



**Project:** Whitby Hospice  
Prince of Wales / Crawford Street  
Whitby, Ontario

**Project ID:** ROA23-001

**Addendum:** 1

**Attention:** Project Bidders

**Date:** May 30, 2024

This Addendum is hereby made a part of the Contract Documents and modifies the original Bidding Documents as noted below. The following additions, deletions and amendments shall be incorporated into the bid submission.

- 1.1 Refer to Specifications
  - 1. Add Electrical Specification as enclosed with this addendum.
  - 2. Add Geotechnical Report as enclosed with this addendum.
- 1.2 Refer to Specifications Section 10 51 13 Metal Lockers
  - .1 ASI Group is an approved manufacturer for the Lockers.

**END OF ADDENDUM**

**PREPARED BY THE CONSULTANT**

**Joseph Ouellette**

**Construction Administration | Principal**

**Signature**

**05-30-2024**

**Date: MM.DD.YEAR**



## 1 GENERAL

### 1.01 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.

### 1.02 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.

### 1.03 NOTE RE: BOLD LETTERING

- .1 **"Bold"** type lettering is used throughout this Specification in an attempt to enhance the readability of the text. The use of **"bold"** lettering does not indicate a greater level of importance.

### 1.04 SUBMITTALS

- .1 As specified in this Section, submit the following to the Consultant:
  - .1 **project close-out documentation:** O & M Manuals, record as-built drawings, and all associated data
  - .2 **progress payment breakdown:** a detailed breakdown of the electrical work cost
  - .3 **Contractor's P. Eng. Documentation:** the name, qualifications, and evidence of current liability insurance for all professional engineers to be retained by the Contractor to perform work associated with the Contract
  - .4 **Extended Warranties:** copies of all extended warranties specified, and in the name of the Owner
  - .5 **O & M Training Schedules & Manual:** a proposed schedule of demonstration and training dates and times, and a preliminary copy of the training manual developed for operational and maintenance training

### 1.05 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, walls and partitions
  - .2 "exposed" – means work normally visible, including work in electrical and 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
- .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 "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", "inspected by", etc., the Consultant.
- .4 In the electrical specification, singular may be read as plural, and vice-versa.

## **1.06 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 approval.
- .2 An experienced and qualified superintendent is to be on-site at all times when electrical work is being performed.

## **1.07 CODES, REGULATIONS, AND STANDARDS**

- .1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time of bidding on this Project.
- .2 All electrical items 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.
- .3 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

## **1.08 IMPERIAL AND METRIC MEASUREMENTS**

- .1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .2 Both Metric and Imperial units of measurement are indicated in the electrical Specification. Metric measurements are "soft" and have been rounded off.

## **1.09 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.

## **1.10 DRAWINGS AND SPECIFICATION**

- .1 Read the electrical work drawings in conjunction with all other structural, architectural, sprinkler, mechanical, etc., drawings.
- .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 your cost, 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 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at your cost.
- .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 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the costliest arrangement will take precedence.
- .9 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
- .10 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

#### **1.11 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, including structural components of the building. 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 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") diameter
- .7 smaller branch ductwork
- .8 conduit less than 100 mm (4") diameter
- .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, raceway, 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 your work.
- .4 All junction boxes, 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.

#### **1.12 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 notifications 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

#### **1.13 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. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- .2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.

#### **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.
- .3 **Asbestos, Mould, Lead Paint, Etc.:** If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from the Owner.

#### 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. The number of copies of shop drawings and/or product data sheets will be as later directed.
- .2 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.
- .3 Unless otherwise specified or required, submit shop drawings/product data sheets via email in AutoCAD or PDF format only.
- .4 Wherever possible, shop drawings and/or product data sheets are to be 215 mm x 280 mm (8½" x 11"), 215 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17") single side white bond paper with sufficient clear space for review stamps, comments, and identification as specified below.
- .5 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.
- .6 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. "Lighting Fixture F1", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.

- .7 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "Correct for Review By Consultant", or "Certified to Be In Accordance With All Requirements" and include your company name, the submittal date, and the signature of an officer of your company to indicate your review and approval as above.
- .8 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 Noted"** to indicate that his review is final and no re-submittal is required
  - .2 **"Returned For Correction"** 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
- .9 The Consultant will retain one or two copies of each shop drawing or product data sheet submission.
- .10 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:

"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 product data/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 product data/shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be 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."

## 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 approval, a quotation being your proposed cost for executing the change or revision.
- .2 Your quotation is to be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 Unless otherwise stated in the Contract Documents, 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 such as Allpriser, less applicable trade discounts

- .3 costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and must reflect the actual personnel performing the work
  - .4 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 if overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in preceding Sections of the Specification, but allowable under the Contract, then allowable percentages for mark-up and overhead and profit are to be 10% and 5% respectively
  - .7 the overhead percentage will be deemed to cover all quotation costs other than actual site labour, product 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 your 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 SCAFFOLDING, RIGGING, AND HOISTING**

- .1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

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

- .1 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following:
  - .1 Operating and Maintenance Manuals
  - .2 as-built record drawings and associated data
  - .3 extended warranties for equipment as specified
  - .4 all operating test certificates, i.e. Fire Alarm System Test Certificate
  - .5 identified keys for electrical equipment and/or panels for which keys are required, and all other items required to be submitted

.6 other data or products specified

.2 **Operating and Maintenance Manuals:** Submit three hard copies of operating and maintenance manuals consolidated in hardcover three "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently 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

.2 a Table of Contents sheet, and corresponding index tab sheets

.3 a copy of each "Reviewed" or "Reviewed As Noted" 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 test reports, and certificates issued by governing authorities

.5 **Operating Data:** Operating data is to include:

.1 a description of each system and its controls

.2 operation instruction for each system and each component

.3 description of actions to be taken in event of emergencies and/or equipment failure

.6 **Maintenance Data:** Maintenance data is to include:

.1 servicing maintenance, operation and trouble-shooting instructions for each item of equipment and each system

.2 schedules of tasks, frequency, tools required, and estimated task time

.3 complete parts list with numbers

.7 **Performance Data:** Performance data is to include:

.1 equipment and system start-up data sheets

.2 equipment performance verification test results, and final commissioning report

.8 **Review Submittal:** Assemble one copy of the O & M Manual and submit to the Consultant for review prior to Owner training and instructions, and assembling the remaining copies. Incorporate all comments into the final submission.

.9 **Digital O & M Manuals:** Submit 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".

- .3 **Record "As-Built" Drawings and Data:** As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the Contract 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 dimensioned location of all inaccessible concealed work
  - .2 the locations of control devices with identification for each
  - .3 the location of all junction boxes, terminal cabinets, etc.
  - .4 for underground conduit, ducts, etc., record dimensions, invert elevations, all offsets, fittings, and accessories if applicable, and locate dimensions from benchmarks that will be preserved after construction is complete
  - .5 the location of all concealed services terminated for future extension
  - .6 **Digital Record "As-Built" Drawings:** 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 disc with CAD work of equal quality to the Contract Drawings. Obtain a CAD disc as described below.
  - .7 **Obtaining CAD Discs:** The electrical drawings have been prepared on a CAD system using the latest Release of AutoCad software. For the purpose of producing final as-built drawings, discs of the Contract Drawings will be supplied free of charge by the Consultant.
  - .8 **Review and Submittal:** Prior to inspection for Substantial Performance of the work, submit for review, the red line site as-built white prints, a CAD disc of the as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings) made from the disc. The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the disc and white prints until they are determined to be acceptable, all prior to issue of a Certificate of Substantial Performance.

## 1.20 PROGRESS PAYMENT BREAKDOWN

- .1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.

- .2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning, and project closeout submittals.

#### **1.21 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS**

- .1 All professional engineers retained by you to perform consulting services with regard to your work, i.e. structural engineer, 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 Your engineer's professional liability insurance is to protect your Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your 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
  - .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 form 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

#### **1.22 EXTENDED WARRANTIES**

- .1 Unless otherwise specified, all extended warranties specified in electrical work Sections of the Specification 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.

#### **1.23 EQUIPMENT AND MATERIAL MANUFACTURER REQUIREMENTS**

- .1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.



- .2 In most cases acceptable equipment and material manufacturers are listed for any product specified by manufacturer's name and model number. Unless otherwise stated the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.
- .3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by 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 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, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

#### **1.24 LIST OF ACCEPTABLE MANUFACTURERS AND SUPPLIERS**

- .1 Within one day after award of a Contract, submit to the Consultant for review, a list to indicate the name of the manufacturers/suppliers you propose to use for each item of equipment, material, or service listed, except for items such as conduit, branch circuit conductors, and similar products. Manufacturers and/or suppliers on the list must be named in the Specification or on the drawings.
- .2 If the List of Acceptable Manufacturers and Suppliers is not submitted within one day after award of a Contract, the products specified and scheduled by manufacturer's name and model number and on which the Project is based are to be supplied. No substitutions whatsoever will be accepted unless previously approved in writing by the Consultant.
- .3 If a Supplementary Bid Form is issued with the Bid Documents and requests the list of acceptable manufacturers and suppliers, the completed Supplementary Bid Form is to be submitted within one day after the date for bid closing.

#### **1.25 SUBSTITUTED OR ALTERNATIVE PRODUCTS**

- .1 Products supplied by a manufacturer/supplier other than a manufacturer specified as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of five full working days prior to the bid closing date. Requests may be made by letter, 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 manufacturer. In addition, in equipment spaces where substituted or alternative products are used in lieu of the specified or acceptable products and the dimensions of such products differ from the specified or acceptable products, prepare and submit for review, if requested, 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.

#### **1.26 IDENTIFIED PRICES**

- .1 Identified prices for work consist of alternative prices, separate prices, and itemized prices. Definitions of these prices are as follows:
  - .1 **Alternative Price(s):** An alternative price the difference in the bid amount (plus or minus) for substituting specified work or products for alternative work or products.
  - .2 **Separate Price(s):** A separate price is the amount of money to be added to the bid amount for new work not included as part of the Bid Documents.
  - .3 **Itemized Price(s):** An itemized price is the amount of money included in the bid amount for work as described.

#### **1.27 HEALTH CARE FACILITY INFECTION CONTROL**

- .1 The following CAN/CSA Standards apply to the work of this Project and are to be adhered to:
  - .1 CAN/CSA-Z317.13, Infection Control During Construction, Renovation, and Maintenance of Health Care Facilities: Prepare a list of all areas of the work where the infection control procedures are to be in force and review the list and procedures with the Hospital's Infection Control Officer or a designated hospital representative prior to any work in the areas commencing, and as work proceeds ensure that all infection control procedures are being maintained.
  - .2 CAN/CSA-Z317.10, Handling of Waste Materials in Healthcare Facilities
  - .3 CAN/CSA-Z32-99. Electrical Safety and Essential Electrical Systems in Healthcare Facilities
  - .4 CAN/CSA-Z318.0, Commissioning of Healthcare Facilities

#### **1.28 PHASING OF THE WORK**

- .1 Phasing of the work is required to maintain the existing building in operation, all as specified in Division 01. Include all costs for phasing the work including all required "off hours" premium time labour costs.

#### **1.29 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 and in accordance with the equipment/system manufacturer's instructions.

#### **1.30 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:
  - .1 submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review, and incorporate any comments
  - .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

### 1.31 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 After successful start-up and prior to Substantial Performance, commission the electrical work using approved commissioning sheets. Submit final commissioning data sheets. Include for equipment manufacturer's representation at the site to assist in the commissioning process

### 1.32 EQUIPMENT AND SYSTEM O & M DEMONSTRATION & 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, preventive 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 7 working days' notice.
- .6 **Demonstration and Training Confirmation:** Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

## 2 PRODUCTS

NOT APPLICABLE

## 3 EXECUTION

NOT APPLICABLE

**END OF SECTION**

## 1 GENERAL

### 1.01 APPLICATION

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

### 1.02 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 **access door locations:** submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas
  - .3 **samples:** submit a sample of each proposed type of access door, and samples of materials and any other items as specified in electrical work Sections of the Specification
  - .4 **list of equipment nameplates:** submit a list of equipment identification nameplates indicating proposed wording and sizes
  - .5 **conduit & conductor identification:** submit a list of conduit and conductor identification colour coding and wording
  - .6 **sleeve and formed opening location drawings:** submit, prior to concrete pours, accurately dimensioned drawings to locate all required sleeves, formed openings, and recesses required in poured concrete
  - .7 **waste management and reduction plan:** submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section
  - .8 **additional submittals:** submit any other submittals specified in this Section or other electrical work Sections of the Specification

## 2 PRODUCTS

### 2.01 SLEEVES

- .1 **Galvanized Sheet Steel:** Minimum #16 gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.

- .2 **Polyethylene:** Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.
- .3 **Waterproof Sleeves:** Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint, or PSI-Thunderline "Century-Line" Model CS HDPE sleeves.
- .4 **Galvanized Steel:** Schedule 40 mild galvanized steel.

## **2.02 MULTI-CABLE TRANSITS**

- .1 UL/ULC listed and labelled multi-cable transits sized to suit the fire barrier opening and the number of cables/conduits involved and to facilitate a minimum 2 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.

## **2.03 FIRESTOPPING AND SMOKE SEAL MATERIALS**

- .1 Firestopping and smoke seal system materials for electrical penetrations through fire rated construction are specified in Division 07 and the work will be done as part of the work of Division 07.
- .2 Firestopping and smoke seal system materials for electrical penetrations through fire rated construction are specified in the electrical work Section entitled Firestopping and Smoke Seal Systems and the work is to be done as part of the electrical work.

## **2.04 WATERPROOFING SEAL MATERIALS**

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe 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 pipe size and the sleeve size or wall opening size. Acceptable products are:
  - .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
  - .2 The Metraflex Co. "MetraSeal" type ES.

## **2.05 ESCUTCHEON PLATES**

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the conduit/cable sleeve or building surface opening, and to fit tightly around the conduit or cable.

## **2.06 ACCESS DOORS**

- .1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16 gauge frame, minimum #18 gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it is to be installed.

- .2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.
- .4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish.

## 2.07 IDENTIFICATION MATERIALS

- .1 **Equipment Nameplates:** Minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as single phase starters and switches, minimum 25 mm x 65 mm (1" x 2½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
  - .1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved capital letter wording to completely identify the equipment and its use with no abbreviations;
  - .2 wording is generally to be as per the drawings, i.e. Lighting Panel A, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;
  - .3 supply stainless steel screws for securing nameplates in place
  - .4 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 is to be approved by the Consultant 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), pressure sensitive adhesive on the back, and stainless steel screws.
- .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
- .6 **Conductor Colour Coding:** As specified with the conductors.
- .7

## **2.08 ELECTRICAL ENCLOSURES**

- .1 Unless otherwise specified electrical enclosure are to be wall mounting NEMA/EEMAC/CSA enclosures as follows:
  - .1 indoor in sprinkler protected areas, Type 2
  - .2 indoor in high humidity/washdown areas, Type 4
  - .3 indoor in corrosive environments, Type 4X, 316 stainless steel
  - .4 indoor explosion-proof, Class 1, Groups C & D, Type 7
  - .5 outdoor, Type 3R
  - .6 indoor in non-hazardous areas except as noted above, Type 1

## **2.09 ENCLOSURE BACKBOARDS**

- .1 Construction grade Fir plywood, G1S, 20 mm ( $\frac{3}{4}$ ") thick with width and length to suit enclosure dimensions, coated on all surfaces with a ULC listed water based latex intumescent flame retardant paint, ASTM E-84 Class A rated.

