

**ISSUED FOR TENDER**

**MECHANICAL & ELECTRICAL  
SPECIFICATIONS FOR:**

**Brownsville Community Centre Fire  
Hall Back-up Generator  
292244 Culloden Line  
Tillsonburg, ON**

**V&R PROJECT #25-069  
March 31, 2026**

**Vanderwesten & Rutherford Associates Inc.**

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## **GENERAL**

### **1.1 GENERAL REQUIREMENTS**

- .1 Read and meet requirements of:
  - .1 The Contract CCDC 2-2020, Stipulated Price Contract as amended.
  - .2 Division 01 requirements and documents referred to therein.
- .2 Section 20 01 01 applies to and governs the work of all Sections of Mechanical Divisions 20, 21, 22, 23 and 25.
- .3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the work.
- .4 The specifications are integral with the drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
- .5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the costliest arrangement.

### **1.2 WORK INCLUDED**

- .1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .2 Cutting and patching of new or existing work.
- .3 Identification of equipment, piping, ductwork, valves and controllers.
- .4 Concrete equipment bases, housekeeping pads, sump pits and trenches.
- .5 Take such measures and include in Bid Price for the proper protection of the existing building and its finishes at all times during alterations and construction of the new addition. Coordinate this protective work with all trades.
- .6 Refer to Mechanical/Electrical Equipment Schedule for extent of wiring and electrical characteristics.
- .7 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval before starting and/or returning to operation.

### **1.3 RELATED WORK**

- .1 Power wiring, conduit and connections for motors under Mechanical Divisions 20, 21, 22, 23 will be by Electrical Division 26.
- .2 Power wiring, conduit and connections to variable frequency drives for motors under Mechanical Divisions 20, 21, 22, 23, 25 will be by Electrical Division 26. Wiring and connections from VFD to motors under Mechanical Divisions 20, 21, 22, 23, 25 will be by Electrical Division 26.
- .3 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under Mechanical Divisions 20, 21, 22, 23, 25.
- .4 Painting of exposed piping and ductwork other than for identification will be supplied under Division 22.
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches will be provided under Division 26.

### **1.4 METRIC AND IMPERIAL MEASUREMENTS**

- .1 Both Imperial and Metric units of measurement are indicated in the Mechanical Specification.

### **1.5 SUBMITTALS**

- .1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction and obtain two (2) copies of approved drawings for retention by Consultant before commencement of work under Mechanical Divisions 20, 21, 22, 23, 25.

- .2 Shop Drawings: Prepare and submit one (1) electronic copy of shop drawings of major equipment items (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant will return one electronic copy, marked with comments and his review stamp as he deems appropriate. Prepare the necessary number of copies of the returned set and distribute to the Owner, the Prime Consultant, the General Contractor, the site, and to subcontractors and suppliers.
  - .1 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities, and performance. Before submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by Consultant, has been returned to Contractor.
  - .2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.
  - .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
  - .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted:

*"This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades."*
- .3 Composite Wiring Diagrams: Prepare and submit one (1) copy of complete composite wiring diagrams of each specific mechanical system. Indicate all electrical equipment and wiring, both internal and external, for review and coordination of trades.
- .4 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they meet the requirements of those documents (eg. NFPA-Standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:
  - .1 Description of the system (description and type),
  - .2 Description of the tests conducted and results observed, including re-testing, where necessary,
  - .3 Description of any corrective measures undertaken,
  - .4 Description of materials used (pipe and fittings),
  - .5 List of witnesses for each test conducted,
  - .6 Date system left ready for service,
  - .7 Signature of Installing Contractor.
- .5 Directories & Schematics
  - .1 Submit a copy of a neat directory indicating the valve number, related service, and location of each valve under Mechanical Divisions 20, 21, 22, 23, 25.
  - .2 Submit five (5) copies of system control schematics for each mechanical system indicating relative locations of equipment and control devices.
  - .3 Provide one (1) copy of each directory/schematic under glass in a neat polished 18" x24" (460 mm x 610 mm) metal frame, complete with mounting clips.
- .6 Maintenance Data and Operating Instructions
  - .1 Submit prior to application for Substantial Performance, three (3) copies of Operation and Maintenance Manuals, consolidated in black hardcover 3 "D" ring binders, each binder sized to include 25% spare space for future data, and one (1) PDF format on DVD disc clearly marked and labelled accordingly.
  - .2 Ensure the binder spines have typewritten lettering as follows:

OPERATION & MAINTENANCE MANUAL  
For  
**SWOX – Brownsville Generator**  
[Insert date of submission]

[Insert Division Title]

- .3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, general contractors, architect and Consultant. Include special telephone numbers for service departments on normal and emergency call basis.
- .4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item. Shop drawing or product data sheet to be "Reviewed" or "Reviewed As Modified" with manufacturer's/supplier's name, telephone, email address, and the contact information for local source of parts and service.
- .5 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.
- .6 Ensure operating instructions include the following:
  - .1 General description of each mechanical system.
  - .2 Step by step procedure to follow in putting each piece of equipment into service.
  - .3 Schematic control diagrams for each separate mechanical system, control thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating settings for each control device on these diagrams.
  - .4 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches and relays.
  - .5 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.
- .7 Ensure maintenance instructions include the following:
  - .1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.
  - .2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
  - .3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.
  - .4 Include Owner's equipment numbers on all equipment submitted.
  - .5 Balancing and testing reports.
  - .6 Copy of valve directory.
- .7 As-Built Records:
  - .1 Prepare and submit complete as-built records before Substantial Performance of the Contract. Refer to Division 1 for requirements.
- .8 Requests for Start-up:
  - .1 Obtain permission from the Owner to start-up any item of equipment, system or service installed new or previously shut-down. Refer to Division 1 for additional requirements.

## 1.6 QUALITY ASSURANCE

- .1 Meet the requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.
- .2 Ensure materials supplied under this Division meet the requirements and recommendations or better of applicable standards of the following:
  - .1 AABC Associated Air Balance Council
  - .2 AMCA Air Moving and Conditioning Association
  - .3 ANSI American National Standards Institute
  - .4 ASA American Standards Association
  - .5 ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
  - .6 ASME American Society of Mechanical Engineers
  - .7 ASSE American Society of Sanitary Engineers
  - .8 ASPE American Society of Plumbing Engineers

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|-----|--------|---|
| .9  | ASTM   | American Society of Testing and Materials                       |
| .10 | AWWA   | American Water Works Association                                |
| .11 | CAN2   | National Standard of Canada (Published by CGSB)                 |
| .12 | CAN3   | National Standard of Canada (Published by CSA)                  |
| .13 | CGSB   | Canadian General Standards Board                                |
| .14 | CSA    | Canadian Standards Association                                  |
| .15 | EEMAC  | Electrical & Electronic Manufacturer's Association of Canada    |
| .16 | NBC    | National Building Code of Canada                                |
| .17 | NEBB   | National Environmental Balancing Bureau                         |
| .18 | NFPA   | National Fire Protection Association                            |
| .19 | NEMA   | National Electrical Manufacturers Association                   |
| .20 | OBC    | Ontario Building Code   |
| .21 | OFC    | Ontario Fire Code   |
| .22 | OFM    | Ontario Fire Marshall   |
| .23 | SMACNA | Sheet Metal & Air Conditioning Contractors National Association |
| .24 | TIAC   | Thermal Insulation Association of Canada                        |
| .25 | ULC    | Underwriter's Laboratories of Canada Ltd.                       |
| .26 | UL     | Underwriter's Laboratories (including cUL)                      |
- .3 Use latest editions and amendments in effect on date of Bid call subject to requirements of OBC.
- .4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.
- .5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.
- .6 All welding and brazing shall be executed by certified welders in accordance with registered procedures.
- .7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

### 1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under Mechanical Divisions 20, 21, 22, 23, 25 that are received at the site by respective Division.

### 1.8 JOB CONDITIONS

- .1 Visit site and examine existing conditions which may affect work of this Mechanical Divisions 20, 21, 22, 23, 25.
- .2 Examine all Contract Documents to ensure that work of respective Division may be satisfactorily completed.
- .3 Notify Consultant upon discovery of conditions which adversely affect work of Mechanical Divisions 20, 21, 22, 23, 25. No allowance will be made after letting of contract for any expenses incurred through failure to do so. No extras will be granted due to lack of a thorough preliminary investigation of the site.
- .4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted in the Bid.

### 1.9 WARRANTY

- .1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .2 Make submissions necessary to register product warranties to the benefit of the Owner.
- .3 Submit to Consultant, before Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.
- .4 All extended warranties specified in mechanical work Sections of the Specifications are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but

direct from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

## 1.10 DEFINITIONS

- .1 The following are definitions of words found in this specification and on associated drawings under this Division:
  - .1 "Concealed"-locations hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
  - .2 "Exposed"-mechanical work normally visible to building occupants.
  - .3 "Furnish"-(and its derivatives) has the same meaning as the term "Supply".
  - .4 "Install"-(and its derivatives) - receive, store and handle at the site, mount and support and connect all required services. Includes adjustments and calibration, testing, commissioning inspection by authorities having jurisdiction and documentation.
  - .5 "Provide" -(and its derivatives) - supply, install in place, connect the associated required services ready for operation, adjust and calibrate, test, commission, warrant, and document. Includes inspection by authorities having jurisdiction.
  - .6 "Supply"-(and its derivatives) purchase and deliver to the site for installation. Include submittals, manufacturer's field inspection and warranty.
  - .7 "Wet" - locations exposed to moisture, requiring special materials and arrangement.
  - .8 "Consultant"-means the Architect or Consulting Engineer who has prepared the Contract.
  - .9 "Owner"-means Building Owner as defined in the Contract or the Owner's designated representative.
  - .10 "Governing Authority" and/or "Regulatory Authority" and/or "Municipality Authority"-means all government departments, agencies, standards, rules and regulations that apply to and govern the mechanical work and to which the work must adhere.
  - .11 "O&M"-means Operating and Maintenance.
- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "noted", "listed", or "noted" on the drawings.
- .3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is approved by, "satisfactory", "as directed by", "submit", "permitted by", "inspected by", the Consultant.

## 1.11 SCHEDULING

- .1 Refer to Section 01 SCHEDULING OF THE WORK.
- .2 Coordinate work of all Sections of Mechanical Divisions 20, 21, 22, 23 and 25 with other trades and assist in the development of the Phasing Strategy.
- .3 Refer to O.B.C. Division C, Part 1, Subsection 1.3.3 Occupancy of Unfinished Building
- .4 Refer to Article 8.0 of Section 01120.
- .5 Where occupancy of a part of the work is required before completion of the entire project, ensure that equipment, systems and services that serve the areas to be occupied are completed, tested and fully operational 2-weeks before scheduled turn over and ensure that reports, certificates and documentation are submitted at that time.

## PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- .1 Ensure materials and equipment provided under Mechanical Divisions 20, 21, 22, 23, 25 are new and free from defects and bear labels of approval as required by codes referred to each Division and/or by inspection authorities.
- .2 Ensure apparatus and equipment provided under Mechanical Divisions 20, 21, 22, 23, 25 bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.

- .3 Ensure manufacturers and suppliers of equipment or materials under Mechanical Divisions 20, 21, 22, 23, 25 determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site before doing so.
- .4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

## 2.2 ACCEPTABLE PRODUCTS

- .1 First item named or specified by catalogue number meets specifications regarding performance, quality of material and workmanship, and is acceptable to the Consultant.
- .2 Items, other than first named, meeting specifications regarding quality of materials and workmanship are acceptable to the Consultant, only, if they also meet performance and/or capacities specified and can be accommodated within the space allotted.
- .3 General approval indicated by inclusion of other manufacturers named is subject to final review of shop drawings, performance data and test reports.

## 2.3 EQUIVALENTS AND ALTERNATIVES

- .1 Suppliers wishing approval for additional equipment items as equivalent to those specified must submit complete description, technical and performance data to Consultant at least five (5) working days before Bid closing date. Such equivalent equipment, if accepted, meet the requirement specifications with regards to all details, accessories, modifications, features, and performance. Deviations from specifications must be stated in writing at time of submission for approval.
- .2 Bid Prices shall include only products specified or approved equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of general contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with unsolicited alternative proposals such as larger motor starters, larger power feeders, and space revisions to associated equipment, controls, etc. shall be included in alternative price. Prior approval by Consultant is not required for unsolicited alternative proposals.
- .3 Where the Contractor uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.

## 2.4 SUBSTITUTIONS DURING PROGRESS OF WORK

- .1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other manufacturers may be permitted by Consultant.
- .2 Apply, in writing, to Consultant for substitution of any products, indicating the following:
  - .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
  - .2 Reason for substitution.
  - .3 Any revisions to the contract price made necessary by substitution.
  - .4 Any revisions to the contract time made necessary by substitution.
  - .5 Any revisions to layout, arrangement or services made necessary by substitution.
- .3 No substitutions will be permitted without written authorization from the Consultant.

## 2.5 CONSULTANT'S REVIEW

- .1 The consultants will review and evaluate unsolicited alternatives and substitutions proposed by the

Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations.

- .2 The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

## **EXECUTION**

### **3.1 RELATIONSHIP WITH OTHER TRADES**

- .1 Cooperate with other trades whose work affects or is affected by work of Mechanical Division to ensure satisfactory installation and to avoid delays.
- .2 Provide materials to be built-in, such as sleeves, anchors, and inserts, together with templates and/or measurements, promptly when required by other trades.
- .3 Provide structural supports for equipment to be mounted on or in walls, supported above floors and/or suspended from the structure.

### **3.2 INSTALLATION REQUIREMENTS**

- .1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings before installation.
- .2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.
- .3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.
- .4 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement. Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will be considered as part of the equipment installation.
- .5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.
- .6 Provide suitable shielding and physical protection for devices.
- .7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.
- .8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.
- .9 Do not use power activated tools without written permission of the Consultant. Use them in accordance with the Owner's health and safety policies.
- .10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural drawings or as directed by the Consultant.

### **3.3 CONTRACT DRAWINGS**

- .1 The drawings of Mechanical Divisions 20, 21, 22, 23, 25 are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given. No allowance will be made for additional costs arising from the failure to obtain proper clarification of conflicting information before Bid.
- .2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes where required to accommodate structural conditions, (beams, columns, etc.). Obtain Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 10 feet (3 Metre) in any direction without a change to the contract price. The Consultant reserves the right to revise the locations of equipment and outlets within any given room without altering the Contract Price provided Notice of Change is

- given before rough-in.
- .5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the documents of Mechanical Divisions 20, 21, 22, 23, 25.
  - .6 The drawings of Mechanical Divisions 20, 21, 22, 23, 25 are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and specifications as shown on the mechanical documents. If there is a difference in quantity between the architectural and mechanical drawings, base the contract price on the greater quantity. No adjustment to the Contract Price will be allowed to complete the work.
  - .7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

### **3.4 CONSTRUCTION DRAWINGS**

- .1 Prepare fully dimensioned drawings showing devices, fixtures, equipment, outlets, sleeves and openings through structure. Indicate locations and weights on load points.
- .2 Prepare fully dimensioned construction drawings of products and services suitably interfaced with work of the sub-trades, in mechanical rooms, service and ceiling spaces, and other critical locations. Coordinate the work with other divisions. Base drawings on reviewed shop drawings and latest architectural drawings. Indicate details pertaining to the following: access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevation of pipes, ducts, conduits.
- .3 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.
- .4 Submit construction drawings to other Divisions. Provide one (1) print copy and one (1) electronic copy of construction drawings to the Consultant for record purposes.
- .5 Submit construction drawings before commencement of work.

### **3.5 RECORD DRAWINGS**

- .1 Maintain project "as-built" record drawings. Identify each set as "Project Record Copy".
- .2 Record deviations from contract documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of Consultants documents.
- .3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.
- .4 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.
- .5 Transfer records from the "Project Record Copy" to a Memory/USB stick in Autocad format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.
- .6 Submit the "Project Record Copy" on one or more Memory/USB stick with PDF prints of each drawing to the Consultant at the time of Substantial Performance.

### **3.6 USE OF EQUIPMENT**

- .1 For the duration of this contract, do not use any piece of equipment provided under this contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the Owner and Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to begin.
- .2 Where specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution systems or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

### **3.7 SPECIAL TOOLS AND SPARE PARTS**

- .1 Within 30 days of award of contract, prepare a complete itemized list of special tools and spare parts and submit to Consultant for review. List will be used as a checklist and should include provision for sign off by the Owner on receipt.
- .2 On completion of the project furnish spare parts to the Owner as follows:
  - .1 One set of mechanical seals for each pump.
  - .2 One casing joint gasket for each pump.
  - .3 One glass for each gauge glass installed.
  - .4 One set of v-belts for each piece of machinery.
  - .5 One set of new filters for each filter bank installed.
- .3 Identify spare parts containers as to contents and replacement parts number.
- .4 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .5 Furnish one grease gun and adaptors to suit different types of grease and fittings.

### **3.8 EXTRAS AND CREDITS**

- .1 Accompany all price submissions requested by Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
  - .1 Materials, quantities and unit costs including any applicable contractors' trade discount clearly identified.
  - .2 Labour hours and unit costs.
  - .3 Total materials and labour costs.
  - .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

### **3.9 EQUIPMENT AND SYSTEM OPERATING AND MAINTENANCE DEMONSTRATION AND TRAINING**

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Instruct and familiarize Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.
- .3 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.
- .4 Ensure each instruction period includes, but is not limited to the following;
  - .1 Demonstration of the proper operating procedures for each item of equipment,
  - .2 Explanation of the purpose and function of all safety devices provided,
  - .3 Demonstration of all measures required for safe and proper access for operation and maintenance.
- .5 Provide a period of follow-up instruction (on two occasions) approximately one month after completing Owner's instruction to clarify and reinforce earlier instructions.
- .6 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant before substantial completion of the project.

**END OF SECTION**

## **1 GENERAL**

### **1.1 GENERAL REQUIREMENTS**

- .1 Comply with General Requirements of Section 20 01 01.

### **1.2 COMMON WORK RESULTS**

- .1 Section 20 05 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

### **1.3 REFERENCE STANDARDS**

- .1 Provide all work in accordance with requirements of Regulatory Agencies and meet requirements of:
  - .1 Local and district by-laws, regulations and published engineering standards.
  - .2 Ontario Building Code as amended,
  - .3 Ontario Gas Utilization Code as amended
  - .4 Regulations for Construction Projects under The Occupational Health and Safety Act.
  - .5 Fire Code made under the Fire Marshal's Act.
- .2 Meet requirements of the following CSA Standards:
  - .1 CSA B242 Groove and Shoulder Type: Mechanical Pipe Couplings.
  - .2 CSA W48 series Electrodes.
  - .3 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
  - .4 CAN/CSA-W117.2, Safety in Welding, Cutting and Allied Processes
  - .5 CAN1-B149.1 Natural gas and propane installation code.
- .3 Meet the requirements of the following National Research Council Canada publications:
  - .1 National Building Code of Canada and Supplements to National Building Code of Canada
  - .2 National Fire Code of Canada.
  - .3 Canadian Plumbing Code.
- .4 Meet the requirements of the following American Welding Society (AWS) Standards:
  - .1 AWS C1.1, Recommended Practices for Resistance Welding.
  - .2 AWS Z49.1, Safety Welding, Cutting and Allied Process.
  - .3 AWS W1, Welding Inspection.
- .5 The above documents or portions thereof are referenced within the work of Mechanical Divisions 21, 22 and 23 and shall be considered part of the requirements of this document as though fully repeated herein.

