minimum letter size to be "FIRE" – 2" high, "DO NOT ENTER" – 1-1/2" high. Lettering not to be visible until sign is energized.

2.10 VISUAL NOTIFICATION APPLIANCES (STROBE LIGHTS)

- .1 Visual notification appliances to be ULC listed and labelled, equal to Wheelocks Series RSS, synchronized, suitable for intended application with input polarized for standard reverse polarity supervision by fire alarm controls and designed with zero inrush current at 15, 30 and 110 candela intensities. Exact intensities to be to fire authority requirements and as approved by Consultant. Exterior mounted units or units mounted in non-climate controlled areas to be equal to type RSSWP weatherproof type strobes with weatherproof backbox.

2.11 DUCT DETECTION:

- .1 Duct type smoke detector units with features as follows:
 - .1 addressable photoelectric detector features;
 - .2 duct air sampling tube of suitable required length;
 - .3 magnetic activated test switch;
 - .4 status LEDs;
 - .5 form C auxiliary alarm relays;
 - .6 remote alarm indicator assembly with LED type lamp and single gang stainless steel faceplate;
 - .7 remote test station for detectors in locations not easily accessible to test.
- .2 Duct housing assembly to consist of air tight housing mounted on side of duct. This housing to contain detector base into which photoelectric detector head is inserted.
- .3 For units located within ductwork as shown on drawings and for units within air intake ductwork provide ULC listed and labelled weatherproof housing complete with integral heater and thermostat control with alarm contacts for monitoring and annunciation of low temperature. Provide wiring in conduit back to transponder/control panel.

2.12 END-OF-LINE RESISTORS

- .1 End-of-line resistors for standard alarm and signalling circuits to be sized to ensure correct supervisory current flows in each circuit.
- .2 End-of-line resistors to be mounted on a stainless steel plate for mounting on a standard single gang box and bear ULC label.

2.13 ISOLATORS

- .1 Isolators to be provided in accordance with code requirements and installed as per system manufacturer's requirements to isolate/monitor zones, loops, group of devices within building and between buildings.

2.14 SELF CONTAINED 120 V.A.C. ALARMS:

- .1 Smoke alarms in suites shall be installed in conformance with the latest OBC requirements and in conformance with CAN/ULC-S553.
- .2 The products of combustion self-contained smoke alarms in suites shall have two ionization chambers. Detectors shall have a built-in buzzer with 85 db sound level. A 120V A.C. supply circuit shall be provided for the detectors. These detectors may be interconnected to maximum of eight detectors.
- .3 The smoke alarm shall contain a manually operated silencing device within the circuitry of the smoke alarm as per the latest OBC requirements.
- .4 The smoke alarm shall have a permanent connection to an electrical circuit with no disconnect switch between the over current device and the smoke alarm.
- .5 The smoke alarm shall be provided with a battery as an alternative power supply that can continue to provide power to the smoke alarm for a period of not less than seven days in the normal condition, followed by 4 minutes of alarm as per the latest OBC requirements.
- .6 The smoke alarm shall have a visual signalling component conforming to the requirements in 18.5.3. (Light, Colour and Pulse Characteristics) of NFPA 72, "National Fire Alarm and Signalling Code". The luminous intensity for visual signalling components installed in sleeping rooms are required to be minimum of 175 cd.

2.15 AUDIBLE APPLIANCES:

- .1 Alarm signal devices shall be re-entrant type speakers housed in die-cast aluminum frames and grilles finished in high gloss red enamel. The housing shall contain a short rapidly-flared, folded, re-entrant type horn and will reasonably protect the horn mechanism from vandalism.
- .2 In all finished areas, as shown on the drawings, alarm signals shall be cone type speakers protected by baffles with light beige acrylic finish. The speakers shall be complete with a flush back box and 4" or 8" in diameter as indicated on the plans. They shall be tapped at 1 watt in most areas and at 1/4 watt in small enclosed areas and suites.
- .3 In suite where applicable the speakers shall be capable to be silenced as required by codes or the equipment shall be in accordance with OBC 3.2.4.19 (13). Audible signals shall be wired in 2 class 'A' configuration (one for the corridors and one for the suites).

2.16 ANNUNCIATOR:

-
- .1 The annunciator shall provide at least one supervised lamp indication for each supervisory circuit or detection circuit. The annunciator shall contain a trouble buzzer and trouble lamp. The annunciator shall be flush mounted in the main panel.