## **3 EXECUTION**

### **3.01 GENERAL ELECTRICAL WORK INSTALLATION REQUIREMENTS**

- .1 Unless otherwise specified, locate and arrange horizontal conduits, raceways, 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 conduits 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 Unless otherwise specified conduits and main distribution conductors may be exposed in equipment rooms.
- .4 Install all exposed conduits, raceways, and conductors parallel to building lines and to each other.
- .5 Do not install conduit, raceway, or conductors within 150 mm (6") of "hot" piping or equipment.
- .6 All conduit, raceway, conductors, etc., must be supported from the structure, not from ceiling hangers, piping, ductwork, cable tray, and similar mechanical or electrical products.
- .7 Neatly group and arrange all exposed work. Do not install conduit to prevent access into equipment.



- .8 **Access:** Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all products which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where such products occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.
- .9 **Manufacturer's Instructions:** Ensure that equipment and material manufacturer's installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.
- .10 **Cleaning:** Carefully clean all conduits, raceway, fittings prior to installation. Temporarily cap or plug ends of conduit which are open and exposed during construction.
- .11 **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.
- .12 **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.
- .13 **Work In High Humidity Areas:** Where electrical work is located in high humidity 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.
- .14 **Work In Health Care Facility Patient Care Areas:** Provide conduit, conductors, and similar work in health care facility patient care areas in accordance with the Ontario Electrical Safety Code, including amendments, and test branch circuits in accordance with CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

### 3.02 INSTALLATION OF SLEEVES

- .1 Where conduits, round ducts, and armoured cable pass through concrete and/or masonry surfaces provide sleeves as follows:
  - .1 **in poured concrete slabs:** unless otherwise specified - minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves
  - .2 **in concrete or masonry walls:** Schedule 40 galvanized steel pipe
- .2 **Waterproof Sleeves:** 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
- .3 Size sleeves, unless otherwise specified, to leave 12 mm (1/2") clearance around the conduit, duct, cable, etc.
- .4 Pack and seal the void between the sleeves and the conduit, duct, cable, etc., in non-fire rated construction for the length of the sleeves as follows:
  - .1 **interior construction:** pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound
  - .2 **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 base caulking compound unless mechanical type seals have been specified
  - .3 **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.
- .5 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
- .6 Terminate 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.
- .7 "Gang" type sleeving will not be permitted.
- .8 Where sleeves are provided in non-fire rated construction for future services, or where conduit, ducts, cable, etc., has been removed from existing sleeves, cap and seal both ends of the sleeved opening.

### 3.03 RECTANGULAR OPENINGS

- .1 Rectangular openings for cable tray, raceways, multiple conduits and/or cables and similar rectangular openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.
- .2 **Waterproof Openings:** Provide watertight link type mechanical seals in exterior wall openings where shown or specified. Assemble and install each mechanical seal in accordance with the manufacturer's instructions. After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.
- .3 **Openings In Non-Fire Rated Construction:** For all rectangular openings in non-fire rated construction pack and seal the space between the conduits, ducts, cables, etc., with mineral wool for the full thickness of the building surface penetrated, and seal both ends.
- .4 **Openings In Fire Rated Construction:** Provide multi-cable transits in all fire rated openings and install in accordance with the manufacturer's instructions.

### **3.04 SLEEVE AND FORMED OPENING LOCATION DRAWINGS**

- .1 Prepare and submit for review, white print drawings indicating the size and location of all required sleeves, recesses and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

### **3.05 INSTALLATION OF ESCUTCHEON PLATES**

- .1 Provide escutcheon plates suitable secured over all exposed conduits, ducts, armoured cable, etc., passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
- .2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.

### **3.06 INSTALLATION OF FASTENING AND SECURING HARDWARE**

- .1 Provide fastening and securing hardware required for electrical work to maintain installations attached to the structure or to finished floors, pads, 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 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. Provide reinforcing or connecting supports where required to distribute loading to structural components.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is given comply with requirements of CAN3-Z166.1 and .2.
- .5 Do not attach fasteners to steel deck without written consent from the Consultant.

### **3.07 SUPPLY OF ACCESS DOORS**

- .1 Supply access doors to give access to all electrical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.
- .2 Locate access doors as inconspicuously as possible in walls and partitions and arrange electrical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.

- .3 Group services to ensure the minimum number of access doors is required. Access doors will be installed by the trades responsible for the particular type of construction in which the doors are required.
- .4 Submit a sample of each proposed access door for review prior to ordering.

### 3.08 ELECTRICAL WORK IDENTIFICATION

- .1 Identify all new/relocated electrical work in accordance with existing identification standards at the site.
- .2 Identify all electrical work, including conduit systems and wiring, as follows:
  - .1 the size and wording of identification nameplates must be approved by the Consultant
  - .2 identification wording for equipment is to follow drawing nomenclature unless otherwise specified
  - .3 secure nameplates to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces
  - .4 locate 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 cell or component
  - .6 where electrical work is to be identified in conjunction with mechanical work, coordinate with the mechanical trades to ensure identical tagging
  - .7 all identification wording is to be in English
  - .8 all identification and colour coding is to be indicated on "as-built" record drawings
- .2 **Terminal Cabinets, Pull Boxes, Junction Boxes, Etc.:** Clearly identify terminal cabinets, main pull and junction boxes by neatly spray painting the outside surface of the cover with a paint colour as specified below for conduit and conductor identification. Provide a nameplate on terminal boxes, main pull and junction boxes in communication systems specified in Division 27.
- .3 **Transformers:** Transformer nameplate must identify the transformer capacity as well as primary and secondary voltages.
- .4 **Branch Circuit Panelboards:** Panelboard nameplates must identify the electrical source connected to the panelboard, each circuit breaker, and, neatly typed on the door directory card, the load connected to each breaker.
- .5 **Motor Starters and Disconnect Switches:** Provide nameplates for each motor starter and disconnect located in a motor control centre or on a motor starter panel, and on each individually mounted starter and disconnect provided as part of the electrical work. Nameplates must also indicate the voltage and phase.

- .6 **Luminaires On Emergency Circuits:** Identify all luminaires on emergency circuit by means of a 15 mm (½") diameter self-adhesive red label secured to the T-bar ceiling component adjacent to the luminaire, or if not in a T-bar ceiling, to the frame of the luminaire.
- .7 **Lighting Switches & Receptacles:** Identify each lighting switch and each receptacle by means of a permanent self-adhesive label indicating the source panelboard and circuit number and secured to the device faceplate.
- .8 **Communication Equipment/Systems:** Identify all "head end" equipment with nameplates and all "downstream" devices with self-adhesive labels indicating circuit numbers.
- .9 **Warning Signs:** Provide appropriately worded warning signs secured in place with stainless steel hardware in locations as follows:
  - .1 on all doors into transformer vaults
  - .2 on all doors into high voltage switchgear rooms
  - .3 on all collector bus enclosures
  - .4 on pad mounted transformer enclosures
  - .5 wherever else required by Code
- .10 **Conduit & Armoured Cable:** Colour code conduit and armoured cable by means of 25 mm (1") wide primary colour plastic adhesive backed tape or neatly applied suitable paint with, where scheduled, a 20 mm (¾") wide auxiliary colour at all points where the conduit or cable penetrates a wall, ceiling, floor, at 6 m (20') intervals or at least once in each room or accessible ceiling space, at each access door location, and elsewhere at 15 m (45') intervals. Unless otherwise indicated/specified, colours are to be as follows:

Service	Primary Colour	Secondary Colour
up to 250 volts	yellow	
250 to & including 600 volts	yellow	green
above 600 volts to 5 kV	yellow	blue
above 5 kV to 28 kV	yellow	red
telephone	green	
fire alarm	red	
emergency voice	red	blue
security systems	red	yellow
other communication systems	green	
isolated power	orange	
- .11 **Wire & Cable Terminations:** Identify both end of wire and cable terminations with the same unique number. Where numbers are not indicated or specified, assign a number and record them.
- .12 **Buried Cable/Duct Runs:** Identify buried cable/duct runs under paved and landscaped areas with appropriate concrete markers, flush with grade at each change in direction, at least twice on runs less than 60 m (200') and on 60 m (200') centres on longer runs.

- .13 **Overhead Wiring Service Poles:** Unless otherwise indicated on the drawings identify poles with wording such as "HV#1". For wooden poles use 50 mm (2") high non-corrosive embossed aluminium pole markers. For concrete poles use non-corrosive metal plated secured to the pole with metal strapping.
- .14 **Health Care Patient Care Area Circuits:** For dedicated circuits provide identification as previously specified plus engraved "Dedicated Circuit" nameplates on the device faceplate, or provide faceplates with "Dedicated Circuit" engraved wording. For 20 ampere corridor housekeeping receptacles provide "20A Housekeeping" nameplates on the device faceplate.
- .15 **Distribution System Schematic Diagrams:** Prepare AutoCAD, coloured, 1200 mm x 900 mm (48" x 36") schematic diagrams of electrical distribution systems to identify all equipment and circuits. Install framed and glazed diagrams in electrical rooms housing the system equipment. Confirm location prior to installation. Include reduced size copies of the diagrams in each copy of the O & M Manuals.

### **3.09 INSTALLATION OF TERMINAL BACKBOARDS**

- .1 Provide properly sized plywood backboards for wiring terminals in terminal cabinets and enclosures where shown/specified/required.

### **3.10 GENERAL ELECTRICAL WORK TESTING**

- .1 Perform testing in accordance with the Electrical Work Testing Section, and, in addition, any tests required by governing Codes, Standards.

### **3.11 BRANCH CIRCUIT BALANCING**

- .1 Connect all branch circuits to panelboards so as to balance the actual loads (wattage) to within 5%. If required, transpose branch circuits to achieve this requirement.
- .2 After the building is occupied and if requested by the Consultant, demonstrate that branch circuit balancing has been achieved.

### **3.12 FINISH PAINTING OF ELECTRICAL WORK**

- .1 Finish paint exposed electrical work as specified and/or scheduled in accordance with requirements of the painting Section in Division 09.
- .2 Touch-up paint all damaged factory applied finishes on electrical work products.

### **3.13 SUPPLY OF MOTOR STARTERS AND ACCESSORIES**

- .1 Motor starters for mechanical equipment will be supplied as part of the mechanical work.

### **3.14 ELECTRICAL WIRING WORK FOR MECHANICAL WORK**

- .1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment is to be done as part of the electrical work:

- .1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment
- .2 mounting of individual starters, "line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment
- .3 "line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment
- .4 provision of receptacles for plug-in equipment
- .5 provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring
- .6 all motor starter interlocking in excess of 24 volts
- .7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts
- .8 provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work
- .9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;
- .10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units
- .11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels
- .2 Mechanical wiring work not listed above or specified herein or on the drawings will be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

### **3.15 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 Friday until 6:00 a.m. Monday morning.
- .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 seventy-two hours 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.

### 3.16 EQUIPMENT BASES AND SUPPORTS

- .1 **Concrete Housekeeping Pads:** Unless otherwise specified or required, set all floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the following requirements:
  - .1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads
  - .2 place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment
  - .3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details
- .2 **Structural Steel Stands/Supports:** For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to the following requirements:
  - .1 all stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review
  - .2 all steel stands are to be flange bolted to concrete housekeeping pads
  - .3 all stands and supports are to be seismically restrained in accordance with applicable requirements

### 3.17 CONCRETE WORK FOR EQUIPMENT BASES/PADS

- .1 Provide all poured concrete work, including reinforcing and formwork, required for duct bank and pole bases. Concrete work for equipment pads by Division 03. Perform concrete work in accordance with requirements specified in Division 03.
- .2 Concrete is to be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.
- .3 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.
- .4 Accurately mark-out the location and routing of excavation required for your work, as well as the required depth.

### 3.18 EXCAVATION AND BACKFILL WORK



- .1 Do all excavation, backfill and related work required for your work. Perform such work in accordance with requirements of the Excavation and Backfill Section, 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 ducts, conduits, 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 service. 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 service, 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 grade level.
- .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 You 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 After the first lift of backfill has been compacted, mark the entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.
- .10 Engage the services of an independent soils testing agency to test the final backfill compaction density of each backfilled location. Compact the backfill to the satisfaction of the testing agency and in accordance with the Specification. Submit a copy of the testing agency's report to the Consultant for review.

### **3.19 CUTTING, DRILLING, AND PATCHING**

- .1 Do all cutting, drilling and patching of the existing building for the installation of your 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 (½") clearance around the product involved.

- .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 if required.
- .5 You will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of your 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 ( $\frac{1}{2}$ ") clearance around the product involved. 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.

### 3.20 PACKING AND SEALING CORE DRILLED OPENINGS

- .1 Pack and seal the void between the core drilled opening and the service insulation 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 **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 base caulking compound unless mechanical type seals have been specified;
  - .3 **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.

### 3.21 FLASHING FOR ELECTRICAL WORK PENETRATING THE ROOF

- .1 Do all required flashing work, including counter-flashing, for electrical work penetrating and/or set in the roof.
- .2 Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

### 3.22 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.

### 3.23 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

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

### 3.24 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with requirements specified in Division 01.
- .2 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.
- .3 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.
- .4 Place materials defined as hazardous or toxic waste in designated containers.
- .5 Ensure emptied containers are sealed and stored safely for disposal.

### **3.25 SEISMIC RESTRAINT ANCHOR POINTS FOR EQUIPMENT**

- .1 All electrical equipment requiring seismic restraint (see the electrical work Section entitled Seismic Control and Restraint) is to be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by the equipment manufacturers, so that the equipment may be bolted down or restrained in the field.
- .2 The equipment to be restrained must be designed such that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.

### **3.26 REQUIREMENTS FOR BARRIER-FREE ACCESS**

- .1 Include for all applicable requirements for barrier-free access to electrical devices in accordance with governing Codes and Regulations, whether shown on the drawings, specified, or not

**END OF SECTION**

## **1 GENERAL**

### **1.01 APPLICATION**

- .1 This Section specifies fire stopping and smoke seal 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.

### **1.02 SUBMITTALS**

- .1 **Firestop & Smoke Seal System Samples:** At least four weeks prior to work commencing, submit a sample of each type of firestop and smoke seal system in applied form, for approval. Identify each system with the manufacturer's name and type, the ULC designation, and the proposed use. When the samples are approved, all work is to conform to the approved samples.
- .2 **Product Data & WHMIS Sheets:** Submit a product data sheet and a WHMIS sheet for each firestopping and smoke seal product.
- .3 **Name & Experience of Proposed Applicator:** Submit for approval the full company name and experience of the proposed firestopping and smoke seal system applicator.
- .4 **Letter of Certification:** Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

### **1.03 QUALITY ASSURANCE**

- .1 **Applicator:** The applicator is to have a minimum of three years of successful experience on projects of similar size and complexity, and is to be approved by the Consultant.
- .2 **Environment Conditions:** Comply with the firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

## **2 PRODUCTS**

### **2.01 FIRESTOPPING AND SMOKE SEAL SYSTEM MATERIALS**

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials 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 fire rated 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.