### **1.4 QUALIFICATIONS**

- .1 Firestop Sealant Manufacturer: Company specializing in manufacture of sealants with minimum three years documented product development, testing, and manufacturing experience.
- .2 Firestop components and assemblies shall be ULC listed and tested in accordance with ULC S115 Standard Method of Fire Test for Firestop Systems.

### **1.5 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 20 01 01.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Transport, handle, store, and protect products. Refer to Division 01 requirements as well.
- .2 Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

### **1.7 WASTE MANAGEMENT & DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Division 01 Waste Management and Disposal, and with the Contractor's Waste Reduction Workplan.

- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

## 1.8 WARRANTY

- .1 Provide extended coverage five year warranty for motors larger than 20 HP (15 kW).

## 2 PRODUCTS

### 2.1 ADHESIVES, SEALANTS, PAINTS AND COATINGS

- .1 Adhesives, Sealants, Paints and Coatings: Use only low VOC emitting materials meeting following criteria;
  - .1 Paint for Mechanical Identification: maximum VOC emission of 250g/L
  - .2 Touch-Up Paint: maximum VOC emission of 250g/L
  - .3 Zinc-Rich Primer: maximum VOC emission of 250g/L
  - .4 Adhesives for Mechanical Identification: maximum VOC emission of 70g/L
  - .5 Sealants for service penetrations: maximum VOC emission of 650g/L clear and 350 g/L pigmented
  - .6 Sealants for Firestopping: max. VOC emission of 650g/L clear and 350 g/L pigmented
  - .7 Acrylic Sealant for supports and anchors: maximum VOC emission of 250g/L
  - .8 Flame Retardant Adhesive: maximum VOC emission of 650g/L clear and 350 g/L pigmented

### 2.2 WELDING ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

### 2.3 FIRESTOPPING COMPOUND

- .1 Manufacturers:
  - .1 3M products indicated.
  - .2 Dow Corning
  - .3 John Manville
  - .4 Hilti Firestop Systems
- .2 Fire Rated Sealants: Intumescent material, synthetic elastomers, capable of expanding up to 8 to 10 times when exposed to temperatures of 250°F (121°C) or higher. ULC listed and labeled.

### 2.4 NAMEPLATES

- .1 Provide laminated plastic plates with black face and white centre of minimum size 3-1/2" x 1-1/2" x 3/32" (90 x 40 x 2 mm) nominal thickness, engraved with 1/4" (6 mm) high lettering. Use 1" (25 mm) lettering for major equipment.
- .2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.
- .3 Identify equipment type and number and service of areas or zone of building served.

### 2.5 FLASHINGS AND COUNTERFLASHINGS

- .1 Thaler or equivalent mechanical/electrical flashings as recommended for specific purpose.
- .2 Stainless steel flashing sleeve, integral deck flange and EPDM seal.

### 2.6 PENETRATION SEALS

- .1 Manufacturer: Link-Seal
- .2 Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut.

### **3 EXECUTION**

#### **3.1 INSPECTION**

- .1 Inspect installed work of other trades and verify that such work is complete to point where work under Mechanical Divisions 20, 21, 22, 23, 25 may properly begin.
- .2 Verify that work of Mechanical Divisions 20, 21, 22, 23, 25 may be executed in accordance with pertinent codes and regulations, specifications, drawings, and referenced standards.
- .3 Review drawings and verify dimensions at the site. Report discrepancies immediately to Consultant before proceeding with any construction work or shop drawings.

#### **3.2 PREPARATION**

- .1 Existing services and equipment shall be relocated or removed to suit new construction and renovation work.
- .2 Services that are no longer required shall be removed or cut back and capped to the satisfaction of Consultant.
- .3 Obtain written authorization from Consultant for renovation work that is not specifically indicated.
- .4 Where modifications or connections to existing systems require shutdown of the system the Contractor shall submit a request for system shutdown describing the system or part to be shutdown, the duration of the shutdown, the work planned and steps to be taken to reinstate the system to full operation. The request shall be submitted in the format stipulated by the Owner.
- .5 All work required to prepare systems for shutdown and/or re-instatement, such as draining, chemical treatments, and re-filling shall be included in this Bid Price.

#### **3.3 PIPING INSTALLATION - ABOVE GROUND**

- .1 Cooperate with other trades whose work affects or is affected by work of Mechanical Sections, to ensure satisfactory installation and to avoid delays. Provide all materials to be built-in such as sleeves, anchors, etc., together with accurate dimensions or templates, promptly.
- .2 Layout all work accurately, installing piping parallel to lines of building.
- .3 Install piping, wherever possible, in partitions and above ceiling. Do not install piping in outside walls unless so shown on drawings. Wrap uninsulated piping in masonry walls with building paper.
- .4 Install concealed piping close to building structure to minimize furring dimensions.
- .5 Provide adequate space around piping to facilitate application of insulation.
- .6 Use dielectric couplings where piping of dissimilar metals connect.
- .7 Where piping passes through concrete floors, or walls, sleeves shall be sized to permit the pipe to expand freely without binding or crushing pipe insulation.
- .8 Where branch pipes are welded into main without the use of "T" connections, torch cut openings must be cut true, beveled and filed smooth. Branch pipes must not be allowed to project inside of main pipe. Openings must not be cut large enough to permit entry of welding metal and slag within the pipe.
- .9 Arrange all take-offs from mains to allow for expansion and contraction of pipes. Hot water branches serving downfeed risers must be taken from lower sides or bottom of mains and grade down slightly to risers. Branches which serve units above the mains shall be taken from the top or sides of mains.
- .10 Install automatic control valves and wells supplied under other Sections of Mechanical Divisions.

#### **3.4 WELDING**

- .1 Welder's Qualifications
  - .1 Welding qualifications to be in accordance with CSA B51.
  - .2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction.
  - .3 Furnish welder's qualifications to Consultant and Owner.
  - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
- .2 Inspector's Qualifications: qualified to CSA W178.2
- .3 Welding Procedures

- .1 Registration of welding procedures in Procedures accordance with CSA B51.
- .2 Copy of welding procedures to be available for inspection at all times.
- .3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2.
- .4 Workmanship: Welding to be in accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, special procedures specified elsewhere in Division 23 applicable requirements of provincial authority having jurisdiction.
- .5 Installation Requirements:
  - .1 Identify each weld with welder's identification symbol.
  - .2 Backing rings:
    - .1 Where used, fit to minimize gaps between ring and pipe bore.
    - .2 Do not install at orifice flanges.
  - .3 Fittings:
    - .1 NPS 2 and smaller: install welding type sockets.
    - .2 Branch connections: install welding tees or forged branch outlet fittings.
- .6 Inspection and Testing:
  - .1 Hydrostatically test all welds to requirements of ANSI/ASME B31.1.
  - .2 Review all weld quality requirements and defect limits of applicable codes and standards with Consultant before any work is started.
  - .3 Formulate "Inspection and Test Plan" in co-operation with Consultant.
  - .4 Do not conceal welds until they have been inspected, tested and approved by inspector.
  - .5 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Consultant, to ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
  - .6 Visual examinations: include entire circumference of weld externally and wherever possible internally.
  - .7 Failure of visual examinations: on failure of any weld by visual examination, perform additional testing as directed by Consultant of a total of up to 25% of all welds, selected at random by Consultant, by particle tests.
  - .8 Inspect and test all welds in high pressure steam and high pressure condensate piping in accordance with "Inspection and Test Plan" by magnetic particle (hereinafter referred to as "particle") tests.
- .7 Defects Causing Rejection: as described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code, plus;
  - .1 Undercutting greater than 1/32" (0.8 mm) adjacent to cover bead on outside of pipe.
  - .2 Undercutting greater than 1/32" (0.8 mm) adjacent to root bead on inside of pipe.
  - .3 Undercutting greater than 1/32" (0.8 mm) at combination of internal surface and external surface.
  - .4 Incomplete penetration and incomplete fusion greater than total length of 1-1/2" (38 mm) 97% in any 6" (150 mm) length of weld depth of such defects being greater than 1/32" (0.8mm).
  - .5 Repair all cracks and defects in excess of 1/32" (0.8mm) in depth.
  - .6 Repair defects whose depth cannot be determined accurately on the basis of visual examination or particle tests.
- .8 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

### 3.5 FLUSHING AND CLEANING

- .1 Flush water mains in accordance with procedures established by NFPA 24
- .2 Thoroughly flush all piping installed by Mechanical Divisions.
- .3 Flush and sterilize domestic water mains in accordance with procedures established by AWWA Specification C601.
- .4 Flush new domestic water piping in accordance with Local and Provincial Codes.
- .5 Remove, clean and replace all strainers in systems after flushing.
- .6 Thoroughly clean all equipment and fixtures, and lubricate HVAC equipment, and leave all items in perfect order ready for operation.

### 3.6 PIPING SYSTEMS TESTING AND INSPECTION

- .1 Before tests, isolate all equipment or other parts which are not designed to withstand test pressures.
- .2 Test all piping at the completion of roughing-in, before connecting to existing systems, and before concealment, insulation or covering of piping.
- .3 Make tests that are required by any authority having jurisdiction, in the presence of the authority's authorized inspector and shall be certified by him.
- .4 Conduct tests in the presence of:
  - .1 Authorized inspector(s) for authorities having jurisdiction.
  - .2 The Commissioning Agent
  - .3 The Owner's Representative
  - .4 The Consultant
- .5 Notification must be given at least 48 hours in advance of tests being conducted, to all persons required to be present.
- .6 Repair all leaks exposed during testing and retest. If defects in pipe or fittings are discovered in the system, they shall be removed and replaced.
- .7 Certify tests not required by authorities having jurisdiction.

### 3.7 ELECTRICAL COMPONENTS AND WIRING

- .1 Meet the requirements of Electrical Division 26 for all wiring included in Mechanical Divisions 20, 21, 22 and 23. Includes pre-wired equipment provided within appropriate Sections under Mechanical Divisions 20, 21, 22 and 23.
- .2 Ensure that all pre-wired electrical equipment is CSA approved. Arrange and pay for special approval where this is not possible.
- .3 Coordinate all wiring requirements with other Divisions. Line voltage wiring from power distribution panels to starters and from starters to motors will be provided under Division 26. All the field wiring for equipment shall be included under Mechanical Divisions 21, 22 and 23, unless specifically called for under Division 25.

### 3.8 PROTECTION

- .1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under Mechanical Divisions.
- .2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.
- .3 All existing air intake and exhaust openings that may be affected by dust and/or debris from the construction work shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. The Contractor shall replace existing filters that become contaminated with dust and/or debris from construction work with new filters.
- .4 In the event that dust and debris from construction work does penetrate the building and/or its air distribution systems, the Contractor shall be responsible for cleaning the affected areas and/or systems.
- .5 Temporary filters shall be removed on completion of the construction works.

### 3.9 EXCAVATING AND BACKFILLING

- .1 Be responsible for excavation and backfilling necessary for installation of underground work under Mechanical Divisions.
- .2 Excavate with suitable machinery or by hand as may be necessary and as follows:
  - .1 Excavate to the depth and dimensions shown on drawings.
  - .2 Keep excavation free of water by bailing, pumping or a system of drainage as required.
  - .3 Cut and trim banks of excavation evenly, as nearly vertical as possible, and shore if required to prevent caving-in.
  - .4 Keep bottom of excavation clean and clear of loose material. Slope or grade as required.
  - .5 Provide shoring in accordance with The Occupational Health and Safety Act and Regulations

- for Construction Projects.
- .6 Notify Consultant immediately in case of encountering any unstable ground, unsuitable for bearing of pipes. Consultant will decide the method of installation of pipes in unstable ground.
- .7 Inform Consultant immediately if the excavation reveals seepage zones, springs or other unexpected sub-surface conditions which may necessitate revisions to drainage or water supply systems.
- .3 Obtain Consultant's approval before commencement of backfilling of trenches. Backfill the trenches carefully to prevent injury to the work and subsequent settlement and execute backfilling generally as follows:
  - .1 Provide minimum 6" (150 mm) fine gravel or coarse sand bedding (Class B) or as indicated for the bottom of trenches.
  - .2 Backfill above pipe bedding with granular material specified, hand tamp in layers of 6" (150 mm) thickness. Extend backfill 12" (300 mm) above pipe.
  - .3 Backfill and consolidate remainder of trench depth below paved or graveled areas with granular Class "B" aggregate in 6" (150 mm) layers to an elevation to allow for thickness of Class "A" aggregate and asphalt pavement.
  - .4 Backfill and consolidate remainder of trench depth below sodded or seeded areas with specified granular material or material obtained from site excavation where approved by Consultant, in 9" (225 mm) layers to an elevation 6" (150 mm) below of proposed grades in sodded/seeded areas.
  - .5 Compact each layer thoroughly at optimum moisture content with approved hand or mechanical tampers to a density equal to;
    - .1 95% of Maximum Standard Proctor Density
      - .1 Behind foundation and retaining walls on grades
      - .2 Below sodded or seeded areas
    - .2 100% of Maximum Standard Proctor Density
      - .1 Below slabs on grade within building areas up to the underside of the crushed stone underlay
      - .2 Below paved or graveled areas
  - .6 Do not puddle or flood with water for consolidating backfill. Add Water during the compaction to optimum moisture content of backfilling material.

### 3.10 SEALANTS & CAULKING

- .1 Fill voids around pipes:
  - .1 Seal between sleeve and pipe in foundation walls and below grade floors with penetration seals (link-seal)). Install as per manufacturer's installation instructions.
  - .2 Where sleeves pass through non-fire rated walls or floors, caulk space between pipe and sleeve with fibreglass. Seal space at each end with waterproof, fire retardant, non-hardening mastic.
  - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
  - .4 Fill future-use sleeves with easily removable filler.
  - .5 Coat exposed exterior surfaces or ferrous sleeves with heavy application of zinc rich paint (VOC content not to exceed 250 g/L).
- .2 Temporarily plug all openings during construction.

### 3.11 FIRESTOPPING

- .1 All openings in fire separations and fire rated assemblies for service penetrations shall be protected with ULC listed service penetration firestop systems (SP).
- .2 The service penetration firestop system shall have F and FT ratings equal to or greater than ratings specified by the Architect for the fire separation (F) and firewall (FT) joint firestop systems (JF).
- .3 All components employed in the service penetration firestop system shall meet the requirements of the ULC listing.
- .4 Contractor shall prepare and submit a schedule of service penetration firestop systems to be employed indicating the ULC listing designation, services involved, location of opening through fire

- separation and the components of the fire separation assembly.  
.5 Refer to architectural drawings for ratings of fire separations and assemblies.

### **3.12 SLEEVES**

- .1 Provide pipe sleeves at points where pipes pass through masonry or concrete.
- .2 Provide sleeves of minimum schedule 20 galvanized steel or cast iron.
- .3 Use cast iron or steel pipe sleeves with annular fin continuously welded at midpoint:
  - .1 through foundation walls, with penetration seals.
  - .2 through floors of mechanical rooms and equipment rooms.
- .4 Provide 1/4" (6 mm) clearance all around, between sleeve and pipes or between sleeve and insulation.
- .5 Where piping passes below footings, provide minimum clearance of 2" (50 mm) between sleeve and pipe. Backfill up to underside of footing with concrete of same strength as footing with concrete of same strength as footing.
- .6 Terminate sleeves flush with surface of concrete and masonry and 2" (50 mm) above floors. Not applicable to concrete floors on grade.
- .7 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction, caulk between sleeve recess and pipe, fasten roof flashing to clamp device, make water-tight durable joint. Coordinate with roofing Section.

### **3.1 FLASHINGS**

- .1 Provide all flashing at each point where piping passes through the roof.
- .2 Coordinate this work with the roofing Trades to ensure a satisfactory installation and to avoid delays.

### **3.2 SUPPORT AND ATTACHMENT**

- .1 Support and attach piping, ductwork fixtures and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls, and do not support from or attach to steel roof deck and/or wall or ceiling finishes. Roof mounted mechanical equipment and services shall be anchored to the roof structure to resist both lateral and uplift wind forces in accordance with requirements of the Ontario Building Code.

### **3.3 PAINTING**

- .1 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections of this division. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.
- .2 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.
- .3 Ensure manufacturer's identification labels are not painted over. Apply masking tape or paper cover to ensure identification labels do not receive field paint finish.

### **3.4 DISSIMILAR METALS**

- .1 Separate dissimilar metals in order to prevent galvanic corrosion.
- .2 Provide gaskets or shims of approved materials to avoid electrolytic action.
- .3 Use dielectric unions and/or flanges where piping of dissimilar metals are connected.

### **3.5 SERVICE CONNECTIONS**

- .1 Include in Bid Price all amounts required by utilities for service connections and /or modifications to service connection. Ensure amounts include fees, assessments, charges, etc., required in relation to service connection.

### **3.6 FIELD QUALITY CONTROL**

- .1 Temporary and Trial Usage
  - .1 Allow the Owner the privilege of temporary and trial usage of installed equipment, as soon as work is complete, for a period of time required to conduct a thorough test.
  - .2 Do not construe such usage as evidence of acceptance of work by Owner.
  - .3 Repair damage to work tested, resulting from such trial usage, by this Contractor at no cost to Owner.
- .2 Systems Verification:
  - .1 Verify the correct installation and proper operation of equipment and systems installed. Adjust and balance each system as necessary to achieve optimum operation of each system.
  - .2 Co-operate with the TAB agency as follows:
    - .1 Provide assistance when and as requested,
    - .2 Co-ordinate completion of work systematically to permit orderly verification and adherence to schedules,
    - .3 Provide additional necessary flow balancing devices as directed by agency,
    - .4 Notify TAB Agency of tests being conducted.

### 3.7 ADJUST AND CLEAN

- .1 Clean equipment and fixtures, lubricate mechanical equipment installed under Mechanical Divisions and leave items in perfect order ready for operation.
- .2 Test and adjust control devices, instrumentation, relief valves, dampers, etc., installed in Mechanical Divisions after cleaning of systems and leave in perfect order ready for operation.
- .3 Remove from the premises upon completion of work of this division, debris, surplus, and waste materials resulting from operations.

### 3.8 MECHANICAL IDENTIFICATION INSTALLATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.
- .2 Prepare surfaces for stencil painting.
- .3 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer (VOC content not to exceed 680 g/L).
- .4 Install tags with corrosion resistant chain.
- .5 Comply with standard detail drawing plate, "Detail of Piping Identification".
- .6 Apply stencil markings on all covered piping.
- .7 Install plastic tape pipe markers complete around bare pipe to manufacturer's instructions.
- .8 Label piping that is heat traced or equipped with heating cable "HEAT TRACED" in addition to other identification. Locate such labels adjacent to other identifications.
- .9 Install underground plastic pipe markers 6"-8" (150-200 mm) below finished grade, directly above buried pipe.
- .10 Identify pumps, water heating equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- .11 Identify control panels and major control components outside panels with plastic nameplates.
- .12 Identify valves in main and branch piping with tags. Consecutively number valves in each system.
- .13 Identify piping, concealed or exposed, with stenciled painting **OR** plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20'-0" (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- .14 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 2-3/8" x 9" (60 x 230 mm), reading: **"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME."**
- .15 Provide colour coded self-adhesive dots to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

### 3.9 MECHANICAL IDENTIFICATION SCHEDULES

- .1 Consult the Owner and identify piping, ductwork and equipment as directed;

- .1 Conforming to the following Pipe and Valve Identification Table based on ANSI/ASME 13.1:

SERVICE	COLOURS		MATERIAL PROPERTIES
	BACKGROUND	LETTERS	
Flammable or Oxidizing	Yellow	Black	Fluids which are a vapour or produce vapors that can ignite and continue to burn in air
Combustible	Brown	White	Fluids that may burn but are not flammable

### 3.10 MANUFACTURER'S NAMEPLATES

- .1 Provide metal nameplates on each piece of equipment, mechanically fastened with raised or recessed letters.
- .2 Include registration plates, Underwriters' Laboratories and CSA approval, as required by respective agency and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, all factory supplied.
- .3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

**END OF SECTION**

## **1 GENERAL**

### **1.1 GENERAL REQUIREMENTS**

- .1 Comply with General Requirements of Section 20 01 01.