3 EXECUTION

3.01 WIRING:

- .1 The power supply to the fire alarm system shall be 120 volts, 60 Hz of adequate capacity taken from the building service emergency distribution system. This shall be through an approved over current device identified in a permanent manner by the words "Fire Alarm System" on a red lamacoid nameplate.

- .2 All wiring shall be fire wiring installed in conduit and conform with the requirements of the Canadian Electrical Code, Part 1 and applicable Provincial Codes. Wiring shall be sized in accordance with Class 2 requirements except for AC signal circuits where the wiring 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.

- .3 Conductors shall be solid copper. The minimum size of any conductor shall be:

#18 AWG for 3 or 4 conductors in a cable;

#14 AWG for 1 or 2 conductors in a cable or individual conductors in conduit.

In no case shall the wire resistance in these circuits exceed 50 ohms.

For audible signal circuits:

#14 AWG for 1 or 2 conductors in a cable, on individual conductors in conduit.

#18 AWG for 3 or 4 conductors in a cable.

In no case shall the voltage drop to any signal exceed 10%.

Temperature rating of cable shall be 90 degree C. min.

Consult the manufacturer of the system for wiring details.

3.02 SYSTEM VERIFICATION:

- .1 The manufacturer's representative shall make an inspection per CAN ULC-S537. of the fire alarm equipment including those components necessary to the direct operation of the system such as: manual and automatic alarm initiating devices and alarm signalling devices and controls (whether or not manufactured by the manufacturer). The inspection shall consist of an examination of such equipment for the following:
 - .1 That the type of equipment installed is that designated by the Engineer's Specification.
 - .2 That the wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.

-
- .3 That equipment has been installed in accordance with the manufacturer's recommendations and that all signalling and detection devices have been operated and tested.
 - .4 That 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 inspecting officials.
 - .2 The manufacturer shall supply to the Electrical Contractor reasonable amounts of technical information with respect to any changes necessary to conform with work to paragraphs 1, 2, 3, and 4 above, as well as programming time.
 - .3 During the period of inspection by the manufacturer, the Electrical Contractor shall make available to the manufacturer, electricians as designated by the manufacturer.
 - .4 To assist the Electrical Contractor in preparing his bid, the manufacturer shall indicate the number of hours necessary to complete this inspection prior to closing of all tenders. On completion of this inspection when all of the previously mentioned have been complied with, the manufacturer shall issue to the Consulting Engineer:
 - a) A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.
 - b) A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.
 - c) All costs involved in this inspection both from the manufacturer and the Electrical Contractor's work, shall be included with the electrical Contractor's total tender price.

3.03 WARRANTIES

- .1 The complete fire alarm system shall have a 2 year guarantee starting on the date of official acceptance.

1 GENERAL

1.01 SUBMITTALS

- .1 Submit shop drawings for products specified in this Section.
- .2 Refer to Section entitled Electrical Work General Instructions, for general submission requirements.

2 PRODUCTS

2.01 SELF CONTAINED 120 V.A.C. ALARMS:

- .1 Smoke alarms in suites shall be installed in conformance with the latest OBC requirements and in conformance with CAN/ULC-S553.
- .2 The products of combustion self-contained smoke alarms in suites shall have two ionization chambers. Detectors shall have a built-in buzzer with 85 db sound level. A 120V A.C. supply circuit shall be provided for the detectors. These detectors may be interconnected to maximum of eight detectors.
- .3 The smoke alarm shall contain a manually operated silencing device within the circuitry of the smoke alarm as per the latest OBC requirements.
- .4 The smoke alarm shall have a permanent connection to an electrical circuit with no disconnect switch between the over current device and the smoke alarm.
- .5 The smoke alarm shall be provided with a battery as an alternative power supply that can continue to provide power to the smoke alarm for a period of not less than seven days in the normal condition, followed by 4 minutes of alarm as per the latest OBC requirements.
- .6 The smoke alarm shall have a visual signalling component conforming to the requirements in 18.5.3. (Light, Colour and Pulse Characteristics) of NFPA 72, "National Fire Alarm and Signalling Code". The luminous intensity for visual signalling components installed in sleeping rooms is required to be minimum of 175 cd.
- .7 The smoke alarm and CO detector shall be in the same device.

3 EXECUTION

3.01 WARRANTIES

- .1 The complete fire alarm system shall have a 2 year guarantee starting on the date of official acceptance.