### **2.02 ACCEPTABLE MANUFACTURERS**

- .1 Acceptable firestop and smoke seal manufacturers are:
  - .1 A/D Fire Protection Systems "FIREBARRIER"
  - .2 Tremco Inc. Fire Protection Systems Group "TREMstop"
  - .3 3M Canada "Fire Barrier"
  - .4 Hilti (Canada) Ltd. Firestop Systems
  - .5 Specified Technologies Inc.

### **3 EXECUTION**

#### **3.01 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 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and all other governing authorities to seal the penetrations.
- .2 **Preparation:** Abide by the following requirements:
  - .1 examine substrates, openings, voids, adjoining construction and conditions under which the firestop and smoke seal system is to be installed, and confirm compatibility of surfaces
  - .2 verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings
  - .3 report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces
  - .4 mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces
- .3 **Application:** Conform to the following application requirements:
  - .1 use an experienced applicator approved by the manufacturer of the firestopping material manufacturer
  - .2 prime substrates in accordance with the product manufacturer's written instructions
  - .3 provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing
  - .4 tool or trowel exposed surfaces to a neat, smooth, consistent finish
  - .5 remove excess compound promptly as work progresses and upon completion

- .6 at all cable transit locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal
- .4 **Inspection:** Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.
- .5 **Certification:** On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all electrical service penetrations and that the installation has been done in strict accordance with the requirements of the Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and the manufacturer's instructions.

**END OF SECTION**

## **1 GENERAL**

### **1.01 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 copies of 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**

### **3.01 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 luminaries, 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 **Motor Operation:** Test and establish proper motor rotation, measure full load running currents, and check overload elements. Report to the Consultant any discrepancies that are found. Existing motors that have been disconnected and reconnected as part of the electrical work must be checked with rotation meter, and be responsible for any damage caused by reverse rotation.
- .5 **Branch Circuit Voltage Drop:** Demonstrate to the Consultant that branch circuit voltage drop is within specified limits.

### **3.02 HEALTH CARE FACILITY ELECTRICAL WORK TESTING**

- .1 Perform inspection and testing of all electrical work in all patient care areas in accordance with requirements of CAN/CSA Z32, Electrical Systems In Health Care Facilities, and any other governing Codes and Regulations. Prepare and sign test reports to confirm satisfactory completion of testing and submit as specified in Part 1 of this Section. Inspection and testing is to be done by one of the following:

- .1 Enkompass Power & Energy Corp
  - .2 G.T. Wood Co. Ltd.
  - .3 Brosz and Associates Ltd.
  - .4 Rondar Inc.
  - .5 Haronitis & Associates Ltd.
- .2 Perform testing to suit phasing of the work, as applicable.
  - .3 Inspection and testing work is to include electrical devices and communication system components installed in patient service consoles, headwalls, furniture systems, etc., whether or not the devices were provided as Part of the electrical work, isolated power centres including remote alarm stations and panels, and the grounding system.
  - .4 Testing is to be witnessed by the Owner and Consultant. Give the Owner a minimum of five working days notice of date(s) and time(s) for the tests.

### **3.03 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.

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

- .1 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. 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 Enkompass Power & Energy Corp
  - .2 G.T. Wood Co. Ltd.
  - .3 Brosz and Associates Ltd.
  - .4 Rondar Inc.
  - .5 Haronitis & Associates Ltd.
- .2 Conform to requirements of CAN/CSA Z32, Electrical Safety and Essential Systems in Health Care Facilities.
- .3 **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<sup>5</sup> 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 very protection of the various distribution system elements under maximum and minimum fault conditions at the various points in the system
- .3 plot the time current characteristic curves for the following:
  - .1 main and feeder protective devices at voltage levels used in the distribution system
  - .2 protective devices associated with the largest motor in each motor control centre, the refrigeration machine compressors (as applicable), and the largest lead fed from each distribution panelboard
  - .3 emergency power engine generator set protective devices, damage curves, and current decrement curves
  - .4 where relays, breakers, etc., do not perform to approved coordination curves they are to be revised at no cost as part of the work
- .4 Review the existing distribution equipment and, where possible, obtain the existing distribution system coordination study to determine the best coordination between the existing and new equipment. If an existing coordination study is not available, survey the existing equipment and prepare calculations of proper coordination between the new and existing equipment. Where defective or incorrectly applied relays or breakers are found, clearly identify the problem on curves submitted with the report and suggest a recommended course of action.
- .5 The on-site test and coordination study of distribution system protective devices is to include, as applicable:
  - .1 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).
  - .2 a function test of associated control device
  - .3 replacement of any fuses destroyed during tests
  - .4 an acceptance test in the presence of and to the satisfaction of the Consultant
  - .5 the presence at the site, for the length of time required, of qualified equipment manufacturer's representatives
  - .6 an insulation resistance test of "load" side feeders with respect to ground
  - .7 testing of motor control centres, motor starters, and where supplied as part of the electrical work, viable speed drives

- .8 witnessing EMI testing and signing test reports as verification of result
- .6 **Arc Flash Hazard Analysis:** Perform an arc hazard analysis and prepare and submit a report with calculations to determine the flash protection boundary and the incident energy at locations in the electrical distribution system (switchboards, switchgear, motor control centres, distribution panelboards, bus duct, splitters), and other equipment where work could be performed on energized equipment. Include significant locations in systems fed from transformers 125 kVa and greater, and specify safe working distances for calculated fault locations based on the calculated arc flash boundary considering an incident energy of 1.2 cal/cm<sup>2</sup>. Provide minimum 90 mm x 125 mm (3½" x 5") thermal transfer type high adhesion polyester warning labels at each work location and piece of equipment analyzed. Labels are to have an orange header with machine printed wording warning, ARC FLASH HAZARD, and the following information:
  - .1 nominal voltage
  - .2 flash protection boundary
  - .3 hazard risk category
  - .4 incident energy
  - .5 working distance

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** If requested, submit product data sheets for products specified in this Section.
- .2 **Samples:** If requested, submit samples of products specified in this Section.

## **2 PRODUCTS**

### **2.01 SPLITTER TROUGH**

- .1 Formed #16 gauge steel Type 1 splitter trough in accordance with CSA C22.2 No. 76, Splitters, finished inside and outside with ANSI 61 gray heat cured powder epoxy paint, and complete with welded seams ground smooth, various size knockouts on each side, back mounting holes, removable doors with stainless steel hinges and hinge pins, terminal blocks for conductor connections, a single point ground lug
- .2 **Enclosures:** Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:
  - .1 all enclosures located in sprinklered areas – Type 2
  - .2 all enclosures except as noted above – Type 1

### **2.02 PULL BOXES AND JUNCTION BOXES**

- .1 Each box is to be CSA certified, sized to suit the number and size of conduit and conductors, and complete with connecting and securing facilities. Unless otherwise specified, pull boxes and junction boxes are to be as follows:
  - .1 galvanized or prime coat plated steel, suitable in all respects for the application and complete with screw-on or hinged covers as required and connectors suitable for the connected conduit
  - .2 “Condulet”, threaded galvanized cast iron or cast aluminium pull boxes and junction boxes of an exact type to suit the application, each complete with a screw-on gasketed cover
  - .3 rigid plastic (PVC), junction boxes and access fittings with solvent weld type joints and screw-on PVC covers
  - .4 equal to Square D (Schneider Canada) Catalogue No. 970 cast bronze water-proof junction box for underwater lighting

## **3 EXECUTION**

### **3.01 INSTALLATION OF SPLITTER TROUGH**

- .1 Provide all required splitter trough in accordance with drawing plans, schedules, details, and requirements of the Specification.
- .2 Rigidly secure the splitter trough in place, level and plumb.
- .3 Ensure that the splitter trough itself, and all branch circuits, are properly identified.

### **3.02 INSTALLATION OF PULL BOXES AND JUNCTION BOXES**

- .1 Provide pull boxes in conduit systems wherever shown on the drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100') in length, or with more than three 90° bends, are to be equipped with a pull box installed at a convenient and suitable intermediate accessible location.
- .2 Provide junction boxes wherever required and/or indicated on the drawings.
- .3 Unless otherwise specified, boxes are to be as follows:
  - .1 in rigid conduit and EMT inside the building – stamped galvanized or prime coated steel
  - .2 in exterior rigid conduit – “Condulet” cast aluminium gasketed boxes unless otherwise noted
  - .3 in plastic conduit – rigid PVC boxes
  - .4 in bronze underwater conduit – cast bronze boxes
- .4 All pull boxes and junction boxes must be accessible after the work is complete. Provide suitable access panel in all drywall surfaces where access to junction boxes are required. Confirm finish colour with architect prior to ordering. Install junction boxes to minimize use of access panels.
- .5 Accurately locate and identify all concealed pull boxes and junction boxes on “as-built” record drawings.
- .6 Cover boxes in fire walls with aluminium tape and seal with caulking.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** If requested, submit product data sheets for products specified in this Section.
- .2 **Samples:** If requested, submit samples of products specified in this Section.

## 2 PRODUCTS

### 2.01 OUTLET BOXES

- .1 Unless otherwise specified, each box is to be CSA certified, suitable in all respects for the application, single or multi-gang as required, and complete with suitable securing lugs, connectors suitable for the connected conduit, knockouts, and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory. Unless otherwise specified, outlet boxes are to be as follows:
  - .1 stamped, electro-galvanized steel outlet boxes
  - .2 zinc coated cast malleable iron or cast aluminum "FS and "FD" boxes with threaded inlet/outlet hubs
  - .3 rigid PVC outlet boxes equal to Hubbell Canada Inc. UL/ULC or ETL listed, single or multi-gang as required, fully adjustable both vertical and angular, formed galvanized cast iron, round, rectangular, or square as required flush concrete floor boxes complete with adjustable collars and brass screw-on hinged flip-open cover with provisions for installation of duplex power receptacles, telephone data jacks, and, for boxes containing both power and communication system outlets, proper barriers
  - .5 Hubbell or Legrand-Wiremold flush, fire rated "poke-through" box assemblies to suit the devices required, with grey, black or brass flanges and covers as selected by the Consultant

## 3 EXECUTION

### 3.01 INSTALLATION OF OUTLET AND CONDUIT BOXES

- .1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and all other such outlets.
- .2 **Stamped Galvanized Steel:** Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where the connecting conduit is EMT are to be stamped galvanized steel outlet boxes unless otherwise noted.

- .3 **“FS” and “FD” Series Boxes:** Outlet boxes for surface mounted for exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where the connecting conduit is rigid, and for boxes in perimeter walls where insulation and vapour barrier is present, are to be “FS” or “FD” Series cast boxes unless otherwise noted, cast iron inside the building, cast aluminium outside the building.
- .4 **Rigid PVC Boxes In New Concrete Slabs:** Provide rigid PVC outlet boxes in locations as follows:
  - .1 in underground polyethylene conduit systems
  - .2 for devices connected to isolated power system panelboards
  - .3 for rigid PVC conduit systems where permitted
- .5 **Flush Floor Boxes:** Provide water-tight flush floor boxes where shown, installed in accordance with the manufacturer's instructions, and ensure that the boxes are not dislodged during the concrete pour.
- .6 **Flush Floor Boxes In Existing Concrete Slabs:** Flush “poke-through” box assemblies installed in 75 mm (3”) diameter core drilled openings and connected with conduit at the underside of the slab.
- .7 Outlet boxes for special wiring devices, for special equipment and special applications if required, are specified hereinafter in other Sections or on the drawings.
- .8 The size and arrangement of outlet boxes are to suit the device which they serve.
- .9 Generally, mounting heights and locations for outlets are indicated on the drawings, however, confirm the exact location and arrangement of all outlets prior to roughing-in. Architectural drawings and the Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting height and locations. In addition, abide by the following requirements:
  - .1 locate flush mounting boxes in masonry walls to require cutting of the masonry unit corner only, and coordinate masonry cutting to achieve a neat opening
  - .2 position outlet boxes to locate luminaires as shown on reflected ceiling plans
  - .3 coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes
- .10 Do not install outlet or back boxes “back-to-back” in walls and partitions. Stagger such outlets and seal against noise transmission with acoustic insulation. “Thru-wall” type boxes will not be permitted for any application.
- .11 Where boxes are multi-ganged or grouped together, mount boxes level and spaced consistently.
- .12 Temporarily pack all open boxes located in concrete and masonry to prevent debris from entering the box.

- .13 Include all costs for installed boxes that have not been covered by wall/ceiling finishes, to be relocated up to 1 m (3') to suit final device location coordination.
- .14 Provide blank coverplates over all boxes left empty for future installation of devices. Clearly identify each box as to its intended use to the Consultant's approval. Generally, blank overplates are to be stainless steel.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.
- .2 **Colour Chart:** Submit a colour chart with product data and do not order raceway until the colour selection has been confirmed by the Consultant.

### **1.02 QUALITY ASSURANCE**

- .1 Surface raceway is to be in accordance with requirements of CAN/CSA C22.2 No. 62, Surface Raceway Systems.

## **2 PRODUCTS**

### **2.01 SURFACE RACEWAY**

- .1 Unless otherwise specified, surface raceway and accessories are to be of steel construction with no sharp edges, sized as shown or required, and complete with all required fittings and accessories. Raceway is to be as follows:
  - .1 **wall/ceiling wiring pulled in type:** one piece raceway and two piece fittings and accessories with an ivory or buff enamel finish as selected by the Consultant
  - .2 **wall/ceiling wiring laid in type:** two piece raceway and fittings and accessories, with an ivory or buff finish as selected by the Consultant.
  - .3 **lighting fixture raceway laid in type:** two piece raceway and fittings with snap-on covers
  - .4 **floor wiring pulled in type:** two piece raceway and fittings and accessories, unpainted hot dipped galvanized

### **2.02 CHANNEL SURFACE RACEWAY**

- .1 Two piece satin finish aluminium construction channel raceway for wiring lay in, sized as shown or as required.
- .2 Channel raceway is to be complete with:
  - .1 a barrier strip as required
  - .2 outlets (receptacle/telephone/data) as indicated on the drawings
  - .3 pre-manufactured wiring harness to suit outlets and outlet spacing
- .3 **Acceptable raceway manufacturers are:**
  - .1 Legrand Canada "Wiremold"
  - .2 Hubbell Canada



.3 Panduit Corp.

### **3 EXECUTION**

#### **3.01 INSTALLATION OF SURFACE RACEWAY**

- .1 Provide surface raceway of the type(s) shown. Confirm exact locations and routing prior to installation. Provide supports, fittings, adaptors, and accessories as required but keep the number of elbows, offsets, and connections to the minimum
- .2 Provide covers for two piece raceway and fittings after installation of wiring.
- .3 Use wiring with mechanical protection in channel raceway.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for all products where submittal is specified in Part 2 or Part 3 of this Section.
- .2 **Colour Coated EMT Colour Chart:** Submit the colour coated EMT manufacturer's standard colour chart for colour selection(s) by the Consultant.
- .3 **Drawing(s) of Conduit Locations/sizes In Structural Poured Concrete:** As specified in Part 3 of this Section, submit drawings to indicate the proposed location, size, and length of run for conduit proposed to be installed in structural poured concrete work.

## **2 PRODUCTS**

### **2.01 EMT**

- .1 Galvanized steel to CSA C22.2 No. 83, Electrical Metallic Tubing, complete with factory made bends where site bending is not possible, and joints and terminations made with steel couplings and set screw type connectors, concrete tight where required.