### **1.2 SECTION INCLUDES**

- .1 Pipe and pipe fittings.
- .2 Hangers and supports.
- .3 Labelling and identification.
- .4 Valves.
- .5 Installation.

### **1.3 REFERENCES**

- .1 CSA B149.1 Natural gas and propane installation code, as adopted.
- .2 ANSI B31.1 - Power Piping.
- .3 ASME SEC IX - Welding and Brazing Qualifications.
- .4 ASME B16.3 - Malleable Iron Threaded Fittings.
- .5 ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- .6 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .7 NFPA 31 - Installation of Oil-Burning Equipment.

### **1.4 SUBMITTALS**

- .1 Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- .2 Project Record Documents: Record actual locations of piping system, storage tanks, and system components.
- .3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- .4 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- .5 Contractor's material and test certificates.

### **1.5 QUALITY ASSURANCE**

- .1 Welding Materials and Procedures: Conform to ASME Code.
- .2 Welders Certification: To ASME SEC IX.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- .5 Valves: Manufacturer's name and pressure rating marked on valve body.

### **1.6 REGULATORY REQUIREMENTS**

- .1 Conform to CSA B149.1 Natural Gas and Propane installation code
- .2 Conform to ANSI B31.1 for installation of fuel oil piping.
- .3 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

### **1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Transport, handle, store, and protect products.
- .2 Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain protection in place until installation.

### **1.8 EXTRA MATERIALS**

- .1 Provide two repacking kits for each size valve.

## 2 PRODUCTS

### 2.1 BURIED PIPING

- .1 Steel Pipe: ASTM A53/A53M or A106, Schedule 40, seamless
  - .1 Fittings: steel to ANSI/ASME B 16, rated for not less than 125 psig working pressure.
  - .2 Joints: ANSI B31.1 welded.
  - .3 Jacket: AWWA C105 polyethylene or double layer, half-lapped 0.25 mm polyethylene tape.
- .2 Plastic: CSA-B137.4, Polyethylene piping.
  - .1 Operating temperature -20°f up to 140°f. technical personal performing pipe installation must be qualified and trained. KWH pipe - Wehogas or approved equal.

### 2.2 ABOVE GROUND PIPING

- .1 Steel Pipe: ASTM A53/A53M Gr. B, ERW or A106 SMLS, schedule 40.
  - .1 Fittings: ASTM B16.3, malleable iron class 150, screwed or flanged or ASTM A234/A234M, wrought carbon steel and alloy steel welding type.
  - .2 Joints: NFPA 30, threaded, flanged or welded to ANSI B31.1.
    - .1 Screwed fittings: pulverized lead paste.
    - .2 Welded fittings: butt-welding fittings to CSA W47.1.
    - .3 Flange gaskets: nonmetallic flat, to ASME B16.5.
    - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A47M.
    - .5 Bolts and nuts: to ASME B18.2.1.
    - .6 Nipples: schedule 40, to ASTM A 53/A53M.
- .2 All piping, indoor and outdoor, to be protected by painting with metal primer and exterior enamel paint. Paint the entire piping system yellow and provide "NATURAL GAS" labels with "GAS PRESSURE" identification at 20ft (6m) intervals.

### 2.3 ISOLATION VALVES

- .1 2" (50 mm) and smaller: Class 150, 600 psi (4140 kPa) CWP, Brass Body ASTM 283 C37700, two piece body, Chrome plated Ball and brass stem, full port, virgin PTFE seats, Double O Ring design or Adjustable PTFE packing, blow-out proof stem, Lever Handle.  
Kitz 58, MAS B3, Toyo Red & White 5044A (Threaded)
- .2 2-1/2" (65 mm) and 3" (75 mm): Class 150, Carbon Steel A216WCB Body, S.S. Ball and Stem, RPTFE Packing and Gaskets, Lever Handle, Flanged.  
Kitz 150 SCTDZM-N (Full Port), Kitz 150 SCTAZM-N (Reduced Port)

## 3 EXECUTION

### 3.1 SERVICE CONNECTIONS

- .1 Coordinate with gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7"-14"W.C.

### 3.2 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that excavations are to required grade, dry, and not over-excavated.

### 3.3 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- .2 Remove scale and dirt, on inside and outside, before assembly.

- .3 Prepare piping connections to equipment with flanges or unions.
- .4 Excavate and backfill for work of this Section.

### 3.4 INSTALLATION

- .1 Install to to CSA B149.1 as adopted.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- .3 Route piping in orderly manner and maintain gradient.
- .4 Group piping whenever practical at common elevations.
- .5 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .6 Establish elevations of buried piping outside the building to ensure not less than 1m of cover.
- .7 Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
- .8 Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- .9 Identify piping systems including underground piping.
- .10 Install valves with stems upright or horizontal, not inverted.
- .11 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- .12 Owner to pay all gas company costs.

**END OF SECTION**

## **1 GENERAL**

### **1.1 REFERENCES**

- .1 The General Conditions of the Contract, the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

### **1.2 APPLICATION**

- .1 This Section specifies requirements that are common to electrical work Sections of the Specification, and it is a supplement to each Section and is to be read accordingly.

### **1.3 DEFINITIONS**

- .1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:
  - .1 "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, underground, walls and partitions
  - .2 "exposed" – means work normally visible, including work in equipment rooms and similar spaces
  - .3 "provide" (and tenses of provide) – means supply and install complete
  - .4 "install" (and tenses of install) – means install and connect complete
  - .5 "supply" – means supply only
  - .6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished
  - .7 "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the electrical work and to which the work must adhere
  - .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner
  - .9 "O&M" – means Operating and Maintenance
- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.
- .3 Wherever the words "reviewed", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "inspected by", etc., the Consultant.
- .4 In the electrical specification, singular may be read as plural, and vice-versa.
- .5 "Owner": means Building Owner as defined in the Contract or the Owner's designated representative.
- .6 "Wet": means wet areas requiring special materials. Where indicated on drawings and/or specified herein. Includes but not limited to pools, whirlpools, showers, etc.

### **1.4 METRIC AND IMPERIAL MEASUREMENTS**

- .1 Both Metric and Imperial units of measurement are indicated in the electrical Specification.

### **1.5 EXAMINATION OF SITE AND DOCUMENTS**

- .1 When estimating the cost of the work and prior to submitting a bid for the work, carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.
- .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

### **1.6 DRAWINGS AND SPECIFICATION**

- .1 Read the electrical work drawings in conjunction with all other structural, architectural, sprinkler, mechanical, etc., drawings and, where applicable, the Code Consultant's report.
- .2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.
- .3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at no extra cost to this Contract, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 3 meters (10 feet) in any direction without a change to the contract.
- .5 Sections of the electrical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
- .6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.
- .7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- .8 In the case of discrepancies or conflicts between the drawings and specification, the documents will govern in the following order:
  - .1 The specification
  - .2 Drawings of larger scale
  - .3 Drawings of smaller scale
  - .4 Drawings of later date when the scale of the drawings is the same
- .9 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the most costly arrangement will take precedence.
- .10 Provide all products and methods mentioned or shown in the Contract documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.

## **1.7 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS**

- .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions. Unless otherwise specified, the order of right-of-way for services is to be as follows:
  - .1 piping requiring uniform pitch
  - .2 piping 100 mm (4") dia. and larger
  - .3 large air ducts (main runs)
  - .4 electrical cable tray and bus duct
  - .5 conduit 100 mm (4") dia. and larger
  - .6 piping less than 100 mm (4") dia.
  - .7 smaller branch ductwork
  - .8 conduit less than 100 mm (4") dia.
- .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit, cable tray, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
- .3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for

- the cost of alterations in other work required by the alterations to the electrical work.
- .4 All outlet boxes, junction boxes, pullboxes, equipment and similar products, particularly such products located above suspended ceilings, must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
  - .5 Layout Drawings: Do not use the Contract Drawing measurements for prefabrication and layout of work. Locations and routing are to generally be in accordance with the Contract Drawings, however, layout drawings are to be prepared for all such work. Use established bench marks for both horizontal and vertical measurements. Coordinate with and make allowances for the work of other trades, accurately layout the work, and be entirely responsible for all work installed in accordance with layout drawings.
  - .6 Interference Drawings: Prepare dimensioned working interference drawings, supplementary to the Contract Drawings for all areas where multiple services and/or equipment occur, or where the work due to architectural and structural considerations requires special study and treatment. Review interference drawings with the Consultant before the work is installed. Where this Contractor's work has been installed in such areas without preparation of interference drawings and conflicts occur, revise this work to suit at no additional cost.

### **1.8 COORDINATION OF THE WORK**

- .1 Review all the Contract Documents and coordinate the work with the work of all subcontractors. Coordination requirements are to include, but not be limited to, the following:
  - .1 written notification of all concrete work such as housekeeping pads, bases, etc., required for electrical work, and including required dimensions, operating weight of equipment, location, etc.
  - .2 depth and routing of excavation required for electrical work, and requirements for bedding and backfill

### **1.9 QUALITY ASSURANCE**

- .1 All electrical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's review and acceptance.
- .2 All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.
- .3 An experienced and qualified superintendent is to be on-site at all times when electrical work is being performed.

### **1.10 EQUIPMENT AND MATERIALS**

- .1 Unless otherwise specified, all equipment and materials are to be new.
- .2 All equipment is to be installed in accordance with the manufacturer's published instructions, unless specified otherwise in the specification or on the drawings.
- .3 Where price, quality, and local service facilities are equivalent, preference will be given to products produced in the locality of the work or by producers located in the locality of the work. The decision as to the equality of products rests solely with the Owner.

### **1.11 EQUIPMENT AND MATERIAL MANUFACTURERS**

- .1 Equipment and materials selected, scheduled or specified on the drawings or in the specification have been selected to establish a performance and quality standard, and, in some cases, a dimensional standard for the Project. In most cases acceptable manufacturers are listed for any product specified by manufacturer's name and model number. Bid Prices shall include only products specified or acceptable equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of General Contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with

- unsolicited alternative proposals such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in the alternative proposals. Prior review and acceptance by consultant is not required for unsolicited alternative proposals.
- .2 Where Contractor uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.
  - .3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by first named manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the first named specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products, prepare and submit for review, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
  - .4 Do not supply products of different types that have been "bulked" by a supplier who has quoted a lump sum price for the "bulked" products.
  - .5 The Consultant will review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations. The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

#### **1.12 SUBSTITUTED OR ALTERNATIVE PRODUCTS**

- .1 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of five (5) full working days prior to the bid closing date. Requests may be made by letter, by fax, or by email. Telephone requests will not be considered.
- .2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.
- .3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative or other than first named manufacturer. In addition, in equipment spaces where substituted or alternative or other than first named products are used in lieu of the specified first named products and the dimensions of such products differ from the specified first named products, prepare and submit for review, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
- .4 The Consultant's decision regarding any proposed substitution or alternative product is final.

#### **1.13 CODES, REGULATIONS, AND STANDARDS**

- .1 All Codes, Regulations, and Standards referred to in this Section are the latest edition of the Codes, Regulations, and Standards in effect at the time of tendering this Project.
- .2 All work is to be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities.
- .3 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted. Pay all associated costs associated with these submittals.
- .4 All electrical items associated with mechanical equipment are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

- .5 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

#### **1.14 PERMITS, FEES, AND CERTIFICATES**

- .1 Apply for, obtain and pay for all permits required to complete the electrical work.
- .2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

#### **1.15 WORKPLACE SAFETY**

- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain one copy at the site in a visible and accessible location available to all personnel.
- .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.

#### **1.16 SHOP DRAWINGS AND PRODUCT DATA SHEETS**

- .1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification.
- .2 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, i.e. "Panelboard A", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.
- .3 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure that this requirement is clearly indicated on the submission.
- .4 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct, as per the Electrical Supplementary Bid Form as applicable, and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS" and include the company name, the submittal date, and the signature of an officer of the company to indicate your review and approval as above.
- .5 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:
  - .1 "Reviewed" or "Reviewed As Modified" to indicate that the Consultant's review is final and no re-submittal is required subject to compliance with any modifications indicated.
  - .2 "Revise and Resubmit" to indicate that the submission is rejected and is to be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted.
- .6 The following is to be read in conjunction with the wording on the Consultant's review stamp applied to each and every electrical work shop drawing or product data sheet submitted:
  - .1 "This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor remains responsible for dimensions to be confirmed and correlated at the job site, for the information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."
- .7 Submit preliminary short circuit study with distribution equipment shop drawings in sufficient detail to include and provide ratings for all components and wiring and be in conformance with Section 26 03

- 15.
- .8 Provide final commissioning report with record drawings.
- .9 Provide draft copy of all manuals prior to expected date of completion of work for review by Owner.
- .10 Prepare copies of all schematics for training purposes and submit to Owner for review prior to demonstration and training purposes.

#### **1.17 CHANGES OR REVISIONS TO THE WORK**

- .1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that required by the Contract Documents, prepare and submit to the Consultant for review and acceptance, a quotation being your proposed cost for executing the change or revision.
- .2 The Contractor's quotation shall be a detailed and itemized estimate of all product, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 The following requirements apply to all quotations submitted:
  - .1 when the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work
  - .2 material costs are not to exceed those published in local estimating price guides
  - .3 costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and listed in the Supplementary Bid Form and must reflect the actual personnel performing the work
  - .4 the cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary
  - .5 costs for rental tools and/or equipment are not to exceed local rental costs
  - .6 Refer to the General Conditions of the Contract, the Supplementary Conditions and all Sections of Division 01 for allowable percentages for overhead and profit.
  - .7 the overhead percentage will be deemed to cover all quotation costs other than actual site labour and materials, and rentals
  - .8 all quotations, including those for deleted work, must include a figure for any required change to the Contract time
- .4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .5 If, in the Contractor's opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.
- .6 Do not execute any change or revision until written authorization for the change or revision has been obtained.

#### **1.18 NOTICE FOR REQUIRED FIELD REVIEWS**

- .1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect the work for deficiencies prior to Substantial Performance, for commissioning demonstrations, and any other such field review, give the Consultant adequate notice in writing.
- .2 If the Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until the Consultant advises that it may be concealed.

#### **1.19 PROJECT CLOSEOUT SUBMITTALS**

- .1 Prior to application for Substantial Performance of the Project, submit all required documentation

specified, including the following:

- .1 Operating and Maintenance Manuals
- .2 as-built record drawings and associated data
- .3 warranties for equipment as specified
- .4 identified keys for equipment and/or panels for which keys are required
- .5 other data or products specified

## 1.20 OPERATING AND MAINTENANCE MANUALS

- .1 Submit, prior to application for Substantial Performance, 3 hard copies of operating and maintenance manuals consolidated in black hardcover 3 "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently on binder spine with the Project name, "ELECTRICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:
  - .1 an Introduction sheet listing the Consultant's, Contractor's, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses. Include special telephone numbers for service departments on normal and emergency call basis.
  - .2 a Table of Contents sheet, and corresponding index tab sheets. Use plastic tab indices for all sections of the manual with separate sections for each different type of equipment item.
  - .3 a copy of each "Reviewed" or "Reviewed As Modified" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, and the email address for local source of parts and service
  - .4 operating data, which is to include:
    - .1 Description of each system and its controls
    - .2 System schematic wiring diagrams; mark correct operating settings for each device on these diagrams
    - .3 Operation instruction for each system and each component
    - .4 Description of actions to be taken in event of equipment failure; step by step procedure to follow in putting each piece of equipment into service.
    - .5 Drawings of each control panel completely identifying all components on the panels and their functions.
    - .6 Include Owner's equipment numbers on all equipment submitted.
    - .7 Diagram of the electrical system indicating the wiring of all related electrical components such as fuses, interlocks, electrical switches and relays
  - .5 Maintenance data, which is to include:
    - .1 manufacturer's maintenance instructions, servicing maintenance, operation and trouble-shooting instructions for each item of equipment; list parts numbers and lists, name of supplier and maintenance and lubrication instructions
    - .2 schedules of tasks, frequency, tools required, and task time
    - .3 complete parts lists with numbers
    - .4 balancing and testing reports
    - .5 where fuses with maximum let-through current are indicated, provide manufacturer's fuse curve data in Operating and Maintenance Manuals showing fuse coordination with system interrupting capacity at that location in the system
  - .6 performance data, which is to include:
    - .1 equipment and system start-up data sheets
    - .2 equipment performance verification test results, and commissioning report
- .2 Submit, prior to application for Substantial Performance, four digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Electrical Systems". Provide one additional digital version copy for Consultant's use.

## 1.21 RECORD "AS-BUILT" DRAWINGS

- .1 Obtain PDF's from the Consultant for the production of record "AS-BUILT" drawings and pay for costs of reproduction and transmission costs. As work progresses at the site, clearly mark in red in a neat

and legible manner on a set of white prints of the drawings, all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:

- .1 the location of all work such as junction boxes and pullboxes concealed in inaccessible locations
  - .2 the locations of control devices with identification for each
  - .3 for underground work, record dimensions, invert elevations, all offsets, fittings, and locate dimensions from benchmarks that will be preserved after construction is complete
  - .4 the location of all concealed services terminated for future extension
- .2 When work on site is complete, transfer all the as-built red line information from the site as-built drawings to a recordable and identified CAD copy with CAD work of equal quality to the Contract Drawings.
- .3 The electrical drawings have been prepared on a computer aided drafting system. Obtain an electronic version of the drawings from the Consultant for use in producing final as-built drawings.
- .4 Prior to inspection for Total Performance of the work, submit for review, the red line site as-built white prints, a CAD file of the as-built drawings shall be forwarded to The Consultant. The Consultant will review the drawings and, if necessary, return the marked-up file for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the files until they are determined to be acceptable.

#### **1.22 PROGRESS PAYMENT BREAKDOWN**

- .1 Within 15 working days of written notification of award of contract submit a breakdown of the cost of the electrical work to assist the Consultant in reviewing and recommending acceptance of monthly progress payment claims.
- .2 The payment breakdown is subject to the Consultant's review and acceptance. Progress payments will not be processed until a reviewed and accepted breakdown is in place. The breakdown shall include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, and project closeout submittals.