### **2.02 RIGID GALVANIZED STEEL CONDUIT**

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

### **2.03 FLEXIBLE GALVANIZED STEEL LIQUID-TIGHT CONDUIT**

- .1 Flexible galvanized steel liquid-tight conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with Ideal Industries Inc. "Steel Tough" liquid-tight connectors at terminations

### **2.04 FLEXIBLE GALVANIZED STEEL CONDUIT**

- .1 Galvanized steel flexible conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with proper and suitable squeeze type connectors at terminations.

### **2.05 RIGID ALUMINUM CONDUIT**

- .1 Factory or site threaded rigid aluminium to CSA C22.2 No. 45, Rigid Metal Conduit, with bending, threading, fitting, coupling, etc., requirements as specified for rigid galvanized steel conduit.

### **2.06 RIGID BRONZE CONDUIT**

- .1 Factory threaded rigid bronze conduit with water-tight screwed joints, fittings and terminations.

## **2.07 RIGID PVC CONDUIT**

- .1 Rigid PVC conduit to CSA C22.2 No. 211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit, FT-4 rated, complete with site made heat gun bends for conduit to and including 50 mm (2") diameter, factory made fittings for conduit larger than 50 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

## **2.08 FLEXIBLE PVC CONDUIT**

- .1 Equal to Ipex Electrical Inc. "Cor-line" flexible, water-tight, corrugated PVC conduit with Ipex "Kwikon" fittings and ESU conduit supports spaced at every 600 mm to 900 mm (2' to 3'), and proper and suitable terminations and adaptors.

## **2.09 FLEXIBLE POLYETHYLENE CONDUIT**

- .1 Polyethylene pipe to CSA-B137.1, Polyethylene (PE) Pipe, Tubing and Fittings For Cold Water Pressure Service, minimum Series 75, supplied in continuous coils of the proper length.

## **2.10 EPOXY COATED RIGID GALVANIZED STEEL CONDUIT**

- .1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an additional epoxy coating both inside and outside, factory made bends where site bending is not possible, factory made threaded fittings and connectors, and terminations made with rigid couplings.

## **2.11 COLOUR COATED EMT**

- .1 Equal to Allied Tube and Conduit "True Color" EMT as specified for standard EMT but factory coated with colours selected by the Consultant from the conduit manufacturer's standard colours.

## **2.12 STAINLESS STEEL CONDUIT**

- .1 Equal to Allied Tube and Conduit rigid stainless steel conduit to CSA C22.2 No. 45, Rigid Metal Conduit, Type 316 for corrosive environments, Type 304 elsewhere, complete with a smooth polished finish, standard NPT threads on each end, stainless steel fittings to match the conduit type where site bending is not possible, and water-tight rigid stainless steel couplings at terminations.

## **2.13 FISH CORD**

- .1 Polyethylene or nylon fish cord/tape with cable pull accessories to suit the application.

# **3 EXECUTION**

## **3.01 GENERAL RE: INSTALLATION OF CONDUIT**

- .1 Refer to the article entitled General Conduit and Conductor Installation Requirements in the electrical work Section entitled Basic Electrical Materials and Requirements.

- .2 Ensure that all open empty conduit ends are properly protected against dirt and debris during the construction process.

### 3.02 CONDUIT INSTALLATION REQUIREMENTS

- .1 Unless otherwise specified, provide conduit for all conductors except armoured cable, mineral insulated fire rated cable, and except where cable tray, cable duct, or a similar raceway is used.
- .2 **Conduit Types:** 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 concealed conduit in exterior walls – rigid galvanized steel
  - .4 for explosion-proof wiring – rigid galvanized steel
  - .5 for conduit exposed outside the building, except where rigid PVC conduit is permitted – rigid galvanized steel
  - .6 for conduit associated with pool area outlets but not submerged in water – rigid galvanized steel
  - .7 as an alternative to rigid galvanized steel, except in poured concrete construction – rigid aluminium conduit
  - .8 for conduit in corrosive areas – epoxy coated rigid galvanized steel
  - .9 for short (minimum 450 mm (18"), maximum 600 mm (24"), with a 180° loop wherever possible) runs of conduit to electric motors, distribution transformers, and vibration isolated equipment – flexible galvanized steel liquid-tight conduit
  - .10 at points where exposed conduit crosses building expansion joints – flexible galvanized steel conduit
  - .11 for branch circuit conductors underground inside the building, and underground outside the building beneath structures and concrete or asphalt paving – rigid PVC
  - .12 for branch circuit conductors outside the building at roof level – rigid PVC
  - .13 for branch circuit conductors in concrete slabs on grade, and in concrete and masonry walls except exterior walls - rigid PVC
  - .14 for concealed branch circuit conductors associated with isolated power systems – rigid PVC
  - .15 for branch circuit conductors in concrete slabs above grade – flexible PVC
  - .16 for underwater conduit – rigid bronze

- .17 for exposed conduit in corrosive areas, food processing and preparation areas, chemical plants, wash down areas, and hygienically clean rooms or areas – rigid stainless steel with stainless steel support hardware to match conduit type
- .18 for fire alarm system, and communications/security systems conductors – colour coated EMT with colours as selected
- .19 for all conduit except as specified above – EMT
- .3 **Conduit Fittings:** Unless otherwise specified, conduit fittings are to be of the same material as the conduit and suitable in all respects for the application. Provide proper adaptors for joining conduit of different materials.
- .4 **Conduit Bends:** Site made bends for conduit must be made using proper bending equipment, bends must maintain the full conduit diameter with no kinking, and conduit finishes and lining must not flake or crack when the conduit is bent.
- .5 **Site Cutting Conduit:** Cut square and ream all site cut conduit ends.
- .6 **Conduit Threads:** Site cut rigid steel conduit using proper thread cutting equipment, in an approved area. Protect the area and building surfaces from being soiled/damaged by the threading process. Clean and lubricate threads and coat threads with red lead or other zinc rich coating.
- .7 **Conduit Sizes:** Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the governing Codes/Regulations. The sizes of branch circuit conductors shown/specified are minimum sizes and must be increased to suit length of run and voltage drop, and where this occurs, increase the conduit size to suit. Do not use conduit less than 15 mm ( $\frac{1}{2}$ " ) diameter.
- .8 **Empty Conduit:** Ensure that all conduit left empty for future wiring is clean, capped, and properly identified. Provide end bushings and fish cord in all such conduit.
- .9 **Empty Conduit At Panelboards:** Where a suspended ceiling occurs, provide 4, empty, 20 mm ( $\frac{3}{4}$ " ) diameter conduits from each flush wall mounted panelboard terminated in the suspended ceiling above, capped and identified.

### 3.03 CONDUIT INSTALLED IN POURED CONCRETE

- .1 Where conduit is to be embedded in structural poured concrete, obtain the Consultant's approval. Submit a drawing indicating the location and size of the conduit, the length of run, and any other required details. Obtain the Consultant's written approval prior to conduit installation. The Consultant's decision regarding conduit in structural poured concrete is final and is not the basis of a claim for additional costs.
- .2 When and where conduit is permitted in structural poured concrete, abide by the following requirements:
  - .1 install the conduit in accordance with requirements of CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction

- .2 the conduit must be secured in a manner such that the concrete will not be displaced when the concrete is poured, and during the concrete pour, monitor the conduit installation to prevent displacement or damage, and immediately report any misplacement or damage observed
- .3 where conduit extends adjacent to a column, stay away from the column a minimum of 2 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/wall as possible
- .5 where more than 2 conduits are adjacent to each other they are to be spaced the greater of 3 conduit diameters or 100 mm (4") apart
- .6 the total depth of conduits crossing over each other is to be less than 1 third the thickness of the slab
- .7 place conduit in the middle third of the slab thickness, and do not in any case lay conduit directly on reinforcing steel
- .8 do not locate conduit adjacent to parallel reinforcing bars
- .9 the maximum size of any conduit is 1/5<sup>th</sup> of slab thickness
- .10 do not install conduit longitudinally in a beam without specific approval of the Consultant, and extend conduit through a beam at right angles to the beam span
- .11 where conduits extend through beams stay a minimum of twice the depth of the beam away from the supports
- .12 do not install conduit 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 install conduits through shear walls or columns without written approval from the consultant
- .14 do not install conduit in parking garage structures, garage ramps, water retaining structures, or any other concrete subject to the application of de-icing products
- .15 in areas where installation of conduit embedded in concrete is not permitted, extend conduit through beams in sleeves, if the installation of the sleeves is permitted
- .16 slope all underground conduit to drainage points and ensure that the conduit can be drained

### **3.04 CONDUIT UNDER SLAB ON GRADE**

- .1 Where conduit is to be installed under a slab on grade, the system is to be a pull-in system, must consider and address any effects of magnetic fields, and the following is to apply:
  - .1 concrete encased duct bank with non-ferrous conduits is to be used
  - .2 conduit is to be sloped to a proper drainage pit

- .3 20% spare conduit (minimum 1) is to be provided

### **3.05 SEALED CONDUIT PENETRATIONS**

- .1 For isolation rooms, any conduit penetration any surface of the room is to be sealed with a suitable elastomeric and intumescent material to ensure complete isolation of the room/area. The sealing material must be non-hazardous and suitable in all respects for the specific application, including a fire rating if required. Submit product data for the proposed sealing material as well as WHMIS sheets and product installation instructions.

### **3.06 CONDUIT FOR HEALTHCARE MRI SUITES**

- .1 All conduit for healthcare MRI suites is to be rigid aluminium, installed and supported with non-ferrous hardware, properly coordinated with construction of the room, and connected to non-ferrous boxes.

### **3.07 CONDUIT SUPPORT**

- .1 **Underground Conduit:** Unless otherwise shown or specified, support underground conduit on a well tamped bed of earth or sand, free from rocks or protrusions of any kind.
- .2 **Surface Mounted & Suspended Single/Double Conduit Runs:** Support and secure single and double runs of conduit at support spacing in accordance with Code requirements by means of galvanized steel pipe straps, conduit clips, ring bolt type hangers with galvanized steel hanger rods, or by other approved manufactured devices.
- .3 **Support of Multiple Conduit Runs:** Support multiple conduit runs by means of Electrovert Ltd. "CANTRUSS" or Burndy Ltd. "FLEXIBLE" conduit racks and galvanized steel rods with support spacing to suit requirements of the smallest diameter conduit in the group.
- .4 **Conduit Expansion Facilities:** Abide by the following:
  - .1 wherever concealed or surface mounted conduit extends across a building expansion joint, provide expansion facilities to permit free movement without imposing additional stress or loading on the support system, and to prevent excessive movement at joints and connections
  - .2 provide manufactured expansion joint fittings in rigid PVC conduit at spacing recommended by the expansion joint fitting manufacturer
  - .3 make "snaked" bends in underground flexible polyethylene conduit

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.

## 2 Products

### 2.01 PVC POWER CABLE DUCTS AND FITTINGS

- .1 Rigid PVC duct and fittings to CSA C22.2 No. 211.1, type DB2/ES2 for direct burial or concrete encasement, type EB1 for concrete or masonry encasement, with solvent weld joints.

### 2.02 PVC COMMUNICATIONS DUCT AND FITTINGS

- .1 Rigid PVC duct and fittings to CSA B196.3, Telecommunication Cable Ducting and Fittings, with solvent weld joints.

### 2.03 DUCT SPACERS

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

### 2.04 CABLE PULLING ROPE

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

### 2.05 DUCT MARKERS

- .1 **Concrete Markers:** Precast concrete cable markers, minimum 600 mm x 600 mm x 100 mm (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 communications cables.

### 2.06 DRAINAGE PITS

- .1 Precast concrete pipe section(s), 1 m (3') diameter, filled with Granular "A" material.

### 2.07 EXCAVATION AND BACKFILL, AND CONCRETE WORK

- .1 Refer to Section 26 05 05, Basic Electrical Materials and Methods.

## 3 Execution

### 3.01 DUCT INSTALLATION REQUIREMENTS



- .1 Provide all required underground ducts/ductbank.
- .2 Conform to requirements of drawing details.
- .3 Clean ducts prior to installation and temporarily cap exposed open ends during concrete pours and/or backfilling.
- .4 Install ducts with a minimum 400:1 slope to drainage pits.
- .5 Where deviations in vertical grade are required to avoid utilities or other work, install ducts such that water cannot accumulate in the duct.
- .6 **Power Cable Ducts:** Locate electric service cable ducts a minimum of 1.2 m (4') below grade to the top of the ducts.
- .7 **Communications Cable Ducts:** Locate communications cable ducts a minimum of 900 mm (36") below grade to the top of the ducts.
- .8 Maintain a minimum of 300 mm (12") horizontal separation between electric service and communications ducts.
- .9 Install the duct on undisturbed soil or on a minimum 150 mm (6") thick Granular "B" base compacted to 95% Dry Proctor Density, or, for unstable soil, on a 75 mm (3") thick cured "Mud Slab".
- .10 For ductbank, provide spacers at maximum 1.2 m (48") centres and secure ducts to spacers. Stagger joints of adjacent ducts a minimum of 150 mm (6") and ensure that the joints are water-tight.
- .11 Make offsets and changes in direction using 5° bend sections, and do not exceed a total of 20° with a duct offset.
- .12 Provide bell fittings at duct terminations at manholes and the building(s).
- .13 Provide a continuous pull rope in each duct, with 3 m (10') of excess rope at each end.
- .14 Where ducts are indicated as empty (spare) and intended for future use, plug ends of the ducts with identified plastic plugs.
- .15 Prior to concealing the ducts, arrange for the Consultant to inspect the installation, and demonstrate clear ducts by pulling a steel test mandrel 15 mm (½") in diameter smaller than the duct diameter through selected ducts.
- .16 Coordinate the duct installation with the trade performing the excavation and backfill work, and clearly mark the route of the ducts, and the width, depth, and slope of the trench.
- .17 For concrete encased ductbank, provide continuous marker tape 300 mm (12") below grade over the ductbank.
- .18 Provide concrete markers over direct buried ducts, set so that the top of the marker is 25 mm (1") below grade and located at maximum 150 m (450') intervals and at each changer in duct direction. Indicate concrete marker locations on "as-built record drawings".

### 3.02 INSTALLATION OF DRAINAGE PITS

- .1 Provide drainage pits at duct/ductbank low points. Provide sufficient precast concrete pipe sections so that the pit base is down in permeable soil.
- .2 At each drainage pit location, provide underside perforations in the duct and any other required facility to permit water to drain from the duct into the pit.

### **3.03 CONCRETE ENCASEMENT**

- .1 When the ductbank installation has been cleaned and demonstrated to be clear of debris, encase each duct in a minimum of 75 mm (3") of concrete in accordance with the following requirements:
  - .1 concrete is to be minimum 20 MPa class ready-mix concrete with minimum 10 mm ( $\frac{3}{8}$ ") aggregate
  - .2 provide anchors, ties, and trench jacks as required to secure the ducts in place and prevent movement during the concrete pour
  - .3 fill the entire space between ducts with concrete
  - .4 when connecting ductbank to manholes or buildings, and where ductbank crosses under roads and driveways, provide four 3 m (10') lengths of 15M reinforcing rods, 1 in each corner of the concrete encasement and wired to 10M dowels supported to duct spacers
  - .5 allow concrete to attain 50% of its specified strength prior to backfilling

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.
- .2 **Colour Chart:** Submit a colour chart with product data and do not order raceway until the colour selection has been confirmed by the Consultant.

### **1.02 QUALITY ASSURANCE**

- .1 Wireways and auxiliary gutters are to be in accordance with requirements of CAN/CSA C22.2 No. 26, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

## **2 PRODUCTS**

### **2.01 WIREWAYS AND GUTTERS**

- .1 Wireways and gutters are to be of sheet steel construction with no sharp edges, sized for the wiring as required and/or indicated, complete with all required fittings and accessories, and a baked grey enamel finish. Covers are to be hinged and bolted to give uninterrupted access to wiring.

## **3 EXECUTION**

### **3.01 INSTALLATION OF WIREWAYS AND GUTTERS**

- .1 Provide wireway/gutters where shown. Confirm exact locations and routing prior to installation. Provide supports, fittings, adaptors, and accessories as required but keep the number of elbows, offsets, and connections to the minimum.
- .2 Provide barriers in wireways/gutters where different voltage wiring is required.
- .3 Install gutter to full length of equipment.
- .4 Identify wireways/gutters with engraved nameplates as specified in the Section entitled Basic Electrical Materials and Methods.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for wiring devices. Ensure that the sheets indicate colours and faceplate finishes.

### 1.02 QUALITY ASSURANCE

- .1 All wiring devices are to be CSA certified as a minimum, in accordance with the following standards, as applicable:
  - .1 CAN/CSA C22.2 No. 42, General Use Receptacle, Attachment Plugs and Similar Wiring Devices
  - .2 CAN/CSA C22.2 No. 42.1, Cover plates for Flush Mounted Devices
  - .3 CSA C22.2 No. 111, General Use Snap Switches
- .2 Wherever possible, all wiring devices are to be supplied by the same manufacturer.
- .3 **Acceptable Manufacturers:** Unless otherwise specified in this Section or on the drawings, acceptable manufacturers are:
  - .1 Hubbell Canada LP
  - .2 Cooper Industries (Arrow Hart)
  - .3 Legrand/Pass & Seymour
  - .4 Leviton Canada

### 1.03 WIRING DEVICE AND PLATE COLOURS

- .1 Unless otherwise specified, wiring device colours will be as specified in Part 3 of this Section.

## 2 PRODUCTS

### 2.01 SWITCHES

- .1 Unless otherwise specified, Specification Grade, Premium Quality, back and side wired, 20 ampere, 120-277 volt A.C. quiet action toggle switches, single pole, 2-pole, 3-way, or key type as indicated on the drawings, each complete with a nickel plated steel ground terminal, brass power wiring terminals and screws, silver cadmium oxide contacts with a moveable brass contact arm, and nylon toggle with colour as specified below. Switch types are as follows:
  - .1 **Standard Wall Toggle Switches:** As above.

- .2 **Decorative Wall Rocker Switch:** Generally as specified above for standard toggle switches but rectangular decorative rocker type with rocker handles.
- .3 **Door Switch:** Box, switch and plate assemblies with a 125 volt 3 ampere illuminated switch which is on or off when the door is open (confirm prior to ordering), a 34 mm x 94 mm x 40 mm (1 11/32" x 3 11/16" x 1 1/2") box, cover plate, and mounting screws.
- .4 **Motor Control Snap Action Switch:** Illuminated handle snap action horsepower rated switch, CSA certified for motor control and sized to suit the application.
- .5 **Occupancy Sensor Switch:** Digital ultrasonic sensor type, 120-277 volt A.C. with integral photo sensor and selected to suit the area and occupancy of the room served.
- .6 **Dimmer Switch:** Lutron Diva Series 120V or 0-10V or equal. Coordinate dimmer type with LED drivers. Device and cover plate to be white in colour.
- .7 **ALL DIMMER SWITCH TYPES ARE TO BE COORDINATED WITH FIXTURE DRIVER TYPE/REQUIREMENTS PRIOR TO ORDERING.**

## 2.02 SPECIFICATION GRADE STANDARD RECEPTACLES

- .1 "Decora Style" Back or side wired, U-ground, 2 pole receptacles as follows:
  - .1 **15 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5-15R
  - .2 **15 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6-15R
  - .3 **20 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5-02R
  - .4 **20 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6-20R
  - .5 **30 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6-30R
  - .6 **30 Amp. 125/250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 14-30R
  - .7 **50 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6-50R
  - .8 **50 Amp. 125/250 Volt Simplex Receptacle:** 4-wire receptacles, NEMA configuration 14-50R

## 2.03 HOSPITAL GRADE STANDARD RECEPTACLES

- .1 Hospital grade, "Decora Style", back or side wired, U-ground 2-pole, 3-wire receptacles, each identified on the face with a green dot and as follows:

- .1 **15 Amp. 125 Volt Duplex Receptacle:** NEMA configuration 5-15R
- .2 **15 Amp. 250 Volt Duplex Receptacle:** NEMA configuration 6-15R
- .3 **20 Amp. 125 Volt Duplex Receptacle:** NEMA configuration 5 -20R
- .4 **20 Amp. 250 Volt Duplex Receptacle:** NEMA configuration 6-20R
- .5 **30 Amp. 250 Volt Simplex Receptacle:** NEMA configuration 6-30R

#### **2.04 SPECIFICATION GRADE LOCKING RECEPTACLES**

- .1 Specification Grade, back or side wired, U-ground 2-pole, 3-wire locking type receptacles as follows:
  - .1 **15 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L6-15R
  - .2 **15 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-15R
  - .3 **20 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L5-20R
  - .4 **20 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-20R

#### **2.05 HOSPITAL GRADE LOCKING RECEPTACLES**

- .1 Hospital Grade, back or side wired, U-ground, 2 pole, 3-wire locking type receptacles as follows:
  - .1 **15 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L6-15R
  - .2 **15 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-15R
  - .3 **20 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L5-20R
  - .4 **20 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-20R

#### **2.06 SPECIFICATION GRADE ISOLATED GROUND RECEPTACLES**

- .1 **120 Amp. 125 Volt Duplex Receptacle:** Back and side wired, duplex, U-ground, 2-pole, 20 ampere, 125 volt, 3-wire, orange colour, surge suppression isolated ground nylon construction receptacles, NEMA configuration 5-20R.

#### **2.07 HOSPITAL GRADE ISOLATED GROUND RECEPTACLES**

- .1 **20 Amp. 125 Volt Duplex Receptacle:** Hospital Grade, back and side wired, duplex, U-ground, 2-pole, 20 ampere, 125 volt, 3-wire, orange colour, surge suppression isolated ground nylon construction receptacles, NEMA configuration 5-20R and complete with a green identification dot.

#### **2.08 SPECIFICATION GRADE GROUND FAULT RECEPTACLES**

- .1 Heavy-duty, 15/20 ampere, 125 volt, ULC Class A, Group 1. automatic ground fault circuit interrupting duplex receptacles with a 10 kA short circuit current rating automatic self-test diagnostics, green power on LED, and red ground fault LED. Ground fault receptacles for indoor climate controlled and outdoor or non-climate controlled areas are to be as follows:

- .1 indoor climate controlled areas: equal to Hubbell Canada No. GFST15/GFSTt20 "AUTOGUARD"
- .2 outdoor areas and indoor non-climate areas: equal to Hubbell Canada No. GFR5262TR/GFR 4362TR "AUTOGUARD"

## **2.09 HOSPITAL GRADE GROUND FAULT RECEPTACLES**

- .1 Heavy-duty, 15/20 ampere, 125 volt, ULC Class A, Group 1. automatic ground fault circuit interrupting duplex receptacles with a 10 kA short circuit current rating automatic self-test diagnostics, green power on LED, and red ground fault LED. Ground fault receptacles for indoor climate controlled and outdoor or non-climate controlled areas are to be as follows:

- .1 indoor climate controlled areas: equal to Hubbell Canada No. FR8200H/GFR8300H "AUTOGUARD"
- .2 outdoor areas and indoor non-climate controlled areas: equal to Hubbell Canada No. GFR8200SG/GFR8300SG "AUTOGUARD"

## **2.10 SPECIFICATION GRADE TAMPER-RESISTANT DUPLEX RECEPTACLES**

- .1 Specification Grade, back or side wired, U-ground, 2-pole, 3-wire tamper-resistant duplex receptacles as specified above, 15 ampere or 20 ampere, 125 volt as indicated on the drawings, each with thermoplastic shutters to limit access to energized contacts.

## **2.11 PHOTO ELECTRIC SWITCH**

- .1 Equal to Tork 2100 Series weather-proof, 12 mm (½") dia. conduit mounting photoelectric SPST control switch with model number to suit the voltage and connected load, complete with an adjustable slide for on-off adjustment, a turn-on of one to five fc and a turn-off of three to five fc without the slide in position, a die-cast zinc gasketed enclosure, cadmium sulphide epoxy coated cell, normally closed contacts which fail in the open position, a delay of up to four minutes to prevent false switching due to light from vehicles, lightning, etc., three colour coded 150 mm (6") # 16 AWG leads, a fixed base for conduit connection, and, if required, an accessory bracket for wall mounting the device.

## **2.12 TIME SWITCH**

- .1 Flush wall mounting spring wound ivory time switch with matching faceplate, equal to Tork A500 Series with exact catalogue number to suit the connected load.

## **2.13 DEVICE FACEPLATES**

- .1 Device faceplates are to be ULC listed and CSA certified and, unless otherwise specified, supplied by the device manufacturer. Where two or more devices are installed in a common box, a common one-piece faceplate is to be used. Faceplate colours are specified in Part 3. Faceplates, unless otherwise specified, are to be as follows:

- .1 "Decorator" type Phenolic switch and receptacle faceplates

- .2 type 302 stainless steel switch and receptacle faceplates, brush finish or satin finish as directed, with stainless steel screws
- .3 high impact smooth finish switch and receptacle faceplates
- .4 hot dipped galvanized steel switch and receptacle faceplates
- .5 NEMA 3 rated, single gang, horizontal/vertical mounting, weather-proof in use, gasketed cast aluminium, receptacle faceplates to suit the type of receptacle used
- .6 weather-proof, gasketed, water-tight single gang type 302 stainless steel switch plate with clear silicone rubber bubble over the switch toggle

## **2.14 FIRE RATED GASKETS**

- .1 RECTORSEAL "Bio Fireshield" single highly intumescent component fire rated gasket for use with electrical boxes located in fire rated construction, UL listed to UL 263/ASTM E-19, Fire Tests of Building Construction and Materials.

## **3 EXECUTION**

### **3.01 GENERAL RE: INSTALLATION OF WIRING DEVICES**

- .1 Provide all required wiring devices and faceplates
- .2 Confirm exact locations, including mounting heights prior to roughing-in.
- .3 For barrier-free mounting heights for devices, conform to requirements of the governing code or regulation.
- .4 Ensure that switches located adjacent to doors are located at the strike side of the door. Confirm door swings prior to roughing-in.
- .5 Install single throw switches with the handle in the up position when the switch is closed.
- .6 Confirm all switch, receptacle and faceplate types, colours and finishes prior to ordering
- .7 Provide a separate insulated ground conductor for each isolated ground receptacle.
- .8 Faceplates for housekeeping receptacles are to be permanently identified with "Housekeeping Only" wording.
- .9 Do not install faceplates for flush devices until wall, etc., finishing work is complete
- .10 Where devices are to be installed in casework, millwork, or similar construction, carefully coordinate device installations and device openings with the trade providing the casework, millwork, etc.
- .11 Device locations indicated on the drawings are approximate, and, if requested, relocate the device up to 3 mm (10') away from the location shown at no additional cost.



### 3.02 REQUIREMENTS FOR INSTALLATION OF WIRING DEVICES IN HEALTH CARE FACILITIES

- .1 In addition to requirements specified above, conform to the following requirements for health care facilities:
  - .1 comply with requirements of CSA Z32, Electrical Safety Essential Electrical Systems in health care facilities
  - .2 within imaging/scanning type room, devices, including mounting screws and hardware, are to be of non-ferrous construction
  - .3 safety shutter receptacles are to be provide where shown and where required by CSA Z32
  - .4 do not provide isolated ground receptacles in patient care areas
  - .5 identify devices with engraved Lamacoid plates as per CSA Z32, and confirm identification wording prior to manufacturer of the nameplates
  - .6 faceplates for switches and receptacles circuited to essential or isolated power are to be oversized nylon faceplates with permanent, suitable identification wording and a colour to be confirmed prior to ordering

### 3.03 WIRING DEVICE AND DACEPLATLE TYPES AND COLOURS

- .1 Unless otherwise specified, wiring devices colours and faceplate types and colours are to be as follows:
  - .1 **“Decorator” switches & receptacles in finished areas-non-essential circuits:** white, with white “Decorator” Phenolic faceplates
  - .2 **switches & receptacles in kitchen circuits:** white, stainless steel faceplates
  - .3 **switches & receptacles in unfinished areas-non-essential circuits:** white, stainless steel faceplates
  - .4 **switches & receptacles in finished areas-essential power circuits:** red, with white Phenolic faceplates
  - .5 **weather-proof receptacles:** cast aluminium gasketed weather-proof faceplates to suit the type of receptacle installed
  - .6 **weather-proof switches:** weather-proof stainless steel faceplates with clear silicone bubble over the switch toggle

### **3.04      INSTALLATION OF FIRE RATED GASKETS**

- .1    Provide fire rated gaskets in outlet boxes for single and double switches and receptacles located in fire rated construction. Install in accordance with the manufacturer's instructions.

### **3.05      TESTING**

- .1    When installation is complete, test operation of all devices.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- . 1 **Product Data:** If requested, submit product data sheets for products specified in this Section.

## **2 PRODUCTS**

### **2.01 SAND**

- . 1 Clean sharp sand in accordance with requirements of the Excavation and Backfill Section.

### **2.02 CABLE PROTECTION**

- . 1 Pressure treated planks, 50 mm x 150 mm (2" x 6").
- . 2 Precast concrete slabs, 600 mm x 600 mm x 50 mm (2' x 2' x 2").

### **2.03 DIRECT BURIED DUCTS**

- . 1 In accordance with the electrical work Section entitled Underground Ducts and Ductwork.

### **2.04 DUCT SEALING COMPOUND**

- . 1 Non-thermoplastic sealing compound which allows for expansion and contraction of ducts without loss of sealing properties.