#### **1.23 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS**

- .1 All professional engineers retained by this Contractor to perform consulting services with regard to his work are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.
- .2 This Contractor's retained engineer's professional liability insurance is to protect his Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss of damage resulting from the professional services rendered by his Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.
- .3 Liability insurance requirements are as follows:
  - .1 coverage is to be a minimum of \$1,000,000.00 inclusive of any one occurrence, or as indicated in the Division 0.
  - .2 the insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice
  - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work
  - .4 evidence of the required liability insurance in such forms as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services

#### **1.24 GENERAL RE: INSTALLATION OF EQUIPMENT**

- .1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations.
- .2 Ensure that proper access and code required service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded.

#### **1.25 CONTRACTOR'S MATERIAL AND TEST CERTIFICATES**

- .1 Submit Contractor's Material and Test Certificates for each system installed. Certificates shall include:
  - .1 description of the system (designation and type),
  - .2 description of the tests conducted and results observed, including re-testing where necessary,
  - .3 description of any corrective measures undertaken,
  - .4 description of materials used,
  - .5 list of witnesses for each test conducted,
  - .6 date system left ready for service,
  - .7 signature of installing Contractor.
- .2 Where certificates are prescribed by regulations, codes or standards, they shall conform to the requirements of those documents (eg. NFPA Standards, Electrical Safety Authority (ESA) Standards). A copy of each certificate shall be included in the Operating and Maintenance manuals.

#### **1.26 PRODUCT DELIVERY, HANDLING AND STORAGE**

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

#### **1.27 WARRANTY**

- .1 Make submissions necessary to register product warranties to the benefit of the Owner.
- .2 Submit to Consultant, prior to Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.

#### **1.28 PROTECTION**

- .1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under this Division.
- .2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.

#### **1.29 SERVICE CONNECTIONS**

- .1 Include in Bid Price all amounts required by municipality and/or Supply Authorities/ Utilities for service connections and/or modifications to service connections. Ensure amounts include fees, assessments, charges, etc., required in relation to service connection.

#### **1.30 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION**

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete in accordance with the equipment/system manufacturer's instructions.

#### **1.31 EQUIPMENT AND SYSTEM START-UP**

- .1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in electrical work Sections in accordance with the following requirements:
- .2 Under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor.

### **1.32 EQUIPMENT AND SYSTEM COMMISSIONING**

- .1 After successful start-up and prior to Substantial Performance, commission the electrical work. Commissioning work is the process of the Contractor demonstrating to the Owner and Consultant, for the purpose of final acceptance by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operating and maintained to perform in accordance with requirements of the Contract Document, as further described below.
  - .1 Operational Performance Testing: The Contractor is to test, adjust and operate components, equipment, systems and /or subsystems after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the Contract Documents, including all modes and sequences of control and monitoring, interlocks ,and responses to emergency conditions. The Contractor is to complete commissioning data sheets to document successful operational performance testing.
  - .2 Functional Performance Testing: The Contractor is to repeat successful operational performance testing with complete commissioning data sheet documentation by the Contractor in the presence of the Consultant and Owner to validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
  - .3 Submittals: The Contractor is to submit final commissioning data sheets, and other required submittals.  
EDIT NOTE: Ref: paragraph .3. Use only if a Commissioning Agent is required and commissioning is specified in section 16095 – 26 03 20.
- .2 Commissioning and the use of an independent Commissioning Agent is specified in the electrical work Section entitled Electrical Work Commissioning. Carefully read the Electrical Work Commissioning Section and include for all specified requirements.

### **1.33 EQUIPMENT AND SYSTEM O & M DEMONSTRATION AND TRAINING**

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in electrical work Sections of the Specification. All demonstrations and training is to be performed by qualified technicians employed by the equipment/system manufacturer/supplier.
- .3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:
  - .1 Operational Requirements and Criteria: Requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, and limitations.
  - .2 Troubleshooting: Troubleshooting is to include but not be limited to diagnostic instructions, test and inspection procedures.
  - .3 Documentation: Documentation is to include but not be limited to equipment/system warranties, and manufacturer's supplier's parts and service facilities, telephone numbers, email addresses, and the like.
  - .4 Maintenance: Maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventative

- maintenance procedures, and use of any special tools.
- .5 Repairs: Repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
  - .4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.
  - .5 Schedule demonstrations and training at mutually agreed to times with a minimum of seven working days notice.
  - .6 Training Session DVD: For equipment/system demonstration and training sessions as specified in electrical work Sections, submit an identified DVD of the session prepared by a professional photographer with construction project technical training session experience.
  - .7 Demonstration and Training Confirmation: Obtain from the Consultant, a list of personnel to receive demonstration and training, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

### **1.34 SPECIAL TOOLS AND SPARE PARTS**

- .1 Identify spare parts containers as to contents and replacement parts number.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .3 Prepare a complete itemized list of special tools and spare parts and submit to consultant for review. List will be used as a checklist and should include provision for sign off by Owner on receipt.

### **2 PRODUCTS** Not Applicable

### **3 EXECUTION** Not Applicable

**END OF SECTION**

## **1 GENERAL**

### **1.1 APPLICATION**

- .1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more electrical work Sections of the Specification, and it is intended as a supplement to each Section and is to be read accordingly.

### **1.2 SUBMITTALS**

- .1 Submit the following for review:
  - .1 Product data sheets: submit for:
    - .1 Firestopping and smoke seal products
    - .2 Waterproofing seal assemblies
    - .3 Electrical work identification products
  - .2 Sleeve and formed opening location drawings: upon notification of award of Contract begin to prepare accurately dimensioned drawings to locate all required electrical work sleeves, formed openings, and recesses in poured concrete work, and submit the drawings prior to concrete work commencing. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.
  - .3 List of equipment nameplates: submit a list of equipment identification nameplates indicating proposed wording and sizes
  - .4 Waste management and reduction plan: submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section
  - .5 Additional submittals: submit any other submittals specified in this Section or other electrical work Sections of the Specification

## **2 PRODUCTS**

### **2.1 SLEEVES**

- .1 Polyethylene: Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

### **2.2 FIRESTOPPING AND SMOKE SEAL MATERIALS**

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115 and CAN/ULC-S01 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding construction.
- .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.
- .3 Multi-Cable Transits: UL/ULC listed and labelled multi-cable transits sized to the fire barrier opening and to suit the number of cables/conduits involved, and to provide a minimum two hour water-tight fire and smoke seal. Each assembly is to be complete with a stainless steel frame, cadmium plated compression bolts, proper end packing, compression plates, steel stay plates, and fire rated neoprene insert blocks.

### **2.3 WATERPROOFING SEAL MATERIALS**

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit, duct, etc., and the sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the conduit, duct, etc., size and the sleeve size or wall opening size. Acceptable products are:

- .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S
- .2 The Metraflex Co. "MetraSeal" type ES

## 2.4 ELECTRICAL WORK IDENTIFICATION MATERIALS

- .1 Equipment Nameplates: Minimum 3 mm (1/8") thick 2-ply laminated, engraved, coloured plastic plates, minimum 12 mm x 50 mm (1/2" x 2") for smaller items such as single phase starters and disconnect switches, minimum 25 mm x 65 mm (1" x 2 1/2") for equipment, and minimum 50 mm x 100 mm (2" x 4") for panelboards and similar items. Additional requirements are as follows:
  - .1 Unless otherwise specified or required, nameplates are to be white with black wording, except for emergency power system equipment nameplates which are to be red with white wording
  - .2 Each nameplate is to be complete with bevelled edges and wording is to be as large as possible and completely identify the equipment and its use with no abbreviations
  - .3 Wording is generally to be as per the drawings, i.e. LIGHTING PANEL A, and is to include the building area/zone served, but must be reviewed and accepted by the Consultant prior to engraving
  - .4 Supply stainless steel self-tapping screws for securing nameplates in place
  - .5 Nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level
- .2 Self-Adhesive Labels: Equal to Brother "P-Touch" or Thomas & Betts Canada Ltd. "EZCODE" Model EZL500 electronic labelling system self-adhesive labels with size and colour as directed, and permanently printed circuit identification nomenclature which shall be submitted to the Consultant for review and acceptance prior to producing the labels.
- .3 Warning Signs: Equal to Thomas & Betts Canada Ltd. "BP" Series 250 mm x 355 mm (10" x 14") semi-rigid vinyl signs with corner screw holes, the required printed wording (generally red on a white background with black trim) and pressure sensitive adhesive pads on the back.
- .4 Conduit and Armoured Cable Identification: Equal to Brady Canada minimum 50 mm (2") wide self-adhesive coloured vinyl tape.
- .5 Conductor Terminations: Equal to Electrovert Ltd. slip-on "Z" type.

## 2.5 WALL MOUNTING EQUIPMENT BACKBOARDS

- .1 Construction grade fir plywood, G1S, 20 mm (3/4") thick, with width and length as indicated on the drawings or as required for the equipment to be mounted. Each backboard is to be coated on all surfaces with a white flame retardant primer for a flame spread rating in accordance with Code requirements.

## 2.6 FASTENING AND SECURING HARDWARE

- .1 Concrete Inserts: Zinc alloy cast-in-place or "wood-knocker" type formwork anchors for single or double runs of conduit, cable tray, etc., and for equipment, and Unistrut Ltd. or equal multi type inserts for runs of three or more conduits, etc, or where a grid support system is required.
- .2 Concrete Fasteners: Equal to wej-it Fastening Systems anchors or self-drilling anchors, or, for light loads, lead plugs and screws.
- .3 Masonry Fasteners: Equal to wej-it Fastening Systems expansion shields and machine bolts, or, for light loads, lead plugs and screws.
- .4 Gypsum Board Fasteners: Two-wing spring toggles, for light loads only.
- .5 Structural Steel: Equal to Erico International Corp. "CADDY" beam clamps to suit the application.

## 2.7 ELECTRICAL ENCLOSURES

- .1 Unless otherwise specified herein or on the drawings, NEMA, EEMAC, and CSA enclosures for transformers, switchgear, switchboards, panelboards, disconnect switches, starters, motor control centres, and similar equipment are to be as follows:

- .1 Indoor in sprinklered areas – type 2
- .2 Outdoor – type 3R rain-proof
- .3 Indoor in non-hazardous areas except as noted above – type 1

### **3 EXECUTION**

#### **3.1 GENERAL**

- .1 **Manufacturer's Instructions:** For all materials and equipment, ensure that the manufacturers' installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.
- .2 **Cleaning:** Clean all conduit and equipment prior to installation. Temporarily cap or plug ends of conduits/ducts which are open and exposed during construction.
- .3 **Surfaces to Receive Your Work:** Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.
- .4 **Repair of Finished Surfaces:** For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.
- .5 **Work In High Humidity Areas:** Where electrical work is located in high humidity areas or other "wet" areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on the products to protect against corrosion or provide products which will not corrode in the environment, i.e. galvanized hanger and support hardware, aluminium cable tray, etc.
- .6 **Accessibility:** Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all junction boxes and pull boxes, and any other equipment which will or may need access, maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where boxes and similar conduit and conductor system accessories occur in vertical services in shafts, conduit/conductor spaces or partitions, locate the accessories at the floor level.

#### **3.2 GENERAL CONDUIT & CONDUCTOR SYSTEM INSTALLATION REQUIREMENTS**

- .1 Unless otherwise specified, locate and arrange horizontal conduit and conductors above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.
- .2 Unless otherwise specified, install all conduit and conductors concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.
- .3 Conduit and main distribution conductors may be exposed in electrical and mechanical rooms unless otherwise specified or indicated on the drawings or specified in the Specification.
- .4 Install all exposed conduit and conductors parallel to building lines and to each other. Neatly group and arrange all exposed work.
- .5 Do not install conduit and conductors within 150 mm (6") of "hot" piping or equipment unless the conduit and conductors are associated with the equipment.
- .6 All conduit and conductors must be supported from the structure, not from ceiling hangers, piping, ductwork, cable tray, and similar mechanical or electrical products.

#### **3.3 INSTALLATION OF SLEEVES**

- .1 Where conduits, round ducts, and armoured cables pass through concrete and/or masonry surfaces provide sleeves as follows:
- .2 In poured concrete slabs, unless otherwise specified - minimum 16 gauge flanged galvanized steel or,

- where permitted by governing authorities, factory fabricated plastic sleeves
- .3 In concrete or masonry walls - Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe, cut to length
  - .4 Waterproof Sleeves: Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a water stop. Provide waterproof sleeves in the following locations:
    - .1 In mechanical room floor slabs, except where on grade
    - .2 In slabs over mechanical, fan, electrical and telephone equipment rooms or closets
    - .3 In all floors equipped with waterproof membranes
    - .4 In the roof slab
    - .5 In waterproof walls
  - .5 Size sleeves, unless otherwise specified, to leave 12 mm ( $\frac{1}{2}$ " ) clearance around the conduit, duct, or cable.
  - .6 Pack and seal the void between the sleeves and the conduit, duct, or cable for the length of the sleeves as follows:
    - .1 Fire rated construction: pack sleeves in fire rated construction as specified in the article below entitled "INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS"
    - .2 Non-fire rated construction: pack sleeves in non-fire rated interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound
    - .3 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved, non-hardening, silicone based caulking compound unless mechanical type seals have been specified
    - .4 Exterior walls below grade: seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below
  - .7 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
  - .8 Terminate piping used for sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.
  - .9 "Gang" type sleeving will not be permitted.
  - .10 Where sleeves are provided for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of the sleeved opening. Where the sleeve is located in fire rated construction, ensure that the sleeve is sealed with firestopping material.

### **3.4 INSTALLATION OF WATERPROOF MECHANICAL SEALS**

- .1 Provide watertight link type mechanical seals for conduit, round ducts, and/or conductors through exterior wall openings where shown and/or specified.
- .2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.
- .3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

### **3.5 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS**

- .1 Where electrical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 and CAN/ULC-S101-M to seal the penetrations.
- .2 Work is to be performed only by a specialist company using tradesmen experienced in firestopping and smoke seal work.
- .3 When firestopping and smoke seal work is complete, obtain from the specialist firm who performed the work a letter certifying that all required firestopping and smoke seal work has been completed in strict accordance with requirements of the Building Code, ULC requirements, any other applicable local Municipal Codes or Regulations, and the instructions of the firestopping and smoke seal manufacturer. Submit the letter to the Consultant.

### **3.6 INSTALLATION OF CABLE AND CONDUIT TRANSITS**

- .1 Provide fire rated UL/ULC listed transits in rectangular openings in fire rated slabs and walls where cable tray or multiple conduits, ducts, and/or cables penetrate the fire barrier.

### 3.7 INSTALLATION OF FASTENING AND SECURING HARDWARE

- .1 Provide all fastening and securing hardware required for electrical work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.
- .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- .3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and 2.

### 3.8 ELECTRICAL WORK IDENTIFICATION

- .1 General: The following requirements apply to electrical work identification:
  - .1 The size and wording of identification nameplates must be accepted by the Consultant prior to manufacture. Provide shop drawings of all nameplates and labels for review and comment
  - .2 Identification wording for equipment is to follow drawing nomenclature for the equipment, unless otherwise specified
  - .3 Secure nameplate to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces
  - .4 Locate equipment nameplates in the most conspicuous and readable location
  - .5 For multi-cell or multiple component equipment, provide a main nameplate and a smaller nameplate for each component to identify its name and service
  - .6 Colour code: comply with OESC-4-036.
- .2 Distribution Equipment: Provide identification nameplates for new each piece of equipment, including items such as substations, switchgear, switchboards, distribution panels, and similar products. Identification to include registration plates, ULC and CSA approvals, size, equipment model, manufacturers name, serial number, voltage, phase.
- .3 Terminal Cabinets, Pull Boxes, Junction Boxes, Etc.: Clearly identify main pull and junction boxes by spray painting the outside surface of the covers. Paint colours are to be as specified below for conduit and conductor identification. For communication systems, i.e. intercom, TV, etc., provide a nameplate on the painted cover to identify the system involved.
- .4 Transformers: Provide a nameplate to identify the transformer, its capacity, and primary and secondary voltages. Include ULC and CSA approvals, equipment model, manufacturer's name, serial number.
- .5 Branch Circuit Panels: Provide a nameplate to identify the panelboard, the source from which it is fed, and the voltage, and provide identification labels for each circuit breaker.
- .6 Lighting Switches and Receptacles: Unless otherwise specified identify the source panel and circuit number by means of an identification label applied to the wall above the device and inside the outlet box for each device.
- .7 Wire and Cable Terminations: Identify both ends of wire and cable terminations with the same unique number. Where numbers are not indicated or specified, assign a number and record them.
- .8 Hospital Circuits: For dedicated circuit receptacles in critical care and intermediate patient care areas, in addition to requirements specified above, provide engraved "Dedicated Circuit" nameplates on the device faceplates, or, provide faceplates with engraved identification. For corridor 20 ampere housekeeping receptacles, provide engraved "20A Housekeeping" nameplates on the device

faceplates.

### **3.9 GENERAL ELECTRICAL WORK TESTING**

- .1 In addition to tests required by Codes and Regulations, or tests specified in other electrical work sections of the specification, perform the following:
  - .1 After all luminaires, switches, receptacles, motors, signals, and similar electrical items are installed, whether as part of the electrical work or as part of the work of other sections of the specification (telephone system excepted), test all work to ensure that there are no grounds or crosses
  - .2 Establish proper motor rotation, measure full load running currents, and check overload elements, and report any discrepancies to the Consultant
  - .3 Demonstrate to the Consultant that branch circuit voltage drop is within specified limits
  - .4 Ensure that all devices are commissioned and operable

### **3.10 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS**

- .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight until 6:00 a.m.
- .2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform the Owner and Consultant in writing 5 working days in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.
- .5 Coordinate with the Owner all start-up of existing electrical systems which have been shut-down.
- .6 Include in Bid Price for all overtime or premium time hours necessary to minimize duration of service interruptions.

### **3.11 CONCRETE WORK FOR ELECTRICAL EQUIPMENT BASES/PADS, DUCT-BANKS, LIGHTING STANDARD BASES**

- .1 Provide all poured concrete work, including reinforcing and formwork, required for electrical equipment bases/pads, duct-banks, lighting standard bases and all miscellaneous services as shown. Perform concrete work in accordance with requirements specified in Division 3.
- .2 Submit for review, dimensioned shop drawings for all concrete pads or bases for support of large, heavy equipment. Indicate on the shop drawings the total weight of the pad or base as well as the equipment it is provided for, and concrete reinforcing. Shop drawings are to be prepared and stamped by a professional structural engineer registered in the place of the work.

### **3.12 EXCAVATION AND BACKFILL WORK**

- .1 Provide all excavation, backfill and related work required in execution of work under this Division. Perform such work in accordance with requirements of Division 02, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.
- .2 Grade the bottom of trench excavations as required.
- .3 In firm, undisturbed soil, lay duct, conduit, etc., directly on the soil, unless otherwise directed.
- .4 Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of the work. Hand or machine compact the balance up to grade.
- .5 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the duct/conduit, hand compacted

- to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.
- .6 Unless otherwise specified, backfill trenches outside the building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to gradelevel.
  - .7 The location and inverts of existing underground site services shown on the drawings are based on available information and are assumed to be correct, however, prior to excavation, carefully check inverts and locations and report any serious discrepancy, and contact Utilities to accurately locate their services.
  - .8 The Contractor will be held responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.
  - .9 Ensure that all underground work has the proper amount of cover.

### **3.13 CUTTING, DRILLING, AND PATCHING FOR ELECTRICALWORK**

- .1 Provide all cutting, drilling and patching of the building for the installation of the work. Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.
- .2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.
- .3 Where new conduits, conductors, etc., pass through existing construction, core drill an opening. Size openings to leave 12 mm (1/2") clearance around the conduit conductor, etc.
- .4 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray or Ferro Scan test the walls or slabs required.
- .5 The contractor will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of this cutting or drilling work.
- .6 Where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a sleeve which is sized to leave 12 mm (1/2") clearance around the conduit, duct, etc. Provide a sleeve in the opening. Sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100 mm (4") above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.
- .7 Ensure that cutting and patching of roofs and reinforced concrete structures is executed by specialists familiar with the materials affected, and is performed in a manner to neither damage nor endanger the work. Coordinate and supervise such cutting and patching.

### **3.14 PACKING AND SEALING CORE DRILLED OPENINGS**

- .1 Pack and seal the void between the conduit, conductor, etc., opening and the conduit, conductor, etc., for the length of the opening as follows:
  - .1 non-fire rated interior construction: pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal
  - .2 Fire rated construction: pack and seal openings in fire rated walls and slabs as specified in this Section
  - .3 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved, non-hardening, silicone based caulking compound unless mechanical type seals have been specified
  - .4 Exterior walls below grade: seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below

### **3.15 INSTRUCTIONS TO OWNER**

- .1 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of electrical systems and equipment, on two separate occasions.
- .2 Arrange and pay for the services at the site, for the length of time required, of qualified technicians and other manufacturer's representatives to instruct on specialized portions of the installation.
- .3 Ensure each instruction period includes, but is not limited to the following;
  - .1 A classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
  - .2 Instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
  - .3 Demonstration of the proper operating procedures for each item of equipment,
  - .4 Explanation of the purpose and function of all safety devices provided,
  - .5 Demonstration of all measures required for safe and proper access for operation and maintenance.
- .4 Provide a period of follow-up instruction (on two occasions) approximately one month after completing Owner's instruction to clarify and reinforce earlier instructions.
- .5 Submit, prior to Substantial Performance, a complete list of systems for which instructions were given, stating for each system:
  - .1 Date instructions were given to the Owner's staff
  - .2 Duration of instruction
  - .3 Names of persons instructed
  - .4 Other parties present (manufacturer's representatives, etc.)
- .6 Obtain the signatures of the Owner's staff to verify they properly understood the system installation, operation and maintenance requirements and have received operating and maintenance manuals and record drawings.

### **3.16 CLEANING ELECTRICAL WORK**

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean all electrical work prior to application for Substantial Performance of the work.

### **3.17 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE**

- .1 Maintain all equipment in accordance with the manufacturer's printed instructions prior testing and commissioning.

### **3.18 CONNECTIONS TO OTHER EQUIPMENT**

- .1 Carefully examine the Contract Documents during the bidding period and include for electrical work connections to equipment requiring such connections.

### **3.19 EQUIPMENT AND SYSTEM COMMISSIONING**

- .1 Commissioning shall conform to the following standards:
- .2 CAN/CSAZ318.0-05 (R1999) Commissioning of Health Care Facilities The Commissioning Team shall be comprised of:
  - .1 Representatives of the Commissioning Coordinator (commissioning Agent)
  - .2 The individual, company or agency undertaking the work of each Section,
  - .3 Representatives of the Contractor and his sub-contractors as required,
  - .4 Representatives of equipment manufacturers,
  - .5 Representatives of the Consultants,
  - .6 Representatives of the Owner.
- .3 Prior to Substantial Performance, test, adjust, and commission the electrical work. Commissioning work is the process of the Contractor demonstrating to the Owner and Consultant, for the purpose of final acceptance, by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operated and maintained to perform in accordance

with requirements of the Contract Documents, as further described below.

- .1 Operational Performance Testing: the contractor is to test, adjust and operate components, equipment, systems and/or subsystems after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the contract documents, including all modes and sequences of control and monitoring, interlocks, and responses to emergency conditions
- .2 Functional Performance Testing: The Contractor is to repeat successful operational performance testing with documentation by the Contractor in the presence of the Consultant and Owner to validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
- .3 Submittals: The Contractor is to submit final commissioning reports, project closeout documents, and other required submittals.

### **3.20 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction.
- .2 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- .4 Ensure emptied containers are sealed and stored safely for disposal.

**END OF SECTION**

## **1 GENERAL**

### **1.1 APPLICATION**

- .1 This Section specifies requirements, criteria, methods and execution for electrical demolition work that are common to one or more electrical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

## **2 PRODUCTS**

Not Applicable

## **3 EXECUTION**

### **3.1 DISCONNECTION AND REMOVAL AND/OR RELOCATION OF EXISTING ELECTRICAL WORK**

- .1 Where indicated on the drawings, disconnect and remove existing obsolete electrical work. Disconnect at the point of supply, remove obsolete connecting services and conductors, and make the system safe. Cut back obsolete conduit behind finishes and cap water-tight unless otherwise specified.
- .2 Relocate existing items as indicated. Include for new boxes, conduit, conductors, etc., as required, and test all relocated work as for new work. Provide blank coverplates on existing obsolete boxes which are to remain in position. Material and finish of blank coverplates is to match existing coverplates in the area.
- .3 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Determine the scope, extent and cost of the work at the site during the bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
- .4 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.
- .5 Where existing electrical services extend through or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.
- .6 Under all conditions and circumstances, existing electrical systems and services serving operating portions of the building must be maintained in service. Include for all work to comply with this requirement.
- .7 If and where new openings for doors, windows, etc., are to be cut in existing building surfaces, be present when the work is done and should any damage occur to existing systems required to remain in operation, repair the damage immediately and report the incident to the Consultant.
- .8 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused. Refer to waste management and disposal requirements specified in the Basic Electrical Materials and Methods Section.
- .9 Where existing panelboard breakers are removed, replaced, or otherwise revised, provide new typed panelboard circuit directories.
- .10 Before beginning Work and admittance of any workers on the site, furnish the Consultant with a report in the form of a deficiency list, covering all fittings, fitments, fixtures, surfaces, and any other building component in the existing buildings and exterior building surfaces or site work where Work is being done, whose proximity to alteration Work renders it vulnerable to damage.
- .11 Existing raceways shall not be used for new and/or relocated wiring unless otherwise noted and/or reviewed and accepted in writing by the Consultant.
- .12 Existing items to be relocated shall be cleaned and repaired or altered as required to suit new location. All damaged or ineffective parts shall be replaced and the item made "as new".
- .13 Make good all surfaces and finishes in areas from which items have been removed and in which items are relocated. Cap all existing services required to be severed to effect alterations and do all other

- work necessary to make good such areas to satisfaction of consultant.
- .14 Openings in existing floor assemblies and vertical fire separations necessitated by installation of equipment and systems or construction in general to be temporarily sealed with fire barrier materials such as mineral wool or other noncombustible insulation.
  - .15 Existing equipment and systems that are shut down due to work of this project, shall be tested and proper operation verified when returned to service.
  - .16 All existing dead wiring and conduit in renovated areas shall be removed in its entirety where accessible. Where not accessible, wiring only shall be removed and conduit shall remain.
  - .17 Disconnect and remove any electrical equipment in ceiling space or walls that causes interferences during renovation work. All equipment shall be reinstalled and reconnected upon completion of renovation work.

### **3.2 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS**

- .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight until 6:00 a.m.
- .2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform the Owner in writing 5 working days in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.
- .5 Coordinate all start-up of existing electrical systems which have been shut-down with the Owner.
- .6 Include in Bid Price for all overtime or premium time hours necessary to minimize duration of service interruptions.

**END OF SECTION**

## **1 GENERAL**

### **1.1 SUBMITTALS**

- .1 Test Reports: Submit signed test reports for all testing work specified.
- .2 Approval Certificates: Submit Certificates of Approval as issued by governing authorities.
- .3 Electrical Distribution System Coordination Study: Submit the electrical distribution system protective device coordination study specified in Part 3 of this Section, prior to energizing the electrical distribution equipment.

## **2 PRODUCTS**

Not applicable.

## **3 EXECUTION**

### **3.1 GENERAL ELECTRICAL WORK TESTING REQUIREMENTS**

- .1 Satisfactorily perform all testing required by governing authorities, Codes, Regulation, and the Specification, including general testing specified below. Prepare and sign test reports to confirm satisfactory completion of testing and submit as specified in Part 1 of this Section.
- .2 Perform testing to suit phasing of the work, as applicable.
- .3 Leaks, Grounds, and Crosses: After luminaires, switches, receptacles, motors, signals, and similar equipment has been installed, whether or not the work has been installed as part of the work of this Division of the Specification or by other Divisions (telephone system excepted), test the work to ensure that there are no leaks, grounds, or crosses.
- .4 Branch Circuit Voltage Drop: Demonstrate to the Consultant that branch circuit voltage drop is within specified limits.

### **3.2 EMERGENCY POWER SYSTEM**

- .1 Perform testing and coordination of the emergency engine generator set and distribution to ensure that the system performs in accordance with requirements of CSA C282, Emergency Electrical Power Supply for Buildings. Perform the necessary adjustments, when required, such that the system transfers essential loads to emergency power within the required response time.

### **3.3 GROUNDING AND BONDING SYSTEM**

- .1 Provide visual and mechanical inspection of the grounding and bonding system and verify that the system is in compliance with all requirements.

### **3.4 DISTRIBUTION SYSTEM TESTING AND COORDINATION STUDY**

- .1 Appoint and pay for independent inspection and testing consultant specializing in this work to carry out a complete coordination study of primary and secondary power distribution to verify proposed load shedding arrangements,] and to perform on-site pre-service inspection, testing of electrical equipment, and any other witness tests as required by governing authorities. Prior to appointment of testing consultant obtain approval of Consultant as to the coordination study format.
- .2 Coordinate electrical work and inspection and testing company work and provide adequate advance notice as to when the work of this section will be ready for inspection and testing. Allow sufficient time to carry out inspection and testing as specified herein.
- .3 Submit initial short circuit/coordination study with equipment shop drawings for Consultants review and prior to release of equipment for manufacture. If formal completion of the study may cause delay in equipment manufacturer approval from the Consultant may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
- .4 The electrical distribution system protective devices have been selected such that protection is adequate and proper coordination is possible, however, since differences do exist between

manufacturers of equipment, some changes in trip ratings or relay settings may be necessary and are to be performed as part of the work, prior to energizing the electrical distribution system and these changes shall be included at no extra cost to the Owner. To determine the above, a testing and coordination study of the electrical distribution system equipment is to be performed by one of the following companies:

- .1 G. T. Wood Co. Ltd.
- .2 Brosz and Associates Ltd.
- .3 Rondar Inc.
- .4 Siemens Westinghouse Technical Services
- .5 Schneider Canada
- .6 Cutler-Hammer Engineering Services
- .5 Short Circuit and Coordination Study: Immediately upon notification of award of Contract, arrange for the testing company to perform the following:
  - .1 cooperate with and obtain from manufacturers of the distribution system equipment a list of equipment requiring protective devices to be used, and, along with the manufacturers, ensure that proper control and protective devices are selected such that they can be properly coordinated
  - .2 prepare, as soon as possible, a set of coordination curves on proper time current characteristic graph paper and submit to the Consultant, accompanied by supporting symmetrical as well as asymmetrical fault current calculation data with tabulations to verify protection of the various distribution system elements under maximum and minimum fault conditions at the various points in the system.
- .6 The graph shall include:
  - .1 Up-to-date system single line diagrams for high voltage and low voltage systems
  - .2 Composite time-current characteristic curves of all pertinent relays, breakers, fuses and the like including the thermal damage curves for cables, transformers, motors and the like.
  - .3 Summation chart showing all ratings and settings referenced to the appropriate time-current characteristic curve.
  - .4 Three phase bolted fault current, symmetrical and asymmetrical, and minimal arcing ground fault values.
- .7 Plot the time current characteristic curves for the following:
  - .1 main and feeder protective devices at all voltage levels used in the distribution system
  - .2 protective devices associated with the largest motor in each motor control center, the refrigeration machine compressors (as applicable), and the largest load fed from each distribution panelboard
  - .3 emergency power engine generator set protective devices, damage curves, and current decrement curves
- .8 Where relays, breakers, etc., do not perform to approved coordination curves they are to be revised at no cost as part of the work
- .9 Complete system shall be coordinated as follows:
  - .1 Coordinate all protective devices in all switchgear, switchboards, distribution panels and branch circuit panels so that smaller low voltage branch feeder breaker will, in the event of fault, interrupt before main breaker. Main secondary breakers shall interrupt before high voltage breaker of fuse supplying Supply Authority transformer, and the like. Coordinate with Supply Authority.
  - .2 Coordinate main breakers in all panelboards so that they will trip prior to the breaker in upstream distribution equipment supplying same.
  - .3 Coordination shall typically include at least one stage upstream to the last protective device.
  - .4 Set ground fault, short time, and long time trip devices as directed by coordination study and/or Consultant.
- .10 The on-site test and coordination study of distribution system protective devices is to include, as applicable:
  - .1 Primary and secondary voltage switchgear and transformers.
  - .2 Automatic load shedding and load management arrangement.
  - .3 Major interconnecting cables and busways.
  - .4 testing, cleaning when necessary, and calibrating relays and circuit breaker trip devices

- (calibration of protective devices is to conform to requirements of approved coordination curves)
- .5 a function test of associated control devices
  - .6 replacement of any fuses destroyed during tests at no additional cost
  - .7 an acceptance test in the presence of and to the satisfaction of the Consultant
  - .8 the presence at the site, for the length of time required, of qualified equipment manufacturer's service representatives
  - .9 an insulation resistance test of "load" side feeders with respect to ground
  - .10 a test of cables, distribution and branch circuit panelboards, distribution transformers, power receptacles and switches
  - .11 testing of motor control centers, motor starters, and, where supplied as part of the electrical work, variable speed drives
  - .11 Necessary data required to complete this coordination study shall be obtained from the Supply Authority and manufacturers of protective devices in the system.
  - .12 Ensure that the suggested settings of the devices, as determined from the coordination study are acceptable to the Supply Authority.
  - .13 Short circuit and coordination study shall be prepared under the supervision and sealed by a Professional engineer licensed in the Province of Ontario.
  - .14 Inspection and testing shall be done prior to the system being energized and typically will include:
    - .1 Arrange with manufacturer to witness plant test of all low voltage breakers and associated control equipment and ensure proper functioning of all elements prior to shipment to site.
    - .2 Check all control devices in automatic transfer scheme and ascertain their proper connection prior to energizing the system.
    - .3 Check all bus connections, bus joints, and clearances in all equipment before energizing.
    - .4 Verification of potential and current transformers.
    - .5 All reports required from switchboard and switchgear manufacturers shall be sent to manufacturers prior to commencing of manufacturing of switchgear.

**END OF SECTION**

## 1 GENERAL

### 1.1 SUBMITTALS

- .1 Product Data: Submit product data for cable ducts.

## 2 PRODUCTS

### 2.1 PVC DUCTS AND FITTINGS

- .1 Rigid type EB1 PVC duct to CSA C22.2 No.211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit, with manufactured bends, coupling, bell end fittings, and similar items supplied with the duct and constructed of the same material as the duct, and solvent weld joints.

### 2.2 DUCT SPACERS

- .1 PVC duct spacers to maintain 75 mm (3") spacing between ducts horizontally and vertically, and to suit the configuration of the duct installation and the duct diameter.

### 2.3 CABLE PULLING ROPE

- .1 Minimum 6.4 mm (¼") dia. stranded nylon polypropylene rope, minimum 5 kN tensile strength.

### 2.4 DUCT MARKER TAPE

- .1 Concrete Markers: Precast concrete cable markers, minimum 600 mm x 600 mm x 100 mm thick (24" x 24" x 4") with the required wording and duct direction arrows cast into the top surface.
- .2 Marker Tape: Minimum 150 mm (6") wide minimum 4 mil thick polyethylene marker tape, red with "ELECTRICAL LINE BURIED" wording for service cables, and orange with "COMMUNICATION LINE BURIED" for telephone or other buried communication cable.

## 3 EXECUTION

### 3.1 DUCT INSTALLATION REQUIREMENTS

- .1 Provide all required underground ducts. Conform to drawing details and the duct manufacturer's installation instructions. Clean ducts prior to installation, and temporarily cap exposed ends of duct during construction.
- .2 Locate electric service ducts a minimum of 1.2 m (48") below grade to the top of the ducts. Locate communications cable ducts a minimum of 900 mm (36") below grade to the top of the ducts. Maintain 300 mm (12") horizontal separation between electric service and communication ducts.
- .3 Install the duct on undisturbed soil or on a minimum 150 mm (6") thick granular base compacted to 95% of maximum Proctor dry density, or, for unstable soil, on a 75 mm (3") thick "mud Slab". Install ducts with a slope as indicated, or if not indicated, with a minimum slope of 1 to 400 to drainage points.
- .4 Provide duct spacers at minimum 1.2 m (48") centers and secure ducts to spacers. Stagger joints of adjacent ducts a minimum of 150 mm (6") and ensure that joints are water-tight.
- .5 Make transpositions, offsets, and changes in direction using five degree bend sections, and do not exceed a total of twenty degrees with a duct offset.
- .6 Provide bell fittings at duct terminations at manholes and buildings.
- .7 Prior to concealing, request duct inspection and approval by the Consultant, and demonstrate clear ducts by pulling a steel test mandrel, 12 mm (½") in diameter smaller than the duct diameter through each duct.
- .8 Provide a continuous pull rope in each duct, with 3 m (10') of excess rope at each end.
- .9 Provide continuous marker tape 300 mm (12") below grade over the ducts. Provide concrete markers set so that the top of the marker is 25 mm (1") above grade at maximum 150 m (450") intervals and at each change in direction. Locate concrete markers on "as-built" record drawings.
- .10 Provide electrical trace wire for underground services.

**END OF SECTION**

## 1 GENERAL

### 1.1 SUBMITTALS

- .1 Product Data: Submit product data sheets for all products specified in this Section. Indicate compatibilities and limitations, and application instructions and include data to confirm that the product proposed meets all requirements of the Specification.
- .2 Samples: If requested, submit identified conductor samples.
- .3 MSDS Sheets: Submit Material Safety Data Sheets for conductor pulling lubricants.

## 2 PRODUCTS

### 2.1 DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

- .1 Minimum gauge: #12 AWG, unless specifically noted otherwise. Conductors #12 and #10 AWG are to be solid. Conductors #8 AWG and larger are to be stranded. Use #14 AWG for control wiring unless noted otherwise. All conductors are to be constructed from 98% conductive copper and are to be approved for 600 volts. Conductors are to be colour coded, factory identified on the insulation with the manufacturer's name, conductor size and metal, voltage rating, and CSA type and designation. Conductors are to be as follows:
  - .2 "RW-90" single copper conductor in accordance with CAN/CSA C22.2 No 38, Thermoset-Insulated Wires and Cables, 90°C (194° F) rated, X-link polyethylene insulated for #8 AWG and larger.
  - .3 "TWU" single copper conductor in accordance with CSA C22.2 No. 75, 60° C (140° F) rated, PVC insulated
  - .4 "AC90" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (194° F) rated, X-linked polyethylene insulated copper conductors, a concentric ground conductor, and an interlocking aluminum armor jacket

### 2.2 CONNECTORS

- .1 Conductors In Conduit: Except as noted, equal to Ideal Industries Inc. "Wing Nut" CSA certified, 600 volt rated pressure type twist connectors.
- .2 Conductors 3/0 AWG and Larger: Long barrel, double crimp, compression type lug connectors, unless otherwise specified.
- .3 Armoured Cable: Except as noted, proper squeeze type connectors and plastic anti-short bushings at terminations in accordance with requirements of CSA C22.2 No. 18.3, Conduit, Tubing and Cable Fittings.