## **3 EXECUTION**

### **3.01 CABLE INSTALLATION IN TRENCHES**

- . 1 Provide direct buried cable in trenches where shown.
- . 2 Do all required excavation and backfill work in accordance with requirements specified in the electrical work Section entitled Basic Electrical Materials and Methods, including a minimum of 75 mm (3") clearance from trench sides and 150 mm (6") of sand cable bedding.
- . 3 Mark out the route, depth and extent of excavation work for the trade performing the work and ensure that there is 75 mm (3") clearance from trench sides and a minimum of 150 mm (6") of sand cable bedding.
- . 4 Provide cable offsets for thermal action and minor earth movement. Offset cable 150 mm (6") for each 60 m (250') of cable run while maintaining cable clearances and bending radius requirements.
- . 5 **Cable Clearances In The Trench:** As applicable, maintain cable clearances in the trench
  - . 1 75 mm (3") from trench sides
  - . 2 75 mm (3") between cables of different circuits

- .3 300 mm (12") horizontal separation between high and low voltage cables
- .4 for cables at crossovers 75 mm (3") vertical separation between low voltage cables and 150 mm (6") separation for high voltage cables
- .5 minimum 300 mm (12") lateral and vertical separation for fire alarm and control cables when crossing other cables, with the fire alarm and control cables in the upper position
- . 6 **Cable Splices/Terminations:** Make cable terminations/splices as follows:
  - .1 make terminations and splice only as indicated leaving 600 mm (2') of surplus cable in each direction
  - .2 make terminations and splices in accordance with the cable manufacturer's written instructions using approved splicing kits
  - .3 underground cable splices are not acceptable
- . 7 **Cable Bending Radius:** The minimum cable bending radius is to be eight times the diameter of the cable for rubber, plastic or lead covered cables, twelve times the cable diameter for metal armoured cable, or in accordance with the cable manufacturer's printed instructions, whichever is the least.
- . 8 **Cable Protection:** Prior to backfilling obtain approval of the cable installation and bedding from the Consultant and Electrical Inspection, and, as applicable, protect cables in trenches as follows:
  - .1 provide treated wooden planks over lower cables 600 mm (24") in each direction at crossings
  - .2 continuous protection on top of the sand cover, extended a minimum of 50 mm (2") beyond cables
- . 9 **Backfilling:** The first 150 mm of backfill over cables is to be sand, carefully hand compacted to Proctor densities specified.

### 3.02 CABLE INSTALLATION IN DUCTS

- . 1 Provide cable in underground ducts as indicated. Do not pull spliced cables into ducts.
  - .1 Prior to pulling cable, clean ducts by pulling a stiff bristle brush through each duct.
  - .2 Use approved cable pulling lubricant and pulling hardware.
  - .3 Install multiple cable in ducts simultaneously.
  - .4 To facilitate matching of colour coded multi-conductor control cable, reel off in the same direction during installation.
  - .5 Before pulling lead covered cable into ducts and until the cables are properly terminated, seal ends with wiping solder. Seal the ends of non-lead covered cable with moisture seal tape.

- .6 When installation of the cables is complete, seal the ends of the duct with duct sealing compound.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all equipment specified in this Section. Shop drawings/product data is to include:
  - .1 equipment dimensions and details
  - .2 a single line diagram and a schematic diagram, if applicable
  - .3 component nameplate and warning sign data
  - .4 short circuit ratings, voltage ratings, continuous current ratings, and interrupt ratings
  - .5 any additional information requested by the Consultant
- .2 **Test Reports:** Submit signed copies of all test reports, and include a copy of each report with O & M Manual project close-out data.
- .3 **Spare Fuses:** Submit as specified in Part 3 of this Section.
- .4 **Manufacturer's Installation Certification Letter:** Submit a service entrance board manufacturer's installation certification letter as specified in Part 3 of this Section.

## **2 PRODUCTS**

### **2.01 FUSED DISCONNECT SWITCH**

- .1 In accordance with Section 26 28 23, Disconnect Switches, with rating as indicated on the drawings.

### **2.02 ENCLOSED CIRCUIT BREAKER**

- .1 In accordance with Section 26 28 16, Moulded Case Circuit Breakers, with rating as indicated on the drawings.

### **2.03 PANELBOARD**

- .1 In accordance with Section 26 24 16, Branch Circuit Panelboards, with capacity and branch circuit details as per the drawings.

### **2.04 METERING CABINET**

- .1 In accordance with the electrical work Section entitled Electric Metering.

### **2.05 GROUND FAULT EQUIPMENT**

- .1 In accordance with the electrical work Section entitled Ground Fault Protection Equipment.

## **2.06 METERING CURRENT AND POTENTIAL TRANSFORMERS**

- .1 Supplied with metering equipment **by** the Utility

## **2.07 SERVICE ENTRANCE BOARD**

- .1 Metal enclosed, factory assembled, dead front service entrance board assembly in accordance with the drawing plan, elevations, schedule, and any details, and in accordance with CAN/CSA-C22.2 No. 31 and all other applicable Codes and Standards.
- .2 **Enclosure:** Tamper-resistant enclosure consisting of individual sections cubicles constructed of cold rolled steel and bolted together and reinforced as necessary to form a self-contained structure with the necessary louvres for proper ventilation. The enclosure is to be NEMA/EEMAC Type 1 if the room is not sprinkler protected, NEMA/EEMAC Type 2 if the room is sprinkler protected, and finished with ANSI #61 grey enamel. The enclosure is to be complete with:
  - .1 **hinged access panels** where required, of formed sheet steel and equipped with gasketing, concealed steel hinges with stainless steel hinge pins, and a captive knurled thumb screws
  - .2 **metering cubicle**, for Utility metering equipment, full height and barriered to isolate the cubicle from adjoining cubicles
  - .3 **Utility metering CT's and PT's** as specified above in this Section
  - .4 **fused disconnect switch** as specified above in this Section
  - .5 **enclosed circuit breaker** as specified above in this Section
  - .6 **panelboard** as specified above in this Section
  - .7 **ground fault equipment** as specified above in this Section
  - .8 **power bus** from the load terminal of the main breaker or disconnect switch via the metering cubicle to main lugs of the distribution panelboard, consisting of rectangular, square edge, hard temper, high electrical conductivity copper with colour coded phasing
  - .9 **cable** with colour coded phasing from the load terminal of the main breaker or disconnect switch via the metering cubicle to lugs of the distribution panelboard
  - .10 **ground bus**, electrical grade copper extending the full width of the assembly at the bottom, with lugs at each end for attachment of ground conductors
- .3 **Acceptable Manufacturers:** Acceptable manufacturers are:
  - .1 Schneider Electric Canada
  - .2 Eaton Electric Canada
  - .3 Siemens Canada

### **3 EXECUTION**

#### **3.01 INSTALLATION OF SERVICE ENTRANCE EQUIPMENT**

- .1 Provide electric service entrance equipment where shown.
- .2 Wall mount the equipment where indicated but confirm exact location prior to installation.
- .3 Secure the service entrance board in place, level, and plumb, on a concrete housekeeping pad.
- .4 Make "line" and "load" side connections as indicated.
- .5 Check protective devices against the coordination study results to ensure proper operation of the devices.
- .6 Ground and bond as indicated and as per the electrical work Section entitled Grounding-Secondary.
- .7 If service entrance equipment identification is not factory installed, install at the site using stainless steel screws.
- .8 Supply a complete set of identified fuses for the disconnect switch and store in an identified wall mounted steel cabinet adjacent to the service entrance equipment.
- .9 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Electrical Work General Instructions Section.
- .10 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Electrical Work General Instructions Section.

**END OF SECTION**



## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for products specified in this Section.
- .2 **Factory Test Reports:** Submit certified copies of the transformer manufacturer's standard factory testing.
- .3 **Installation Test Report:** As specified in Part 3 of this Section, submit signed copies of the site installation test report.
- .4 **Transformer Extended Warranty:** Submit a signed copy of the manufacturer's extended warranty as specified below.

### **1.02 QUALITY ASSURANCE**

- .1 Dry type distribution transformers are to be in accordance with requirements of the following:
  - .1 CAN/CSA-C22.2 No. 47, Air-Cooled Transformers (Dry Type)
  - .2 CSA-C9 Dry-Type transformers
  - .3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry-Type Transformers
  - .4 NEMA TP1, Guide for Determining Energy Efficiency for Distribution Transformers

### **1.03 EXTENDED WARRANTY**

- .1 Distribution transformers are to be covered by a 5 year non-prorated extended warranty (as per the Contract warranty) direct from the manufacturer to the Owner against defects in material, workmanship and performance.

## **2 PRODUCTS**

### **2.01 DISTRIBUTION TRANSFORMERS**

- .1 Dry type distribution transformers, factory assembled and tested, supplied with a 5 year extended warranty as per Part 1 of the Section, as per the drawing schedule and with the following features:
  - .1 a minimum NEMA/EEMAC 3R enclosure with rigid end frame, removable gasketed front and rear plates, a bottom terminal compartment, ventilation louvers designed to protect internal live parts from fire protection sprinkler system spray, a drip shield, a factory ASA No. 61 light grey enamel finish, an aluminium nameplate secured to rivets to the front of the enclosure and listing impedance rating, weight connection diagram, style and serial number, and, where required by governing Codes and Regulations, seismic restraint facilities for site connection

- .2 copper windings, a core constructed of stacked laminations of high permeability silicon steel, epoxy resin impregnation, and Class H silicone type coil insulation such that the winding temperature rise will not exceed 150° C (300° F) and the enclosure temperature rise will not exceed 65° C (150° F) under full load in a 40° C (104° F) ambient temperature
- .3 an electrostatic shield for the attenuation of voltage spikes, line noise, and transients
- .4 lugs or pressure type terminals to suit primary and secondary conductors
- .5 four 2½ % full capacity taps, 2 above normal and 2 below normal
- .6 basic impulse level (BIL), standard
- .7 mounting hardware for the location(s) shown
- .8 average sound levels as follows:
  - .1 40 dB for transformers up to 9 kVA
  - .2 45 dB for transformers from 10 to 50 kVA
  - .3 50 dB for transformers 51 to 150 kVA
  - .4 55 dB for transformers 151 to 300 kVA
  - .5 60 dB for transformers 301 kVA and larger
  - .6 integral vibration dampening with anti-vibration pads between the core and enclosure
- .2 **Acceptable Manufacturers:** Acceptable manufacturers are:
  - .1 Eaton Canada
  - .2 Schneider Electric Canada
  - .3 Siemens Canada Inc.
  - .4 Hammond Power Solutions Inc.
  - .5 Rex Power Magnetix

## 2.02 K-RATED POWER CONDITIONING DISTRIBUTION TRANSFORMERS

- .1 K-rated, shielded, 600 volt primary, high efficiency, continuous duty, power conditioning isolation transformers to support harmonic non-linear loads, factory assembled and tested, supplied with a five year extended warranty as per Part 1 of this Section, as per the drawing schedule and with performance and features as indicated below.
  - .1 **Input and Output Specifications:** Input and output specifications include:
    - .1 the normal AC input voltage rating is to have sufficient margin to sustain a constant input of  $\pm 10\%$  without saturation

- .2 the transformer primary is to be configured in a 3 phase delta or 1 phase 2 wire plus ground configuration as applicable and include, unless otherwise indicated, full capacity taps at 2 ½ % increments, two above and four below the nominal voltage tap
  - .3 when energized, the current inrush is not to exceed a maximum of ten times for full load input current for ½ cycle
  - .4 the output scheduled is to be continuous duty, full load output, and the impedance is to be 3% to 4% typical
  - .5 the output K rating is to be in accordance with  $K = \sum I_h(\text{pu})^2 h^2$
- .2 **Performance Specifications:** Performance specifications are to include:
- .1 the output voltage is to be maintained within  $\pm 2.5\%$  or less of nominal from no load to full load, and is to remain sinusoidal with no flat topping when high crest factor (3.0 : 1) non-linear loads are present at the output
  - .2 the overload rating is to be 500% for 10 seconds, and 1000% for 1 cycle
  - .3 the transformer is to add no more than 1% total harmonic distortion to the output waveform under a linear load
  - .4 the audible noise is to be maximum 55 dB at 1m (3')
  - .5 transformer efficiency is to be a minimum of NEMA TP 1 97% efficiency standards under the specified K-rated non-linear load at or between 35% to 50% load and at an operating temperature of 75° C (167° F)
  - .6 the BIL is to be minimum 10,000 volts
- .3 **Construction:** Construction features include the following:
- .1 a minimum NEMA/EEMAC 3R enclosure with rigid end frame, removable gasketed front and rear plates, a terminal compartment with input and output terminal connections hardwired to copper stand-off bus or terminals, a neutral conductor sized for 2 times the ampacity of the phase conductors, natural ventilation louvers designed to protect internal live parts from fire protection sprinkler system spray, a drip shield, a factory ASA No.1 61 light grey enamel finish, an aluminium nameplate secured to the front of the enclosure and listing impedance rating, weight, connection diagram, style and serial number, and where required by governing Codes and Regulations, seismic restraint facilities for site connection
  - .2 copper windings with separate primary and secondary isolated windings, a core constructed of stacked laminations of high permeability silicone steel with flux density not to exceed 15 gauss and core losses limited to 0.6% or less of the KVA rating, and 200° C (390° F) coil insulation such that the winding temperature rise will not exceed 115° C (240° F) above ambient under linear load and 130° C (265° F) under non-linear load

- .3 a double solid copper foil electrostatic shield to minimize inner winding capacitance, transient and noise coupling between primary and secondary windings
  - .4 transverse mode noise attenuation of 3 dB down at 10 kHz, decaying 20 dB per decade
  - .5 integral vibration dampening with anti-vibration pads between the core and enclosure
- .2 **Acceptable Manufacturers:** Acceptable manufacturers are:
- .1 Eaton Canada
  - .2 Schneider Electric Canada
  - .3 Siemens Canada Inc.
  - .4 Hammond Power Solutions Inc.
  - .5 Rex Power Magnetics Div. of Transformer Industries Inc.

### 3 EXECUTION

#### 3.01 INSTALLATION OF DISTRIBUTION TRANSFORMERS

- .1 Provide distribution transformers where shown. Ensure that adequate operation and maintenance clearance is maintained on all sides of each transformer as per Code requirements.
- .2 Wall mount transformers 75 kVA and less on a structural steel primed and enamelled wall mounting bracket assembly located approximately 300 mm (12") below the ceiling and adequately secured to wall construction. Submit wall bracket construction and securing details with transformer product data sheets.
- .3 Secure each transformer large than 75 KVA, level and plumb, on suitable rubber-steel-rubber vibration isolation pads on a concrete housekeeping pad.
- .4 Ground and bond transformers as indicated on the drawings.
- .5 Isolate primary and secondary connections from transformer enclosures by means of from 300 mm to 450 mm (12" to 18") of liquid-tight flexible conduit.
- .6 Identify each transformer with an engraved Lamacoid nameplate in accordance with requirements of the Section entitled Basic Electrical Materials and Methods. Confirm nameplate wording with the Consultant prior to manufacture.
- .7 Provide seismic restraints in accordance with requirements of the electrical work Section entitled Seismic Control and Restraint.

#### 3.02 VERIFICATION AND TESTING

- .1 Test and verify transformer secondary voltage and make any required adjustments to produce secondary voltages specified. Re-test and verify voltages when the building is in normal operation. Submit signed testing and verification reports as per Part 1 of this Section.

### **3.03 TRAINING AND INSTRUCTIONS**

- .1 Include for a minimum of 2 separate 4 hour system operation and maintenance training sessions for up to six persons per session, to be held at the site.
- .2 Prepare and submit for review, an outline of the proposed training session, including a list of all documents visual aids, etc., to be used.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products specified in this Section. Indicate compatibilities and limitations, and application instructions.
- .2 **Samples:** If requested, submit identified conductor samples.
- .3 **MSDS Sheets:** Submit Material Safety Data Sheets for conductor pulling lubricants.
- .4 **Type “MI” Cable Certifications:** Submit a minimum of four copies of a letter from the cable manufacturer certifying proper cable installation and successful testing as specified in Part 3 of this Section, and include cable test sheets.