### 2.3 CONDUCTOR PULLING LUBRICANT

- .1 Equal to Ideal Industries Inc. "Yellow 77" or ClearGlide", as required.

## 3 EXECUTION

### 3.1 GENERAL RE: CONDUCTOR INSTALLATIONS

- .1 Conform to the following conductor installation requirements:
  - .1 Conductor Routing: Conductor routing indicated on the drawings is schematic and approximate. Determine exact routing and conductor lengths at the site. Route conductors to avoid interference with other work. Unless otherwise specified or shown install conductors parallel to building lines.
  - .2 Conductor Pulling: When pulling conductors into conduit use lubricant and ensure that the conductors are kept straight and are not twisted.
  - .3 Securing/Supporting Conductors: Conform to the following requirements:
    - .1 Neatly secure exposed conductors in equipment enclosures with proper supports and/or ties
    - .2 Support flexible armoured cable in ceiling spaces and stud walls with steel two hole

- cable straps to Code requirements
- .4 Conductor Splicing: Generally conductor splicing is not permitted unless otherwise approved by the Consultant, and if approved, splicing is subject to the following conditions:
  - .1 Splicing is permitted to extend existing conductors
  - .2 For thermoplastic insulated conductors, splices are to be made within an approved electrical box with mechanical compression connectors to suit the type and size of conductors, and the box(es) are to be properly identified and locations are to be indicated on "as-built" drawings
  - .3 Do not splice mineral insulated "MI" cable
  - .4 Do not splice "Teck" cable unless justified by cable pulling tension calculations and when approved by the Consultant, and, if approved, locate splices where directed by the Consultant

**3.2 INSTALLATION OF DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS**

- .1 Provide all required conductors.
- .2 Non-Fire Rated Conductors: Unless otherwise specified herein or on the drawings, non-fire rated conductors are to be as follows:
  - .1 Flexible armoured cable AC90 (BX) may be used ONLY for short drops to lighting fixtures (not more than 1525 mm (5 ft.) per drop.)
  - .2 RW-90 for conductors in underground conduit.
  - .3 For conductors except as specified above or elsewhere in the Specification or on the drawings - T90 Nylon or RW90
- .3 "Teck" Cable Installation Requirements: Install "Teck" cable in accordance with the manufacturer's instructions, including the following requirements:
  - .1 support and secure overhead suspended "Teck" cable on a system of cable tray where indicated
  - .2 secure individual cables to cable tray or, where shown, directly to building surfaces by means of single screw non-ferrous clamps
  - .3 terminate cable with lugs and termination kits supplied with the cable
- .4 Conductor Sizing: Generally, conductor sizes are indicated on the drawings. Unless otherwise specified, do not use conductors smaller than No. 12 AWG in systems over 30 volts. Unless otherwise specified, do not use conductors smaller than No. 6 AWG for exterior luminaire wiring. Conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop in accordance with the voltage drop schedule found at the end of this Section.
- .5 Conductor Colour Coding: Unless otherwise specified, colour code conductors to identify phases, neutral, and ground by means of self-laminating coloured vinyl tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours are to be as follows:
  - .1 phase A – red
  - .2 phase B – black
  - .3 phase C – blue
  - .4 neutral – white
  - .5 control – orange

**3.3 MAXIMUM BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 3% VOLTAGE DROP**

Wire Size	Breaker Size (Amperes)	15	20	30	40	50	60	70	80	100
	Max. Load At 80% (Amperes)	12	16	24	32	40	48	56	68	80
No.12	---	22.0	16.0	---	---	---	---	---	---	---
No.10	---	36.0	27.0	18.0	---	---	---	---	---	---

No.8	---	59.0	44.0	30.0	22.0	---	---	---	---	---
No.6	---	91.0	70.0	47.0	35.0	28.0	23.0	---	---	---
No.4	---	---	109.0	73.0	54.0	42.0	35.0	30.0	25.0	---
No.2	---	---	---	114.0	85.0	68.0	57.0	50.0	41.0	35.0
No.1	---	---	---	---	103.0	85.0	73.0	61.0	50.0	43.0
No.1/0	---	---	---	---	128.0	102.0	85.0	73.0	60.0	48.0
No.2/0	---	---	---	---	---	121.0	100.0	86.0	74.0	60.0
No.3/0	---	---	---	---	---	---	118.0	102.0	88.0	70.0
No.4/0	---	---	---	---	---	---	---	120.0	102.0	83.0
250 MCM	---	---	---	---	---	---	---	---	114.0	91.0
300 MCM	---	---	---	---	---	---	---	---	---	103.0

NOTE: DISTANCES INDICATED IN METERS FROM PANEL TO LOAD FOR SINGLE PHASE.

**END OF SECTION**

## 1 GENERAL

### 1.1 SUBMITTALS

- .1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for products specified in this Section.
- .2 Test Reports: Submit signed test reports for all testing work specified.

## 2 PRODUCTS

### 2.1 GROUND RODS

- .1 Copper-clad steel rods, 20 mm ( $\frac{3}{4}$ " ) dia., 3 m (10') long, complete with a driving cap and a bronze tip.

### 2.2 PLATE ELECTRODES

- .1 Copper plates, 2 m<sup>2</sup> (21.5 ft.<sup>2</sup>), 2 mm (3/32") thick.

### 2.3 GRADIENT CONTROL MAT

- .1 Copper mat, 1.5 m x 1.5 m (5' x 5') consisting of 50 x 50 mesh, 2 mm (3/32") thick.

### 2.4 GROUND ROD GROUND CONNECTION INSPECTION BOXES

- .1 PVC or heavy gauge hot dipped galvanized steel or PVC, minimum 200 mm (8") dia., complete with vandal-proof removable cover.

### 2.5 GROUNDING AND BONDING CONDUCTORS

- .1 Equipment Grounding Conductors: Unless otherwise specified, insulated (green colour) stranded copper conductors, except that conductors #10 gauge and smaller may be solid copper.
- .2 Bonding Conductors: As for equipment ground conductors but bare copper.

### 2.6 GROUNDING AND BONDING CONNECTIONS

- .1 Below Grade: Equal to Erico International Corp. "Cadweld" exothermic welded connections.
- .2 Above Grade: Compression type connectors with zinc-plated fasteners and external tooth lock washers, or, if approved by the Consultant, exothermic connections as for below grade connections

## 3 EXECUTION

### 3.1 GENERAL ELECTRICAL WORK GROUNDING REQUIREMENTS

- .1 Perform all required electrical work grounding and bonding. Unless otherwise specified, grounding and bonding work is to be in accordance with requirements of CAN/CSA-C22.2 No. 0.4-04. Bonding of Electrical Equipment, and the requirements of all other governing authorities.
- .2 Bond metallic conduits, boxes, cable trays, ducts, and non-current carrying metal parts of equipment together to form a continuous ground system. In electrical equipment rooms, solidly bond circuits, switchgear, switchboards, panelboards, transformers, conduits, equipment enclosures, and other equipment to perimeter ground bus using bronze connectors and hardware.
- .3 Install connectors in accordance with the manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury. Install underground conductors a minimum of 450 mm (18") below grade.
- .5 Use tinned copper conductors for aluminum structures.
- .6 Do not use bare copper conductors near un-jacketed lead sheath cables.
- .7 Provide a grounding resistor bank, as indicated.
- .8 Provide zig-zag grounding transformer, as indicated.

### **3.2 ELECTRODE INSTALLATION**

- .1 Provide ground rod or plate electrodes as indicated, and make connections to substation equipment. Ground fences to the grounding system, independent of the station ground.
- .2 Provide gradient control mats where indicated and connect to station ground electrodes and switch mechanism operating rods.
- .3 As indicated on the drawings, where rock and/or sand terrain is prevalent, make special provisions for installing electrodes that will give acceptable resistance to ground values.

### **3.3 EQUIPMENT GROUNDING**

- .1 Provide grounding connections to mechanical and electrical equipment as shown and/or specified on the drawings and in accordance with CAN/CSA C22.2 No. 0.4 and requirements of governing authorities.
- .2 Ground hinged doors of electrical equipment to the equipment enclosure main frame using flexible jumpers.

**END OF SECTION**

## **1 GENERAL**

### **1.1 SUBMITTALS**

- .1 Submit the following for review:
- .2 Product data sheets: submit for special conduit as the Consultant directs
- .3 Additional submittals: submit any other submittals specified in this Section of the Specification

## **2 PRODUCTS**

### **2.1 EMT**

- .1 Galvanized electrical metallic tubing (EMT) to CSA C22.2 No. 83, complete with an interior coating, factory made bends where site bending is not possible, and joints and terminations made with steel couplers and set-screw type connectors with insulated throats, concrete tight where required.

### **2.2 RIGID GALVANIZED STEEL CONDUIT**

- .1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an interior enamel coating, galvanized threads where factory cut, red lead coated threads where site cut, factory made bends where site bending is not possible, factory made and threaded fittings and connectors, and terminations made with rigid couplings, concrete tight where required.

### **2.3 RIGID NON-METALLIC (PVC) CONDUIT**

- .1 Rigid PVC conduit to CSA C22.2 No. 211.1, RT-4 rated Rigid PVC (Unplasticized) Conduit, complete with heat gun bends in conduit to 50 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adapters.

### **2.4 FISH CORD**

- .1 Polypropylene rope.

## **3 EXECUTION**

### **3.1 CONDUIT INSTALLATION REQUIREMENTS**

- .1 General: Refer to the article entitled General Conduit and Conductor Installation Requirements in Part 3 of the Section entitled Basic Electrical Materials and Methods.
- .2 Conduit Types: Unless otherwise specified, provide conduit for all conductors except armoured cable, and except where cable duct or tray or similar product is used. Conduit is to be as follows:
  - .1 For main distribution wiring in electrical rooms and similar areas – rigid galvanized steel
  - .2 For exposed conduit from floor level to 1.2 m (4') above the floor in mechanical and other service rooms – rigid galvanized steel
  - .3 For conduit exposed outside the building except where rigid PVC conduit is permitted – rigid galvanized steel
  - .4 At points where conduit crosses building expansion joints – flexible galvanized steel conduit
  - .5 For branch circuit conductors underground inside the building, and underground outside the building beneath structures and concrete or asphalt paving – rigid PVC
  - .6 For all conduit except as specified above – EMT
- .3 Conduit Fittings: Unless otherwise specified, conduit fittings are to be constructed of the same material as the conduit and are to be suitable in all respects for the application. Provide proper adaptors for joining conduits of different materials.
- .4 Conduit Sizes: Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the Ontario Electrical Safety Code. The sizes of branch circuit conductors

- specified are minimum sizes and must be increased to suit length of run and voltage drop as specified, therefore, when conductor sizes are increased to suit length of run and voltage drop, increase the conduit size to suit. Sizes indicated do not include allowance regarding percentage conduit fill for bonding and grounding conductors unless noted otherwise. Increase conduit size as necessary to comply with OESC-12-1014(4). Conductors in conduit. Do not install conduit less than 12 mm ( $\frac{1}{2}$ " dia.
- .5 Conduit Bends: Site made bends for all conduit must be made using proper bending equipment, bends must maintain the full conduit diameter with no kinking, and conduit finishes must not flake or crack when the conduit is bent.
  - .6 Site Cutting Conduit: Cut square and ream all site made conduit ends. Plug or seal ends of roughed-in conduit which are open and exposed during construction.
  - .7 Threading Conduit: Site cut threaded rigid conduit using proper threading equipment located in an approved area and where protection for adjacent building surfaces is in place. Clean threads and lubricate. Coat rigid conduit threads with red lead or other zinc rich coating. Field threads must be of sufficient length to draw conduits up tight.
  - .8 Empty Conduit: Ensure that all conduit left empty for future wiring is clean, capped, and suitably identified. Provide end bushings and fish cord in all such conduit.
  - .9 Conduit in Concrete: Conform to the following requirements:
    - .1 Where conduit or sleeves pass through cast-in-place structural concrete or where conduit is to be embedded in structural concrete, install the conduit in compliance with requirements of CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction, with specific reference to Section 13.5
    - .2 All conduit in cast-in-place concrete must be secured in a manner such that the conduit will not float when the concrete is poured, and during the concrete pour, the work must be observed to ensure that the conduit is not damaged and is protected from water and/or concrete penetration
    - .3 Where conduits pass by a column, stay at least two times the thickness of the slab and drop away from the column
    - .4 Where conduits terminate adjacent to a column or wall, bring the conduit in toward the column/wall as close to 90° to the face of the column as possible within two times the thickness of the slab and drop away from the column
    - .5 The maximum size of conduit in structural slabs is 1/5 of the solid portion of the slab thickness
    - .6 Where more than two conduits are adjacent to each other, they are to be spaced the greater of 3 diameters or 100 mm (4") apart
    - .7 The total depth of conduits crossing over each other is to be less than one-third the thickness of the slab
    - .8 Place conduit in the middle third of the thickness of the slab, and in no case allow conduit to lay directly on the reinforcing steel
    - .9 Do not run conduit adjacent to parallel reinforcing bars
    - .10 Do not run conduit longitudinally in a beam without specific approval of the Consultant, and pass through beams at right angles to the span of the beam
    - .11 Where conduits pass through beams, stay at least twice the depth of the beam away from the supports
    - .12 Do not run conduits in the slab beside a drop or beam within twice the depth of the slab from the edge of the drop or beam
    - .13 Do not run conduits through shear walls or columns without the specific approval of the Consultant
    - .14 Do not place conduit in structural elements in parking garage structures, water retaining structures, or any other structures subjected to de-icing chemicals, without the specific approval of the Consultant
    - .15 In areas where conduit is not approved by Consultant to be embedded in the concrete, run conduits through beams via sleeved openings coordinated with the trades involved and approved by the Consultant
  - .10 Support of Conduit: Conduit support requirements are as follows:
    - .1 Support underground conduit on a well tamped bed of earth or sand, free from rocks or other protrusions of any kind

- .2 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with the Ontario Electrical Safety Code by means of galvanized steel pipe straps, conduit clips, ring bolt type hangers with galvanized steel hanger rod, or by other approved manufactured devices
- .3 Support multiple metal conduits by means of conduit racks and galvanized steel rod with spacing to suit the requirements of the smallest dia. conduit in the group
- .4 Perforated pipe straps not acceptable
- .11 Conduit Under Slabs-On-Grade: Any proposed use of conduit runs underground below slab, must include for following provisions:
  - .1 Concrete encase conduits of non-ferrous materials and slope to drain properly into a “soak-away” pit
  - .2 The system is to be a pull-in system

**END OF SECTION**

## SUMMARY

- .1 This section includes the following items:
  - .1 Gas-engine generator assembly.
  - .2 Gas engine.
  - .3 Gas fuel system.
  - .4 Control and monitoring.
  - .5 Generator overcurrent and fault protection.
  - .6 Alternator, exciter, and voltage regulator.
  - .7 Outdoor generator-set enclosure.
  - .8 Remote radiator motors.
  - .9 Vibration isolation devices.
  - .10 Finishes.
  - .11 Related Accessories as specified
  
1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
2. KOHLER model KG100 is the basis of design, any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
3. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.
5. Manufacturer Qualifications shall include:
  - .1 ISO 9001 certified for design, development, production, and service complete product line.
  - .2 Produced this type of equipment for a period of at least 10 years.
  - .3 Actively maintaining a 24-hour parts and service organization regularly engaged in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified.
  - .4 Furnish a service agreement that includes system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.
  - .5 Engine-driven generator assembly furnished by a single manufacturer, responsible for design, coordination, and testing of the complete system.

## 1.2 SUBMITTALS

- .1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for the engine-generator set. Ensure that the shop drawings and product data sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section. Shop drawings and product data sheets are to be submitted for:

- .2 The engine and the generator (alternator) and associated engine coolant components with weights, dimensions, electrical characteristics and all performance data, and installation instructions and diagrams for wiring and piping
  - .1 The control panel, including a control wiring schematic, and a description of control panel sequences and integration with other building systems
  - .2 Engine-generator set sound pressure levels under full load
  - .3 Engine exhaust components
  - .4 Certificates.
  - .5 Test and Evaluation Reports
  - .6 Manufacturer's Instruction
  - .7 Source Quality Control Submittals
  - .8 Field or Site Quality Control
  - .9 Manufacturer's Report
  - .10 Special Procedure Submittal
  - .11 Qualification Statement
- .3 Engine Exhaust System Review and Confirmation: Submit a letter from the engine-generator set manufacturer which confirms that the engine exhaust system design and layout, including backpressure, is suitable for proper operation of the set.
- .4 Engine-Generator Set Vibration Analysis: Submit an engine-generator set torsional vibration analysis and a critical vibration analysis prepared by the set manufacturer.
- .5 Emission Summary Report: Submit emission summary report which confirms compliance with the requirements of MOECC, O. Reg. 419/05, Air Pollution – Local Air Quality.
- .6 Spare Parts and Maintenance Supplies: Supply the following spare parts and maintenance supplies:
  - .1 A surface wall mounting identified enameled steel cabinet with shelves, hinged door(s), and keyed lock with a minimum of three identified keys
  - .2 Six fuel oil filter elements with gaskets
  - .3 Six lubricating oil filter elements with gaskets
  - .4 Six air filters elements
  - .5 Two complete sets of spare fuses
  - .6 Two complete and identified sets of spare lamps for all indicating and warning lights
  - .7 One complete set of spare belts
  - .8 A litre of touch up paint for each colour/type of finish used on the set
  - .9 Any special service and/or maintenance tools
- .7 Manufacturer's Inspection & Certification & Start-Up & Test Reports: Submit a report from the generator set manufacturer to confirm that the manufacturer has inspected the completed generator set installation and found it acceptable, and a report documenting that he has supervised successful start-up and adjustment of the equipment, all as specified in Part 3 of this Section.
- .8 Control Panel Keys: Submit a minimum of three identified keys for the engine-generator set control panel door.
- .9 Closeout Submittal: Maintenance Contracts, Operation And Maintenance Data and Warranty Documentation and Training Plan.
- .10 Generator enclosure.
- .11 Maintenance Material Submittals: Provide one (1) copy of the following documents and manuals for the engine, the alternator, and the generator set:
  - .1 Operation Manuals
  - .2 Parts Catalogs
  - .3 Wiring Diagrams.

### 1.3 QUALITY ASSURANCE

- .1 The engine-generator set(s) is to be in accordance with requirements of the following:
  - .1 CSA 282, Emergency Electrical Power Supply for Buildings
  - .2 CSA C22.2 No. 107.2, Battery Chargers

### 1.4 ACCEPTABLE MANUFACTURERS/SUPPLIERS

- .1 Acceptable generator set manufacturers/suppliers are:
  - .1 Cummins Eastern Canada LP
  - .2 Kohler
  - .3 Generac Total Power Ltd.
  - .4 Toromont Cat

## 1.5 ON-SITE TRAINING

- .1 The engine-generator set manufacturer/supplier is to provide the required on-site training for members of the Owner's designated personnel on generator set operation and maintenance procedures up-to a full day if required. The Operating and Maintenance Manuals are to be used during this training.

## 1.6 ON-SITE ONE YEAR SERVICE AND MAINTENANCE

- .1 Include for supplying a generator set supplier's qualified service representative for the following on-site engine-generator set service and maintenance for one year following Substantial Performance of the work:
  - .1 twenty-four hour, seven day a week emergency repair service with a maximum two hour response time
  - .2 all required service and maintenance in accordance with requirements of the O & M Manual, including at least one oil and filter change, and supply of all consumables
  - .3 at the end of the one year period, an inspection and test in accordance with CAN/CSA-C282, Annual Inspection Test and Maintenance Requirements
- .2 Notify the Owner forty-eight hours in advance of each site visit for service and maintenance procedures. One or more Owner's personnel will accompany the service representative during each visit to gain further knowledge re: service and maintenance procedures.

## 1.7 WARRANTY PERIOD TEMPORARY ENGINE-GENERATOR SET

- .1 As part of warranty obligations, include all costs for providing at the site, within two hours of notification by the Owner and failure of a service technician to rectify an operating problem, a fully connected and operating temporary engine-generator set of equal capacity and performance of the specified engine-generator set, should any engine-generator set component failure occur that would prevent the set from operating properly at full capacity.

## 2 PRODUCTS

### 2.1 ENGINE GENERATOR ASSEMBLY

- .1 Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- .2 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and use.
- .3 Power Rating: Standby.
- .4 Nameplate Rating/ Fuel Type: 100 kW NG
- .5 Power Factor: 0.8, lagging.
- .6 Frequency: 60 Hz.
- .7 Voltage: 208V ac.
- .8 Phase: Three-phase four wire, wye
- .9 Governor: Adjustable isochronous, with speed sensing.
- .10 Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
- .11 Capacities and Characteristics:
  - .1 Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries [, with capacity as

- required to operate as a unit as evidenced by records of prototype testing].
- .2 Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- .12 Engine Generator Performance:
- .1 Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
  - .2 Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease and meets ISO 8528-5, Class G2 for standard loads. Voltage recovers and remains within the steady-state operating band within six seconds.
  - .3 Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
  - .4 Transient Frequency Performance: Less than 20 percent variation for 50 percent step-load increase or decrease and meets ISO 8528-5, Class G2 for standard loads. Frequency recovers and remains within the steady-state operating band within five seconds.
  - .5 Output Waveform: At no load, harmonic content measured line to line or line to neutral will not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined in accordance with NEMA MG 1, to not exceed 50.
  - .6 Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system will supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
  - .7 Start Time:
    - a. Comply with NFPA 110, Type 60 system requirements.

## 2.2 GAS ENGINE

- .1 Fuel: Natural gas vapor withdrawal system.
- .2 Rated Engine Speed: 1800 rpm.
- .3 Minimum Standby Load Factor Rating: 82 percent.
- .4 Lubrication System: Engine or skid-mounted.
  - .1 Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  - .2 Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit will be capable of full flow and is designed to be fail-safe.
  - .3 Closed Crankcase Ventilation: System: Prevents crankcase oil vapor from draining or escaping the engine.
  - .4 Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- .5 Review manufacturer's options for generator-mounted cooling system. Some models use charge air cooling.
- .6 Integral Cooling System: Closed loop, liquid cooled, charge air cooler, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
  - .1 Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  - .2 Size of Radiator: Adequate to contain expansion of total system coolant to 110 percent of capacity.
  - .3 Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gauge glass and petcock.
  - .4 Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  - .5 Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant material.
    - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 215 deg F (102 deg C), and noncollapsible under vacuum.
- .7 Muffler/Silencer /Exhaust Aftertreatment:

- .1 Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
  - a. Minimum 65 dB at 500 Hz at 7m distance from enclosure.
- .2 Exhaust Aftertreatment: Selective Catalytic Reduction (SCR) technology.
- .8 Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- .9 Starting System: 12 V electric, with negative ground.
  - .1 Cranking Cycle: As required by NFPA 110 for system level specified.
  - .2 Battery: AGM maintenance free, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
  - .3 Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  - .4 Battery Heater: Thermostatically controlled heater will be arranged to maintain battery above 50 deg F (10 deg C) regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
  - .5 Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and continuous rating per manufacturer's standard.
- .10 Battery Charger:
  - .1 Source Limitations: Obtain battery charger from engine-driven generator manufacturer.
  - .2 UL Compliance: Comply with UL 1236 for Category BBHH.
  - .3 CE Certified.
  - .4 NFPA Compliance: Comply with NFPA 110.
  - .5 Environmental Conditions: Battery charger to withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
    - b. Ambient Temperature: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C) with full charger output available up to 122 deg F (50 deg C).
    - c. Relative Humidity: 0 to 95 percent.
    - d. Altitude: Meets full performance requirements from sea level to 5000 ft. (1600 m). Chargers installed at higher altitudes may automatically derate output power to prevent overheating of internal components but remain operable.
  - .6 Charger Operation: Current-limited, constant-voltage, automatic-boost-type charger designed for AGM maintenance-free batteries, with the following features:
    - a. Automatic three-stage charge cycle for up to three independent batteries simultaneously per charger.
    - b. Output Voltage Regulation: Charger regulates output to within plus or minus 0.5 percent of manufacturer-provided voltage settings despite variations of input voltage, input frequency, and output current.
    - c. Battery Thermal Compensation: Battery temperature compensation with adjustable slope, factory set at minus 0.18 percent per degree C, and equipped for sensing battery temperature.
    - d. AC Input: Charger operates from any 45 to 65 Hz ac source with voltage ranging from 105 to 264 V rms.
  - .7 Retain "LCD Digital Display" Subparagraph below for NFPA level 1 installations.
  - .8 LCD Digital Display: AC input voltmeter, DC output voltmeter, and ammeter (1 percent accuracy).
  - .9 LED Lamp Indicators: Current limit, AC ON, and charger fail.
  - .10 Charger Fail Alarm Contact: Voltage-free (dry type) form "C" output.
  - .11 Filtered output for type VRLA AGM batteries.
  - .12 Charger Enclosure: NEMA 250, Type 1 (IP20), wall mounted and rated for generator duty with charger enclosure vibration resistance.

### 2.3 GAS FUEL SYSTEM

- .1 Natural Gas Piping: Comply with requirements in Section 231123 "Facility Natural Gas Piping."

- .2 Gas Train: Comply with NFPA 37.
- .3 Engine Fuel System:
  - .1 Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to the building exterior.
  - .2 Fuel-Shutoff Solenoid Valves: UL-listed, normally closed, safety shutoff valves; one for each fuel source.
  - .3 Fuel Filters: One for each fuel type.
  - .4 Manual Fuel Shutoff Valves: One for each fuel type.
  - .5 Flexible Fuel Connectors: Minimum one for each fuel connection.

## 2.4 CONTROL AND MONITORING

- .1 This article specifies the subsystem that monitors, protects, and controls the engine generator.
- .2 Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of the same switch initiates generator-set shutdown. When the engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- .3 Rehlko APM603 controller complies with UL 6200 while the APM402 controller complies with UL 508A.
- .4 Comply with UL 508A, UL 6200.
- .5 Configuration:
  - .1 Operating and safety indications, protective devices, basic system controls, and engine gauges will be grouped in a common control and monitoring panel mounted on the engine generator. The mounting method will isolate the control panel from generator-set vibration. Panel will be powered from the engine generator battery.
- .6 Control and Monitoring Panel:
  - .1 Digital engine generator controller with integrated alphanumeric display, providing two lines of data. The display has back lighting for ease of operator use in high- and low-light conditions. Capable of local and remote control, monitoring, and programming.
  - .2 Controller Face Ingress Protection: IP 65.
  - .3 Operating Temperature: Minus 40 to plus 158 deg F (Minus 40 to plus 70 deg C).
  - .4 Maximum Operating Humidity: 95 percent noncondensing.
  - .5 Corrosion Resistant: Tested in accordance with ASTM B117 (salt spray test).
  - .6 Controller Features:
    - a. Mode Selector: Allowing selection of one of the following modes:
      - 1) Off/Reset: Prohibits the generator from starting and resets shutdowns. In this mode, the controller does not respond to remote start and stop commands.
      - 2) Manual: Allows user to locally start and stop to operate the generator. In this mode, the controller does not respond to remote start and stop commands.
      - 3) Auto: Allows generator to start and stop based on remote commands. In this mode, the generator does not respond to manual start and stop commands.
        - a. Emergency Stop Switch: Latch-type remote stop switch, red in color with mushroom-type head. Depressing the stop button will immediately stop the generator set and lock out any automatic remote starting.
        - b. Audible Alarm: Horn sounds for specific warning and shutdown conditions.
        - c. Alarm Silence/Lamp Test Pushbutton: Silences audible alarm when depressed. All controller-indicating lights are simultaneously illuminated while actuated.
        - d. Fault Light: LED indicating abnormal conditions:
          - 1) Yellow: Active warning condition or mode selector switch not in automatic.
          - 2) Red: Active shutdown condition.
            - a. Retain first subparagraph below for Rehlko APM603 controller.

- b. Real-time clock and calendar for time-stamping events.
- c. Engine Control Features:
  - 1) Programmable engine start delay.
  - 2) Programmable engine cool-down delay.
  - 3) Programmable warm-up delay based on time or engine temperature.
  - 4) Programmable idle speed.
  - 5) Programmable cyclic cranking with adjustable on time, off time, and number of cycles.
- d. Event Logging:
  - 1) Maintain record of a minimum of 1,000 events with date and time locally for warning and shutdown faults.
  - 2) Event log easily available for download onto USB storage device or PC.
  - 3) Event Snapshot: Capture 15 seconds of critical data around the time of a fault or warning. Data to be viewable on the controller and downloadable.
- e. Retain first four subparagraphs below for the Rehlko APM603 controller.
- f. Data Logging: Capable of time-based recording of customized parameters.
  - 1) Parameters selectable from all monitored parameters.
  - 2) Sample period configurable from one second to one day.
  - 3) Collected data stored on USB storage device plugged into the control panel.
    - g. Minimum of three user access levels.
    - h. Password protection to prevent unauthorized modification to system parameters.
    - i. Customizable Interface:
  - 4) Overview Screen: Dedicated screen allowing user to display up to 16 parameters for immediate access.
  - 5) Favorites: User-customizable menu set up for enhanced usability.
- .7 Monitoring Instruments: Accessible through the digital engine generator controller and viewable during operation.
  - a. Engine-coolant temperature.
  - b. Battery voltage.
  - c. Running-time meter.
  - d. Engine speed.
  - e. Oil pressure.
  - f. Fuel pressure.
  - g. Retain first five subparagraphs below for the KPS APM603 controller.
  - h. Oil temperature.
  - i. Fuel temperature.
  - j. Intake air temperature.
  - k. Exhaust temperature (with optional sensor).
  - l. Ambient temperature.
  - m. Retain first two subparagraphs below if a charge air cooling system is required, which is only available with Rehlko APM603 controller.
    - n. Charge air pressure.
    - o. Charge air temperature.
    - p. AC output voltage for each phase, 0.25 percent accuracy.
    - q. AC output current for each phase, 0.25 percent accuracy.
    - r. AC frequency meter, 0.25 percent accuracy.
    - s. Retain first subparagraph below for the Rehlko APM603 controller.
    - t. Power factor total and per phase with leading/lagging indication.
    - u. kW total and per phase, 0.5 percent accuracy.

- v. kVARS total and per phase, 0.5 percent accuracy.
- w. kVA total and per phase, 0.5 percent accuracy.
- x. kW hours.
- y. Generator duty level (actual kW loading divided by kW nameplate).
- .8 Service Data: Stored in the controller and available for display.
  - a. Generator model number and serial number.
  - b. Retain first three subparagraphs below for the Rehiko APM603 controller.
  - c. ECM serial number.
  - d. Alternator part number.
  - e. Engine model number and serial number.
  - f. Controller serial number and firmware version.
- .9 Operational Records: Stored in controller beginning at system startup.
  - a. Total run-time hours.
  - b. Total loaded hours.
  - c. Total kW hours.
  - d. Controller run-time hours.
  - e. Number of starts.
  - f. Retain first eight subparagraphs below for the Rehiko APM603 controller.
  - g. Total unloaded hours.
  - h. Controller hours.
  - i. ECM run-time hours.
  - j. Number of crank attempts.
  - k. Last crank duration.
  - l. Last start runtime duration.
  - m. Last start date and time.
- .10 Last stop date and time.
- .11 Maintenance Records: Stored in controller beginning at system startup, user resettable to zero.
  - a. Total run-time hours since last maintenance.
  - b. Total loaded hours since last maintenance.
  - c. Total unloaded hours since last maintenance.
  - d. Total kW hours since last maintenance.
- .12 Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:
  - a. Mode selector switch not in automatic position.
  - b. Overcrank shutdown.
  - c. Low lubricating-oil pressure warning.
  - d. Low lubricating-oil pressure shutdown.
  - e. Low coolant temperature warning.
  - f. First subparagraph below is a common optional feature.
  - g. High engine temperature warning.
  - h. High engine temperature shutdown.
  - i. Overspeed shutdown.
  - j. Low fuel pressure shutdown.
  - k. First subparagraph below is an optional feature for Level 1 engines.
  - l. Coolant low-level shutdown.
  - m. First two subparagraphs below are optional features not required by NFPA 110.
  - n. Coolant high-temperature warning.
  - o. Coolant high-temperature shutdown.
  - p. ECM Digital Trouble Codes warnings.
  - q. ECM Digital Trouble Codes shutdown.
  - r. Loss of ECM Communications shutdown.
  - s. ECM mismatch shutdown.
  - t. Battery high-voltage warning.
  - u. Battery-charger malfunction warning.
  - v. Battery low-voltage warning.

- w. Remote manual stop shutdown.
- x. Local manual stop shutdown.
- y. Alternator protection shutdown.
- z. Overcurrent warning.
- aa. Overcurrent shutdown.
- bb. Underfrequency warning.
- cc. Underfrequency shutdown.
- dd. Overfrequency warning.
- ee. Overfrequency shutdown.
- ff. Overpower warning.
- gg. Overpower shutdown.
- hh. Undervoltage warning.
- ii. Undervoltage shutdown.
- jj. Overvoltage warning.
- kk. Overvoltage shutdown.
- ll. User-defined input warning.
- mm. User-defined input shutdown.
- nn. No oil pressure signal shutdown.
- oo. No speed sensor signal shutdown.
- pp. Fail-to-start shutdown.
- .13 Features in "Connection to Datalink" Paragraph below facilitate connection to building automation system or building control and monitoring system. Coordinate with Drawings and Section covering data transmission and data terminals.
- .14 Connection to Datalink:
  - a. Provide connections for datalink transmission of indications to remote data terminals via [ModBus RTU] [ModBus TCP] [BACnet] [SNMP] <Insert other data protocol>. Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control."
- .15 Supporting Items: Sensors, transducers, terminals, relays, and other devices located on engine or generator unless otherwise indicated.
- .16 Coordinate "Remote Emergency-Stop Switch" Paragraph below with Drawings and NFPA 70.
- .17 Remote Emergency-Stop Switch: Wall mounted unless otherwise indicated. Push button must be permanently labeled and protected from accidental operation.
- .18 Remote Alarm Annunciator: LED indicator light labeled with proper alarm conditions will identify each alarm event, and a common audible signal will sound for each alarm condition in accordance with NFPA 110. The silencing switch in face of panel will silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Controls to include "Lamp Test" momentary switch wired to illuminate all LED indicator lights regardless of alarm state while switch is on. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- .19 Start Signal Wiring Integrity Monitor: UL-listed modular system to monitor condition of generator remote start circuit(s), annunciate faults, and start generator in accordance with NFPA 70, Article 700.10(D)(4).
  - a. Output Contacts: Two form "C" contacts, one for engine start and one for start circuit alarm.

## 2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

- .1 Generator Overcurrent Protective Device:
  - .1 Molded-case circuit breaker, thermal-magnetic type; [100 percent rated; complying with UL 489:
    - a. Tripping Characteristic: Designed specifically for generator protection.
    - b. Trip Rating: Matched to generator output rating.
    - c. Retain "Shunt Trip" Subparagraph below if required for the operation of additional protective relays or devices.
    - d. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.

- e. Mounting: Adjacent to or integrated with control and monitoring panel.
- .2 Insulated-case, electronic-trip breakers in first subparagraph below are susceptible to vibration and should be mounted in a separate enclosure not mounted on the generator skid.
- .3 Insulated-case circuit breaker, electronic-trip type; [80] [100] percent rated; complying with UL 489:
  - a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  - b. Trip Settings: Selected to coordinate with generator thermal damage curve.
  - c. Mounting: Adjacent to or integrated with control and monitoring panel.
- .4 Molded-case type disconnect switch:
  - a. Trip Rating: Matched to generator output rating.

## 2.6 ALTERNATOR, EXCITER, AND VOLTAGE REGULATOR

- .1 Comply with NEMA MG 1.
- .2 Maximum Temperature Rise: 130 deg C at full load over 40 deg C (104 deg F) ambient.
- .3 Drive: Alternator shaft directly connected to engine shaft. Exciter rotated integrally with generator rotor.
- .4 Electrical Insulation: Class H.
- .5 Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation.
- .6 Enclosure: Dripproof.
- .7 Voltage Regulator: Microprocessor-based, high-speed digital voltage regulator, separate from exciter, with three-phase, true RMS sensing, providing performance as specified [ and as required by NFPA 110].
  - .1 Maintain steady-state voltage within 0.25 percent from no load to full load.
  - .2 Adjusting Feature on Control and Monitoring Panel: Provide plus or minus 10 percent adjustment of output-voltage operating band.
- .8 Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- .9 Subtransient Reactance: 16 percent, maximum.

## 2.7 VIBRATION ISOLATION DEVICES

- .1 Review local seismic standard to ensure compliance.
- .2 Elastomeric Vibration Isolators: Oil- and water-resistant elastomer neoprene or natural rubber, molded with a nonslip pattern and baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment. Compliant with ISO 8528.
- .3 Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.
- .4 Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.
- .5 Vibration isolation devices will not be used to accommodate misalignments or to make bends.

## 2.8 FINISHES

- .1 Indoor and Outdoor Enclosures and Components: Heavy-duty, high-durability, fade-, scratch- and corrosion-resistant finish achieved through a multi-stage finishing process from the genset manufacturer including:

2. Pre-cleaning: Enclosure components cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts then subjected to a Zirconium-based conversion coating process to prepare the metal for electrocoat (e-coat) adhesion.
  - .1 Primer: All enclosure parts to receive 100 percent epoxy primer electrocoat (e-coat) with high-edge protection.
  - .2 Finish Coating: Powder-baked paint for superior finish, durability, and appearance.
  - .3 Minimum Enclosure Corrosion Resistance: 3000 hours salt spray test in accordance with ASTM B117.
  - .4 Powder coat for fading and abrasion resistance.

## 2.9 SOURCE QUALITY CONTROL

- .1 Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
  - .1 Tests: Comply with IEEE 115.
- .2 Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  - .1 Test alternator, exciter, and voltage regulator as a unit.
  - .2 Load Test: 25, 50, 75, and 100 percent rated load.
  - .3 Single-step load pickup.
  - .4 Safety shutdown.
  - .5 Overcrank.
  - .6 Locked rotor.
  - .7 Mechanical Readings: Oil pressure, ambient temperature, and coolant temperature.
  - .8 Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  - .9 Maximum power.
  - .10 Voltage regulation.
  - .11 Transient and steady-state governing.
  - .12 Report factory test results within 10 days of completion of test.