## 2 PRODUCTS

### 2.01 DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

- .1 Conductors to and including No. 10 AWG are to be solid. Conductors larger than No. 10 AWG are to be stranded. 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:
  - .1 “T-90 Nylon” single conductor in accordance with CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, 90° C (195° F) rated, PVC insulated and nylon covered
  - .2 “RW-90” single conductor in accordance with CAN/CSA C22.2 No. 38, Thermoset-Insulated Wires and Cable, 90° C (195° F) rated, X-link polyethylene insulated
  - .3 “TWU” single conductor in accordance with CSA C22.2 No. 75, -40° C (-40° F) rated, PVC insulated
  - .4 “AC90” flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric ground conductor, and an interlocking aluminium armour jacket
  - .5 “A90 ISO-BX” flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric bare ground conductor, an insulated ground conductor, and an interlocking aluminium armour jacket
  - .6 Tyco/Pyrotenax “MI” ULC 2 hour fire rated conductor in accordance with CSA C22.2 No. 124, Mineral-Insulated Cable, 90° C (195° F) rated, consisting of a solid copper conductor, magnesium oxide insulation, a seamless soft drawn copper sheath, and factory supplied Pyrotenax terminations
  - .7 Tyco/Raychem “RHW” cable in accordance with requirements of CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables, R90 90° C (195° F) rated, consisting of a stranded copper conductor and silicone rubber insulation, ULC 2 hour fire rated when installed in metal conduit

- .8 Tyco/Raychem "CI" cable in accordance with requirements of CSA C22.2 No. 208, Fire /Alarm and /Signal Cable, FAS90 shielded or un-shielded as required, 90° C (195° F) rated, consisting of a copper conductor, silicone rubber insulation, and a polyolefin outer jacket
- .9 equal to Nexans Canada "Corflex" II" RA90 flexible cable in accordance with requirements of CSA C22.2 No. 123, Aluminium Sheathed Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, as required, an overall PVC jacket
- .10 equal to Nexans Canada "Firex II" TECK 90 cable in accordance with requirements of CSA C22.2 No. 131, Type TECK 90 Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, where required, an overall PV C jacket

## 2.02 LOW VOLTAGE (24 VOLT) CONDUCTORS

- .1 "T-90" or "RW90" stranded copper conductors as specified above.
- .2 Equal to Nexans Canada "Securex II" FAS/LVT/FT1300 volt wire to CSA C22.2 No. 208, Fire /Alarm and Signal Wire, 105° C (220° F) rated, consisting of solid copper conductors (stranded for control wiring), flame retardant PVC insulation, an aluminium/Mylar optional shield with a #22 AWG tinned copper insulation and a drain wire, and, if required for the application, interlocking aluminium armour with or without an overall jacket.

## 2.03 CONNECTORS

- .1 **Conductors In Conduit:** Except as noted, equal to Ideal Industries Inc. "Wing Nut" CSA certified, 60 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.
- .4 **Mineral Insulated Conductors:** Tyco/Pyrotenax "Pyropak" connectors, complete with brass plates with drilled and tapped mounting holes for connections to ferrous cabinets.
- .5 **Corflex/Teck Cable:** Connector and termination hardware supplied by the cable manufacturer to suit the application.

## 2.04 CONDUCTOR PULLING LUBRICANT

- .1 Equal to Ideal Industries Inc. "Yellow 77" or "ClearGlide", as required.
- .2 French Chalk or Talcum Powder conductor pulling lubricant.

## 3 EXECUTION

**3.01** 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 or duct use lubricant and ensure that the conductors are kept straight and are not twisted. For isolated power centre "load" side power wiring, use only French Chalk pulling lubricant.
- .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 "Corflex" cable unless justified by cable pulling tension calculations and when approved by the Consultant, and, if approved, locate splices where directed by the Consultant

**3.02** **INSTALLATION OF CONDUCTORS IN TRENCHES AND DUCTS**

- .1 Refer to the electrical work Section entitled Installation of Cables in Trenches or Ducts.

**3.03** **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-fired rated conductors are to be used as follows:
  - .1 conductors underground inside or outside the building, and in non-climate controlled areas – **TWU**
  - .2 unless otherwise specified, conductors in accessible ceiling spaces, within stud wall construction, and in furniture systems to luminaries and wiring devices – **AC90 (BX) flexible armoured cable, maximum 6 m (20') run permitted**
  - .3 for isolated power system wiring – **RW90**



- .4 for patient care area conductors in accessible ceiling spaces (not walls) to luminaries- **AC90 (BX) flexible armoured cable, maximum 3 m (10') run permitted**
- .5 for conductors in medical headwalls and service consoles, and as per drawing details – **T90 Nylon or RW90 in flexible conduit, or AC90 ISO-BX to Code requirements**
- .6 for conductors except as specified above or elsewhere in the Specification or on the drawings – **T90 Nylon or RW90**
- .3 **Fire Rated Conductors:** Unless otherwise specified herein or on the drawings, fire rated conductors are to be ULC 2 hour rated bare MI cable, or “RHW” or “CI” conductors in steel conduit, provided for service as follows:
  - .1 conductors from engine-generator set to transfer switch
  - .2 power feeders to Fireman’s elevator(s)
  - .3 power feeders to emergency lighting panelboards
  - .4 power feeders to fire alarm panels and transponders
  - .5 fire alarm system risers and other feeders as shown or specified
  - .6 any other conductors as specified on the drawings
- .4 **“MI” Mineral Insulated Conductor Installation Requirements:** Generally, install type “MI” mineral insulated conductors in accordance with the manufacturer’s instructions and recommendation, including the following:
  - .1 provide proper clips, wall brackets, and other support hardware either shown or required
  - .2 terminate the cable using connectors and installation tools supplied by the cable manufacturer
  - .3 terminate cable immediately after installation to avoid moisture ingress
  - .4 do not splice “MI” cables
  - .5 after installation and termination, test cable, including a meggar test, in the presence of the manufacturer’s authorized representative
  - .6 obtain from the manufacturer a letter stating the “MI” cable has been properly installed, tested, and is ready to be energized, and submit the letter and test result sheets to the Consultant
- .5 **“Corflex” Cable Installation Requirements:** Install “Corflex” cable in accordance with the manufacturer’s instructions, including the following requirements:
  - .1 support and secure overhead suspended “Corflex” 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 ground and bond single conductor cable at both ends where the sheath currents do not affect the cable ampacity
- .4 for certain areas, where the sheath currents will reduce the cable ampacity, ground and bond the cable at the supply end and isolate the cable at the load end as recommended by the cable manufacturer, and provide a No. 3/0 AWG green TW ground conductor for each cable, all as per Section No. 10 of the Ontario Electrical Safety Code
- .6 **“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 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
- .7 **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.
- .8 **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 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
  - .
- .9 **Isolated Power System Colour Coding:** Colour code isolated power system “load” side power wiring insulation as follows:
  - .1 live No. 1 – brown
  - .2 live No. 2 – orange
  - .3 ground – green

- .10 **Communication System Colour Coding:** Unless otherwise specified, colour code conductors for communication systems in accordance with the system manufacturer's recommendations.

**MAX. BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 2% 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.	-----	16.8	12.2	-----	-----	-----	-----	-----	-----	-----
No 10	-----	25.9	19.0	-----	-----	-----	-----	-----	-----	-----
No. 8	-----	39.6	30.4	12.9	-----	-----	-----	-----	-----	-----
No. 6	-----	62.4	47.2	32.0	23.6	19.0	16.0	-----	-----	-----
No.4	-----	99.0	73.1	50.2	38.1	30.4	24.3	21.3	19.0	-----
No. 2	-----	-----	114.3	77.2	57.9	47.2	38.8	33.5	28.9	22.8
No. 1	-----	-----	-----	96.0	73.1	57.9	47.2	42.6	36.5	27.4
No.1/0	-----	-----	-----	-----	85.3	68.5	56.3	48.7	41.9	33.5
No. 2//0	-----	-----	-----	-----	102.8	80.7	67.0	57.9	50.2	40.3
No. 3/0	-----	-----	-----	-----	-----	95.2	79.2	68.5	59.4	47.2
No. 4/0	-----	-----	-----	-----	-----	-----	92.9	79.2	70.1	56.3
250 MCM	-----	-----	-----	-----	-----	-----	102.8	86.8	76,.2	60.9
300 MCM	-----	-----	-----	-----	-----	-----	-----	100.5	88.3	70.1

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

**MAX. 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.	-----	24.4	18.3	-----	-----	-----	-----	-----	-----	-----
No 10	-----	38.1	29.0	19.1	-----	-----	-----	-----	-----	-----
No. 8	-----	59.4	44.2	30.5	22.9	-----	-----	-----	-----	-----
No. 6	-----	91.4	70.1	47.2	35.1	28.2	23.6	-----	-----	-----
No.4	-----	-----	109.7	73.2	54.9	42.7	38.1	32.0	27.4	-----
No. 2	-----	-----	-----	114.3	85.3	68.6	57.9	50.3	41.1	35.0
No. 1	-----	-----	-----	-----	103.6	85.3	73.2	61.0	54.9	43.4
No.1/0	-----	-----	-----	-----	128.0	102.9	85.3	73.2	64.0	48.8
No. 2/0	-----	-----	-----	-----	-----	122.9	100.6	86.9	74.7	60.9
No. 3/0	-----	-----	-----	-----	-----	-----	118.1	102.1	88.4	70.1
No. 4/0	-----	-----	-----	-----	-----	-----	-----	120.4	102.9	83.8
250 MCM	-----	-----	-----	-----	-----	-----	-----	-----	114.3	91.4
300 MCM	-----	-----	-----	-----	-----	-----	-----	-----	-----	103.6

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

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for all products specified in Part 2 of this Section except for copper wire/cable conductors.

### **1.02 QUALITY ASSURANCE**

- .1 Grounding and bonding work is to be in accordance with requirements of the following:
  - .1 CSA C22.2 No. 41, Grounding and Bonding Equipment (Tri-National Standard with UL 467)
  - .2 CSA C22.2 No. 0.4, Grounding and Bonding of Electrical Equipment
  - .3 requirements of the Electrical Safety Authority and any other governing authority
  - .4 CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities

### **1.03 COORDINATION**

- .1 Coordinate the installation of grounding hardware and conductors associated with concrete with the trades providing the concrete work.

### **1.04 FIELD QUALITY CONTROL REPORT**

- .1 Submit written and signed report(s) indicating successful results of the ground continuity tests specified in Part 3.

## **2 PRODUCTS**

### **2.01 GROUND RODS**

- .1 Copper clad solid steel ground rods, 20 mm ( $\frac{3}{4}$ " ) diameter, 3 m (10') long, each complete with driving cap, pointed bronze tip, and a #14 gauge hot dipped galvanized steel or PVC, 250 mm (10") diameter, 300 mm (12") long ground rod box with a vandal-proof removable identified cover.

### **2.02 GROUND PLATES**

- .1 Copper plates, 1 m<sup>2</sup> (11 ft.<sup>2</sup> surface area, 6 mm ( $\frac{1}{4}$ " ) thick.

### **2.03 GROUND MAT**

- .1 Copper mesh gradient control mat, 1.5 m (5') square, 2 mm ( $\frac{3}{32}$ " ) thick, 50 x 50 mesh.

### **2.04 GROUND BUS**

- .1 Solid electrical grade copper, minimum 50 mm x 6 mm (2" x ¼"), minimum 600 mm (24") long but with lengths as required (continuous lengths for health care and data centre projects), predrilled for two-hole lug connections, suitable for wall or backboard mounting and complete with corner angles, tamper-proof stainless steel hex head bolts, nuts, and spring lock washers, standoff insulators, and all connection hardware.

## **2.05 GROUND PIT**

- .1 Cast iron or precast concrete pit with a removable identified cast concrete cover with recessed lifting handle to set flush with grade, a ground rod with clamps and grounding conductors as indicated, and a bottom section of clay sewer tile filled with clean crushed stone or gravel for pit drainage.

## **2.06 FLEXIBLE GROUND BRAID**

- .1 Flat 98% conductivity tinned copper grounding braid with dimensions to suit the application.

## **2.07 GROUND CONDUCTORS**

- .1 Unless otherwise specified and/or shown. Stranded un-tinned soft annealed copper wire, bare or green PVC insulated conforming to requirement of the Section entitled Wire and Box Connectors (0-1000volts).

## **2.08 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 Erico International Corp. "CADWELD" welded connections.

## **2.09 COMMUNICATIONS, ACCESS CONTROL, & ELECTRONIC SAFETY SYSTEM GROUND BUS**

- .1 As per the electrical work Section entitled Grounding and Bonding for Communications.

## **2.10 LAN ROOM GROUND BUS**

- .1 Solid electrical Grade copper bus bars, 300 mm x 50 mm x 9 mm (12" x 2" x ¾") with 8 drilled holes, suitable for wall mounting and equipped with standoff insulators.

# **3 EXECUTION**

## **3.01 GENERAL RE: SECONDARY GROUNDING AND BONDING**

- .1 Perform all required secondary electrical work grounding and bonding work in accordance with the Contract Documents and requirements of governing Codes and Standards, including the Electrical Safety Authority.

- .2 Bond metallic conduits, boxes, cable tray, ducts, and non-current carrying metal parts of equipment together to form a continuous ground system. In electrical equipment rooms, solidly bond circuits, panelboards, conduits, equipment enclosures, and other equipment to perimeter ground bus using bronze connectors and hardware.
- .3 Protect exposed conductors from injury. Install underground conductors a minimum of 450 mm (18") below grade.
- .4 Use tinned copper conductors for aluminium structures.
- .5 Do not use bare copper conductors adjacent to un-jacketed lead sheath cables.

### **3.02 INSTALLATION OF GROUND ROD GRIDS**

- .1 Construct ground rod grids consisting of copper clad steel ground rods as indicated/specified where indicated, each consisting of the number of rods shown, driven into the earth a minim of 300 mm (12") below grade and terminated with a galvanized steel box enclosing the ground conductor clamp, and interconnected with minimum #3/0 AWG bare copper conductor. Flush with grade at each ground rod, provide an identification monument.

### **3.03 INSTALLATION OF PLATE ELECTRODE GRID**

- .1 Provide a plate electrode ground grid where indicated/specified.
- .2 Bury the plate electrode level a minimum of 765 mm (30") below grade and connect with minimum #3/0 AWG bare copper conductor. Flush with grade at each plate electrode, provide an identification monument.

### **3.04 INSTALLATION OF GROUND BUS**

- .1 Provide ground bus where shown/specified. Wall mount 300 mm (12") above finished floor level on standoff insulators and follow the outline of door frames and room corners using 90° bus angles to form continuous bus. Connect the ground bus to the ground rod grid by means of two minimum #3/0 copper conductors terminated with approved fittings.
- .2 Provide flexible braided copper ground straps from the ground bus to each steel door frame and door in the room, each securely bolted in place.
- .3 Tighten all bus bar joint connection bolts and lug using a torque wrench to the bus manufacturer's prescribed tension, then coat the bus with two 100% covering coats of shellac to prevent copper oxidization.

### **3.05 NEUTRAL GROUNDING**

- .1 Connect transformer neutral and distribution neutral together using 1000 volt insulated conductor to one side of a ground test link, the other side of the test link being connected directly to the main station ground. Ensure that distribution neutral and neutrals of potential transformers and service banks are bonded directly to the transformer neutral and not to the station ground.
- .2 Connect the neutral of the station transformer to the main neutral bus with a tap of the same size as the secondary neutral.

- .3 Ground the transformer tank with a continuous conductor from the tank ground lug through the connector on the ground bus to the primary neutral. Connect the neutral bushing at the transformer to the primary neutral in the same manner.