## 3 EXECUTION

### 3.1 EXAMINATION

- .1 Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- .2 Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

### 1.2 PREPARATION

- .1 Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service in accordance with requirements indicated:
  - .1 Notify Consultant and Owner no fewer than 5 working days in advance of proposed interruption of electrical service.

### 1.3 INSTALLATION

- .1 Comply with NECA 1 and NECA 404.
- .2 Comply with packaged engine generator manufacturers' written installation and alignment instructions
- .3 Equipment Mounting:
  - 1. Install engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Coordinate size and location of concrete bases for engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
  - 3. Install engine generator with a skin-tight enclosure.
  - .4 Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
  - .5 Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless steel flexible connector, and Schedule 40, black steel pipe, the full size of the drain connection.
  - .6 Gaseous Fuel Piping:
    - 4. Natural gas piping, valves, and specialties for gas distribution are specified in Section 231123 "Facility Natural Gas Piping."
    - 5. LP gas piping, valves, and specialties for gas piping are specified in Section 231126 "Facility Liquefied-Petroleum Gas Piping."
    - .7 Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 1.4 CONNECTIONS

- .1 Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- .2 Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- .3 Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- .4 Connect cooling-system water piping to engine generator with flexible connectors.
- .5 Connect engine exhaust pipe to engine with flexible connector.
- .6 Gaseous Fuel Connections:
  - 1. Connect fuel piping to engines with a gate valve and union and flexible connector.
  - 2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.
  - 3. Vent gas pressure regulators outside building a minimum of 60 inches (1500 mm) from building openings.
- .7 Ground equipment in accordance with [ NFPA 70 and OBC.
- .8 Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide flexible conduit routed to the engine generator from a stationary element.
- .9 Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

### 1.5 IDENTIFICATION

- .1 Identify system components in accordance with Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."
- .2 Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location

## 1.6 FIELD QUALITY CONTROL

- .1 Testing Agency:
  1. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- .2 Tests and Inspections:
  2. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs below as specified in the NETA ATS. Certify compliance with test parameters.
    - a. Visual and Mechanical Inspection:
      - 1) Compare equipment nameplate data with drawings and specifications.
      - 2) Inspect physical and mechanical condition.
      - 3) Inspect anchorage, alignment, and grounding.
      - 4) Verify the unit is clean.
    - b. Electrical and Mechanical Tests:
      - 1) Verify phase rotation, phasing, and synchronized operation as required by the application.
      - 2) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
  3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
  4. Battery Tests: Equalize charging of battery cells in accordance with manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  7. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
  8. Exhaust Emissions Test: Comply with applicable government test criteria.
  9. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 percent step-load increases and decreases and verify that performance is as specified.

10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at **23 ft. (7 m) from edge of the generator enclosure**, and compare measured levels with required values.
  - B. Coordinate tests with tests for transfer switches and run them concurrently.
  - C. Test instruments will have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
  - D. Leak Test: After installation, inspect exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
  - E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
  - F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - G. Remove and replace malfunctioning units and **retest** as specified above.
  - H. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
  - I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
  - J. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load.
    1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
    2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

## 1.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

**END OF SECTION**

## **1 GENERAL**

### **1.1 SUBMITTALS**

- .1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for the transfer switch and all accessories. Ensure that the shop drawings and product data sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section.
- .2 Manufacturer's Inspection & Certification & Start-Up & Test Reports: Submit a report from the transfer switch manufacturer to confirm that the manufacturer has inspected the completed installation and found it acceptable, and a report documenting that he has supervised successful start-up and adjustment of the equipment, all as specified in Part 3 of this Section.
- .3 Operation and Maintenance Training Material: When on-site maintenance and training is complete, supply and hand to the Owner the documents outlining complete operation and maintenance procedures.

### **1.2 QUALITY ASSURANCE**

- .1 The transfer switch is to be in accordance with requirements of the following, as applicable:
  - .1 UL 1008, Standard for Safety Transfer Switch Equipment
  - .2 CSA C22.2 No. 178, Automatic Transfer Switches
  - .3 CSA C282, Emergency Electrical Power Supply for Buildings

### **1.3 ON-SITE TRAINING**

- .1 The transfer switch manufacturer/supplier is to provide the required on-site training session for members of the Owner's designated personnel on transfer switch operation and maintenance procedures up to four hours if needed.

### **1.4 ON-SITE ONE YEAR SERVICE AND MAINTENANCE**

- .1 Include for supplying a transfer switch supplier's qualified service representative for the following on-site transfer switch service and maintenance for one year following Substantial Performance of the work:
  - .1 twenty-four hour, seven day a week emergency repair service with a maximum two hour response time
  - .2 all required service and maintenance in accordance with requirements of the O & M Manual
  - .3 at the end of the one year period, a complete inspection and test
- .2 Notify the Owner forty-eight hours in advance of each site visit for service and maintenance procedures. One or more Owner's personnel will accompany the service representative during each visit to gain further knowledge re: service and maintenance procedures.

## **2 PRODUCTS**

### **2.1 MECHANICALLY HELD LOAD TRANSFER SWITCH**

- .1 Open Transition Type
  - .1 The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators that include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
  - .2 All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
  - .3 The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

- .4 All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
- .5 Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
- .6 Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources is not acceptable.
- .7 Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated CU pressure connectors shall be provided.
- .2 Microprocessor Controller
  - .1 The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
  - .2 A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to  $\square$  1% of nominal voltage. Frequency sensing shall be accurate to  $\square$  0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C (-4 to +140 degrees F) and storage from -55 to +85 degrees C (-67 to +185 degrees F).
  - .3 The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
  - .4 All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
  - .5 The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
    - .1 IEEE472 (ANSI C37.90A) Ring Wave Test.
    - .2 ENC55011 1991 Class A Conducted and Radiated Emission.
    - .3 EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge.
    - .4 EN61000-4-3 Radiated Electromagnetic Field Immunity.
    - .5 EN61000-4-4 Electrical Fast Transient Immunity.
    - .6 EN61000-4-5 Surge Immunity.
    - .7 ENV50141 HF Conducted Disturbances Immunity.
- .3 Enclosure
  - .1 The ATS/BPS shall be furnished in an EEMAC type 1 enclosure unless otherwise shown on the plans.
  - .2 All standard and optional door-mounted switches and pilot lights shall be 16-mm (5/8") industrial grade type or equivalent for easy viewing and replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.
- .4 Controller Display and Keypad
  - .1 A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
    - .1 Nominal line voltage and frequency
    - .2 Single or three phase sensing
    - .3 Operating parameter protection
    - .4 Transfer operating mode configuration  
(Open transition, Closed transition or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without

the use of codes, calculations, or instruction manuals.

.5 Voltage, Frequency and Phase Rotation Sensing

.1 Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E,3 $\phi$	70 to 98%	85 to 100%
Overvoltage	N&E,3 $\phi$	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

.2 Repetitive accuracy of all settings shall be within  $\pm 0.5\%$  over an operating temperature range of  $-20^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ ).

.3 Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

.4 The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

.5 Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

.6 Time Delays

.1 An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

.2 A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

.3 Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

.4 A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

.5 A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes: Acc 31Z

.1 Prior to transfer only.

.2 Prior to and after transfer.

.3 Normal to emergency only.

.4 Emergency to normal only.

.5 Normal to emergency and emergency to normal.

.6 All transfer conditions or only when both sources are available.

.7 All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

.8 All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

.6 Additional Features

.1 A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

.2 A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

- .3 Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
- .4 LED indicating lights (16 mm (5/8") industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- .5 LED indicating lights (16 mm (5/8") industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.  
The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
- .6 Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- .7 Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
- .8 An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.
- .9 The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- .10 Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
  - .1 Enable or disable the routine.
  - .2 Enable or disable transfer of the load during routine.
  - .3 Set the start time.
    - .1 time of day
    - .2 day of week
    - .3 week of month (1st, 2nd, 3rd, 4th, alternate or every)
  - .4 Set the duration of the run.  
At the end of the specified duration, the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- .11 System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,  
Normal Failed  
Load on Normal  
TD Normal to Emergency  
2min15s  
Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
- .12 Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller, which may be preventing load transfer commands from being completed.
- .13 Double Pole Double Throw contacts shall be provided to indicate voltage present at

- the Normal and Emergency source transfer switch terminals.
- .14 Selective load disconnect contacts with double pole double throw contacts with adjustable times delays to operate pre and post transfer.
- .15 Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
  - .1 Event Logging
    - .1 Date and time and reason for transfer normal to emergency.
    - .2 Date and time and reason for transfer emergency to normal.
    - .3 Date and time and reason for engine start.
    - .4 Date and time engine stopped.
    - .5 Date and time emergency source available.
    - .6 Date and time emergency source not available.
  - .2 Statistical Data
    - .1 Total number of transfers.
    - .2 Total number of transfers due to source failure.
    - .3 Total number of day's controller is energized.
    - .4 Total numbers of hours both normal and emergency sources are available.
- .16 Communications Module - The communications shall be capable of connecting to the Ethernet TCP/IP network with standard 10base T(RJ-45) connector. This module shall allow for the seamless integration of existing or new communication transfer devices.
- .7 Withstand and Closing Ratings
  - .1 The ATS/BPS shall be rated 200 kA to close on and withstand the available RMS symmetrical short circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans.
  - .2 The ATS/BPS shall be CSA listed in accordance with CSA C22.2 N0. 178 and be labeled in accordance with that standard's ratings. ATS/BPS which are not tested and labeled in accordance with that standard's section 7, are not acceptable.

**WITHSTAND CURRENT RATINGS when used with MOLDED-CASE CIRCUIT BREAKERS**

<b>Switch Rating (Amps)</b>	<b>WCR</b>	<b>Available Symmetrical Amperes RMS at 600 Volts AC Max. Fuse Size (Amps)</b>
30	100,000	50
70	200,000	150
100	200,000	150
150	200,000	225
260	200,000	600
400	200,000	600
600	200,000	2000
800	200,000	2000
1000	200,000	2500
1200	200,000	2500
1600	200,000	2500
2000	200,000	2500

- .8 Tests and Certification
  - .1 The complete ATS/BPS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
  - .2 Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
  - .3 The ATS/BPS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.
- .9 Service Representation
  - .1 The ATS/BPS manufacturer shall maintain a national service organization of company-employed personnel located throughout Canada. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
  - .2 the manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

### **3 EXECUTION**

#### **3.1 INSTALLATION OF TRANSFER SWITCH**

- .1 Provide an emergency power transfer switch where shown. Unless otherwise indicated, secure the switch enclosure in place, level and plumb, on a concrete housekeeping pad. Ensure adequate clearance for access and maintenance as per Code requirements.
- .2 Provide housekeeping pad and extend 4 inches beyond enclosure.
- .3 Do all required power and control connections in accordance with certified power and control wiring schematics and the switch manufacturer's instructions.
- .4 Carefully coordinate any building automation system connections to the control panel with the trade performing the building automation system work.

#### **3.2 SITE TESTING, START-UP, AND CERTIFICATION**

- .1 When installation of the transfer switch is complete and initial inspections by the supplier's representative have been completed, obtain from the supplier's representative and forward to the Consultant a letter to confirm site inspection and proper installation of the equipment.
- .2 Arrange and pay for the set supplier's representative to supervise start-up of the equipment. and prepare and submit signed start-up reports.
- .3 In addition to testing and verification requirements specified in the Sections entitled Electrical Work Commissioning and Electrical Work Testing, perform testing work as specified herein. Notify the Owner and Consultant ten working days in advance of the site testing, and arrange and pay for the switch supplier's representative and a journeyman electrician to be on-site to conduct the tests. Prepare and submit signed reports to confirm successful testing results. Site tests are to include all functions and features of the transfer switch.

**END OF SECTION**

## 1 GENERAL

### 1.1 SUBMITTALS

- .1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for the engine-generator set enclosure and all accessories. Ensure that the shop drawings and product data sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section. Shop drawings and product data sheets are to indicate:
  - .1 Enclosure design and construction, weights, dimensions, and all features of the enclosure, including the fuel tank sub-base
  - .2 Engine-generator set sound pressure levels (outside the enclosure) under full load
- .2 Acoustic Performance Certification: Submit with enclosure shop drawings a signed and stamped letter from a registered acoustical engineer to state and certify the acoustic performance of the enclosure with the generator-set operating at full emergency power load.
- .3 Enclosure Door Keys: Submit a minimum of three identified keys for the engine-generator set enclosure access door(s).

### 1.2 REFERENCES

- .1 Refer to the following Electrical Specification Divisions:
  - .1 The Section entitled Engine-Generator Set

## 2 PRODUCTS

### 2.1 SKIN-TIGHT TYPE ENGINE-GENERATOR SET ENCLOSURE

- .1 Factory fabricated and assembled outdoor, weather-proof, non-combustible, completely corrosion resistant steel enclosure for mounting on and securement to a concrete base, supplied to the site with the engine-generator set, factory installed and connected, ready for external wiring and exhaust piping connections.
- .2 Enclosure features to include:
  - .1 Dimensions to accommodate all equipment, enclosure to be designed and constructed to suit the environmental conditions of the area at which the engine generator set is to be installed. Enclosure shall be designed and constructed to prevent the entrance of rodents/animals. Enclosure to be installed on the engine generator at the engine generator set manufacturing facility.
  - .2 Emergency stop button accessible from outside enclosure. Tamperproof.
  - .3 Oil and radiator drains. Tamperproof.
  - .4 Rodent guards and skid end caps to prevent animal entry.
  - .5 Paint: the enclosure interior and exterior shall be powder coat painted with a minimum of two (2) coats of rust-inhibiting primer and finished with a minimum of two (2) coats of polyurethane. Final color of finish coat will be selected at shop drawing review.
  - .6 Walls: minimum #12 gauge, factory pre-finished, sheet steel electro-zinc coated before painting, (inside and outside) applied over building wrap with thermal and acoustic insulation, fire rated sound form acoustical sound treatment, a perforated minimum #22 gauge galvanized steel interior liner, and plate type reinforcement behind all wall mounted devices
  - .7 Roof: factory finished sheet steel roofing panels secured to the roof structure with acoustic insulation, perforated liner, and plate type reinforcement as specified for walls. Roof to be peaked to prevent water build-up. Roof finish to match walls specification.
  - .8 Doors: doors of a size to permit easy access to all parts of the engine generator set requiring servicing and monitoring and equipped with:
    - .1 Tamperproof high corrosion resistance stainless steel bolt-on, lift-off hinges with pins of a diameter not less than 10mm (0.375")
    - .2 Flush mounted tamperproof key lockable latches – key alike.
    - .3 Magnetic door contact with wiring in conduit extended to a junction box for sit

- extension to the building.
- .4 Door finishes to match wall finishes
- .5 Windows of "Security" glass mounted on enclosure doors for controls and monitoring viewing.
- .6 Doors to be hinged and removeable to facilitate servicing-tamperproof.
- .9 Enclosure and engine ventilation, and sequence: factory installed and connected supply and exhaust air ventilation system for generator set combustion air cooling and enclosure ventilation, sized to suit requirements and equipped with:
  - .1 Extruded aluminum alloy, 100 mm (4") deep fixed blade weather-proof louvers with stainless steel securement hardware, aluminum mesh framed bird screen, and a factory applied finish with colour to match the enclosure colour, provided for all enclosure ventilation openings
  - .2 Factory installed galvanized steel silencers to ASHRAE and SMACNA standards, selected to meet enclosure noise criteria
  - .3 Opposed blade, insulated, extruded aluminum low leakage dampers with spring stainless steel side seals, self-lubricating bronze bearings, end stops, linkage, and 120 volt or 24 volt spring return, normally open damper operators with enclosures to suit the mounting location
  - .4 Sound attenuated galvanized steel snow/rain hoods, finished to match the enclosure wall finish and supplied loose for site installation over the supply and exhaust air openings
  - .5 A wall mounted propeller exhaust fan with motor guard, motorized damper, and exterior wall hood
  - .6 Ventilation controls are to be factory wired and tested, and the air intake damper is to fully open when the engine starts, and the exhaust fan and motorized damper is to modulate according to the controller, engine temperature sensor, and enclosure ambient temperature
  - .7 Under no circumstance shall the floor area or any of its parts be considered for cooling air intake of discharge requirement of the generator set or its associated equipment.
- .10 Engine exhaust system: factory installed within the enclosure and complete with flexible connection to the engine, exhaust silencer, Schedule 40 mild black steel piping where inside the enclosure, a section of Schedule 40 stainless steel pipe with thimble where the exhaust penetrates the enclosure, and, inside the enclosure, 50 mm (2") thick rockwool rigid insulation with lagged canvas jacket (all meeting CAN/ULC-S102) for the exhaust pipe and silencer
- .11 Electrical work: factory installed and pre-wired in accordance with standards of this Division of the Specification and consisting of:
  - .1 A 60 ampere 120/208 volt 3 phase 4 wire circuit breaker panelboard with bolt-on breakers sized to accommodate all enclosure loads, plus a minimum of three spare 15A-1P breakers, and a typed circuit directory on the panel door under plastic. Panel to conform to Branch Circuit Panelboards specification section of this Division.
  - .2 Totally enclosed LED light fixtures factory installed and connected for a minimum adequate illumination, and controlled by a light switch at enclosure door.
  - .3 An exterior, weather-proof and vandal-resistant lighting fixture with photocell control over each entrance door.
  - .4 A minimum of 1 Specification Grade, duplex, u-ground, 20 ampere duplex receptacles with stainless steel plates and weather proof in use heavy duty cover.
  - .5 A weather-proof, exterior, vandal resistant, emergency power off push button equal to Rockwell Automation/Allen-Bradley 800T Series 55 mm (2¼ ") diameter red mushroom head push button with shroud, thrust washer, and aluminum faceplate with 'EMERGENCY POWER OFF' identification wording, housed in a break glass cover with locking handle operator, located adjacent to each entrance door and factory connected to the engine control panel
  - .6 EMT conduit with galvanized steel boxes inside the enclosure, rigid conduit with FS/FD cast boxes outside the enclosure, with 450 mm (18") of liquid-tight flexible conduit for final connections to motorized or vibrating equipment

- .12 identification and signage: electrical work identification is to be as specified in the Section entitled Basic Electrical Work Materials and Requirements, and signage is to be weather-proof, UV resistant signage with red lettering on a white background, permanently secured in place with exact size and wording approved by the Consultant, but generally, as follows:
  - .1 On the enclosure exterior at each entrance door, AUTHORIZED PERSONNEL ONLY
  - .2 On an interior wall in a visible location at the engine-generator set, "WARNING – KEEP –OFF – GENSET MAY START AUTOMATICALLY AT ANY MOMENT"

### **3 EXECUTION**

#### **3.1 INSTALLATION OF ENGINE-GENERATOR SET ENCLOSURE**

- .1 Include for all lifting, rigging, and hoisting required to place the enclosure, level and plumb, on a concrete base. Secure the enclosure to the base.
- .2 Do all required power and control/communications wiring from the building to the enclosure. Test all connections and functions.
- .3 Connect the enclosure leak detection wiring with all required relays and contacts to the engine-generator set control panel as a control panel alarm.

**END OF SECTION**