### **3.06 CABLE SHEATH GROUNDING**

- .1 Bond single conductor metallic sheathed cables together at on end only. Break the sheath continuity in an approved manner, and provide #6 AWG flexible copper ground conductor soldered (not clamped) to the cable sheath.

### **3.07 HEALTH CARE PROJECT GROUNDING**

- .1 Perform grounding work for health care projects, including isolated power system grounding, in accordance with requirements of CAN/CSA-Z32.
- .2 Refer to testing requirements in the electrical work Section entitled Electrical Work Testing.

### **3.08 LOCAL AREA NETWORK (LAN) ROOM GROUNDING**

- .1 Provide minimum 3/0 AWG insulated copper ground conductors and wall mounted copper ground bus in each LAN Room. Connect the ground bus to computer equipment racks and to the building ground system.

**END OF SECTION**



## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.
- .2 **Panelboard Door Keys:** Submit an identified key (minimum 3) for panelboards equipped with doors.

### 1.02 QUALITY ASSURANCE

- .1 Distribution panelboards are to be rated to interrupt and withstand short circuit faults greater than the available fault current. Indicate conformance with this requirement on product data sheets submitted for review.

## 2 PRODUCTS

### 2.01 DISTRIBUTION PANELBOARDS

- .1 **General Re: Panelboards:** Distribution panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit devices, as per the drawing schedule and plans, and in accordance with requirements of CAN/CSA- C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products. Comply with OESC Rule 14-014 with regards to series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating at least equal to the available fault current. Each panelboard is to be complete with:
  - .1 silver plated, electrical grade, 95% conductivity copper bus mains for the full length of each enclosure
  - .2 main and branch circuit conductor solderless lugs approved for copper conductors
  - .3 neutral bus and main lugs at the same end, and a removable cover for main lugs
  - .4 for panelboards in Elevator and/or Escalator Machine Rooms, hardware to permit padlocking the switch or breaker in the open position
- .2 **Panelboard Enclosures:** Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light gray equipment enamel. Each enclosure is also to be equipped with:
  - .1 wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No.29 requirements
  - .2 space for future breakers/switches as applicable and as per the drawing schedule, and where spare beaker space is scheduled, breaker connector kits
  - .3 for panelboards in areas other than secure Electrical, etc., Rooms, a concealed hinged door and flush latch with keyed alike lock

- .4 for free-standing floor mounted panelboards, reinforcement as required for a rigid enclosure
- .3 **Circuit Breaker Panelboards:** Breakers are to be moulded case, bolt-on breakers in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, calibrated for operation in a 40° C (150° F) ambient temperature, sized in accordance with the drawing schedules, and complete with:
  - .1 a top main breaker
  - .2 for breakers 225 amperes and larger, a solid-state adjustable trip unit with long time, short time, and instantaneous time functions and time delays, set at ratings in accordance with the distribution coordination study
- .4 **Switch and Fuse Panelboards:** Fusible switches are to be quick-make, quick-break, visible contact bolt-on switches in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, sized in accordance with the drawing schedules, and complete with:
  - .1 a top main switch
  - .2 operating handles which protrude through the dead front enclosure, interlocked with the switch mechanism, and equipped with facilities for padlocking in either the "ON" or "OFF" position
  - .3 fuse clips, and HRC fuses as per the drawing schedule
- .5 **Modifications & Accessories:** Panelboards are to be factory equipped with modifications and accessories as follows:
  - .1 100% rated neutral
  - .2 insulated ground bus assembly
  - .3 isolated ground bus assembly
  - .4 sub-feed lugs
  - .5 through-feed lugs
  - .6 entry plates for Corflex cable
  - .7 a barriered main breaker or switch
  - .8 a main breaker/switch through the cover key interlock
  - .9 an electrically held contactor in the mains, installed in a separate compartment with removable cover
  - .10 a shunt trip for the main breaker
  - .11 undervoltage release for the main breaker
  - .12 an alarm switch for the main breaker

- .13 a surge protection package with audible alarm and silence button, From "C" relay contact, and EMI/RFI filtering providing 50 dB noise attenuation at 100 kHz

**.6 Acceptable Manufacturers:** Acceptable manufacturers are:

- .1 Eaton Canada
- .2 Schneider Electric Canada
- .3 Siemens Electric Canada

### **3 EXECUTION**

#### **3.01 INSTALLATION OF DISTRIBUTION PANELBOARDS**

- .1 Provide distribution panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.
- .2 Wall mount panelboards independent of connected conduit.
- .3 Secure each free-standing panelboard, level and plumb, to a concrete housekeeping pad.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Identify each panelboard and each panelboard component with an engraved Lamacoid nameplate in accordance with requirements of the Section entitled Basic Electrical Materials and Methods. Confirm nameplate wording with the Consultant prior to manufacture. Include a printed circuit directory card in a frame with acetate cover.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for products specified in this Section.
- .2 **Panelboard Door Keys:** Submit identified keys (minimum 6) for panelboard doors.

## 2 PRODUCTS

### 2.01 BRANCH CIRCUIT PANELBOARDS

- .1 **General Re: Panelboards:** Breaker type branch circuit panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit breakers, as per the drawing schedule and plans, and in accordance with requirements CAN/CSA-C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products. Comply with OESC Rule 14-014 with regards to series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating at least equal to the available fault current., Each panelboard is to be complete with:
  - .1 electrical grade, 95% conductivity copper sequence phase bus mains for the full length of each enclosure
  - .2 a fully capacity neutral unless otherwise specified
  - .3 main and branch circuit conductor solderless set-screw type lugs approved for copper conductors
  - .4 neutral bus and main lugs at the same end, and a removable cover for main lugs
  - .5 a manufacturer's nameplate which indicates panelboard characteristics including the fault current that the panelboard, including breakers, has been constructed to withstand
- .2 **Panelboard Enclosures:** Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, flush or surface mounted as indicated, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light gray equipment enamel. Each enclosure is also to be equipped with:
  - .1 wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No. 29 requirements
  - .2 space for future breakers as applicable and as per the drawing schedule
  - .3 a concealed hinged door and flush latch with keyed alike lock, and a frame with acetate cover and a circuit directory card on the inside face of the panel door
  - .4 mylar circuit breaker identification strips secured in place

- .3 **Circuit Breakers:** Breakers are to be moulded case, bolt-on breakers in accordance with CSA/C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, calibrated for operation in a 40° C (105° F) ambient temperature, sized in accordance with the drawing schedules, and as follows:
  - .1 branch circuit breaker interrupting capacity is to suit the panelboard voltage and be as scheduled, or in accordance with Code requirements to suit the application
  - .2 odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number
  - .3 for ground fault breakers, CSA Class A, Group 1 combination thermal magnetic trip breakers with solid-state ground default interrupters
  - .4 for breakers 225 amperes and larger, a solid-state adjustable trip unit with long time, short-time, and instantaneous time functions and time delays, set a ratings in accordance with the distribution coordination study
  - .5 for dedicated breakers, handle lock devices
  - .6 as scheduled or shown, spare breakers or space for future breakers
- .4 **Modification & Accessories:** Where indicated on the drawings or scheduled, panelboards are to be factory equipped with modifications and accessories as follows:
  - .1 a factory installed, maintenance free surge protective device (SPD) in accordance with ANSI/UL 1449, connected to the bussing through a disconnect device and equipped with a diagnostic package with status indicators on each phase, LCD six digit surge counter display, EMI/RFI filtering, audible alarm with silence button, and Form C alarm contacts
  - .2 100% neutrals for panelboards equipped with SPD units and other panels as scheduled
  - .3 isolated ground bus for panelboards feeding electrically sensitive equipment and as scheduled
  - .4 insulated ground bus assembly
  - .5 sub-feed lugs
  - .6 through-feed lugs
  - .7 a non-automatic or automatic (as schedule) main breaker
  - .8 a shunt trip for the main breaker
  - .9 Isolated ground bus
- .5 **Acceptable Manufacturers:** Acceptable Manufacturers are:
  - .1 Eaton Canada
  - .2 Schneider Electric Canada

- .3 Siemens Electric Canada

## **2.02 LOAD CENTRES**

- .1 CSA certified factory assembled load centre type panelboards as indicated and scheduled on the drawings, sized to accommodate a minimum of twenty branch circuit breakers, each complete with a flush wall mounting # 16 gauge EEMAC 1 enamelled steel enclosure with trim and hinged door with latch, and the following:
  - .1 100 ampere electrical grade cooper bus mains
  - .2 a non-automatic main breaker
  - .3 plug-in branch circuit breakers
  - .4 where scheduled or indicated, CSA Class A, Group 1 combination thermal magnetic trip breakers with solid-state ground fault interrupters
  - .5 where scheduled or indicated, arc fault circuit breakers (AFCI's)
  - .6 where indicated and/or required, twin neutral with insulated cross strap for bonding applications
  - .7 numbered breakers and a typed circuit directory card
- .2 **Acceptable Manufacturers:** Acceptable Manufacturers are:
  - .1 Eaton Canada
  - .2 Schneider Canada
  - .3 Siemens Canada

## **3 EXECUTION**

### **3.01 INSTALLATION OF BRANCH CIRCUIT PANELBOARDS**

- .1 Provide breaker type branch circuit panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.
- .2 Unless otherwise specified, supply panelboards from a single manufacturer only.
- .3 Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.
- .4 Where two or more panelboards are installed in one enclosure equip the panelboards with double lugs and increase gutter capacity to accommodate additional cabling.

- .5 In addition to load circuit breakers scheduled and indicated for each normal power panelboard, provide five 15A-1P additional breakers for small power and miscellaneous mechanical loads, each connected with 30 m (100') of 12 mm (½") diameter EMT and two # 12 AWG plus ground, with terminations as directed during construction.
- .6 In each panelboard adjacent to mechanical equipment spaces, provide a dedicated 15A-1P breaker with lock-on device, and 12 mm (½") diameter EMT and two #12 AWG plus ground terminated in an identified junction box (BAS) in the equipment space.
- .7 Provide additional devices and accessories for panelboards as indicated and/or scheduled.
- .8 Test each surge protection device in accordance with the manufacturer's instructions.
- .9 For each GFI breaker demonstrate in the presence of the Consultant that the protected circuit will trip when a simulated ground fault is applied to the "load" side of the breaker, and meggar the "load" side neutral to ensure that the neutral is not grounded on the "load" side of the GFI.

### **3.02 INSTALLATION OF LOAD CENTRE PANELBOARDS**

- .1 Provide load centre type panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.
- .2 Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.
- .3 For each GFI breaker demonstrate in the presence of the Consultant that the protected circuit will trip when a simulated ground fault is applied to the "load" side of the breaker, and meggar the "load" side neutral to ensure that the neutral is not grounded on the "load" side of the GFI.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products specified in this Section. Include all construction and performance details.
- .2 **Switch Keys:** Submit three identified keys for each key operated manual motor starting switch.

### 1.02 QUALITY ASSURANCE

- .1 Motor starters are to be in accordance with the following standards:
  - .1 CSA-C22.2 N0. 14, Industrial Control Equipment
  - .2 Tri-National Standard CAN/CSA-60947-4-1/UL 60947-1A/NMX-J-Z90-ANCE, Low Voltage Switchgear and Controlgear-Part 4-1: Contactors and Motor Starters-Electromechanical Contactors and Motor Starters

## 2 PRODUCTS

### 2.01 MOTOR STARTERS

- .1 **General:** General requirements for motor starters are as follows:
  - .1 all motor starters must be capable of starting the associated motors under the imposed loads
  - .2 confirm that starter voltage matches the motor prior to ordering
  - .3 unless otherwise specified, all motor starters (and disconnect switches) are to have a 50,000 symmetrical SCIA (short circuit interrupting ampacity)
  - .4 equip starters with accessories and modifications as per the drawing Motor Starter Schedule
  - .5 equip every starter associated with a building fire alarm system fan shutdown with a double voltage relay with suitable coil voltage
  - .6 each starter that controls a motor with thermistor protection is to be equipped with a latching relay which controls a blue neon pilot light upon activation of the thermistor and an auxiliary contact installed in series with the overloads, and a reset button to reset the latching relay
- .2 **Single Phase Motor Starters:** Unless otherwise specified or scheduled single phase motor starters are to be manual motor starting switches, each suitable in all respects for the motor it controls and complete with a neon "ON" pilot light, a snap action toggle operator designed to prevent the switch from being held closed under a sustained motor overload, an enclosure to suit the application, and properly sized thermal overload protection which can be reset by moving the toggle to the "OFF" position.



- .2 **Starters For Three Phase Motors Less Than 25 HP:** Unless otherwise specified, starters for three phase motors less than 25 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with a properly sized thermal overload relay per phase, a 120 volt holding coil, and an enclosure to suit the application.
- .3 **Starters For Three Phase Motors 25 HP to 150 HP:** Unless otherwise specified, starters for three phase motors 25 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one properly sized thermal overload relay per phase, and an enclosure to suit the application.
- .4 **Starters For Three Phase Motors 150 HP and Larger:** Unless otherwise specified, starters for three phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one properly sized thermal overload relay per phase, and an enclosure to suit the application.
- .5 **Starters For 2-Speed Double Winding Motors:** Generally as specified above but suitable for the motor and equipped with a 45 second time delay to permit the equipment to coast down to low speed before it is operated at low speed.
- .6 **Starters For 2-Speed Single Winding Motors:** Generally as specified above but suitable for the motor and equipped with a 45 second time delay to permit the equipment to coast down to low speed before it is operated at low speed.
- .7 **Starters For Reversible Motors For Cooling Towers:** Generally as specified above but suitable for the motor and equipped with a 45 second time delay to allow the fan(s) to coast down to a stop before being operated in reverse rotation.
- .8 **Motor Starter Enclosures:** Unless otherwise specified, motor starter enclosures are to be in accordance with the following NEMA/EEMAC ratings:
  - .1 all enclosures located in sprinklered areas – Type 2
  - .2 all enclosures exposed to the elements – Type 3R, constructed of stainless steel
  - .3 all enclosures inside the building in wet areas – Type 3R, constructed of stainless steel
  - .4 all enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application
  - .5 all enclosures except as noted above – Type 1
  - .6 all enclosures located in finished areas – as above but recess type with #4 brushed finish stainless steel faceplate
- .9 Acceptable manufacturers are:
  - .1 Rockwell Automation Inc. - Allen-Bradley
  - .2 Eaton Canada
  - .3 Siemens Canada

.5 Schneider Electric Canada

## **2.02 FUSES**

- .1 Fuses: Unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.

## **2.03 WARNING SIGNS**

- .1 Appropriately sized white PVC warning signs with red lettering, screw holes, and stainless steel screws.

# **3 EXECUTION**

## **3.01 INSTALLATION OF MOTOR STARTERS AND ACCESSORIES**

- .1 Unless otherwise shown or specified, provide a starter for each item of motorized equipment as indicated on the drawings. Refer to the drawing Motor Starter Schedule.
- .2 **Single Phase Motor Starters:** Unless otherwise specified or shown on the drawings, mount single phase motor starters adjacent to the equipment they serve and connect complete.
- .3 **Warning Signs:** Provide warning signs at starter locations where required, i.e. "Motor is Under Remote Control and May Start At Any Time Without Warning".

## **3.02 ELECTRICAL WIRING WORK FOR MECHANICAL WORK**

- .1 Refer to the electrical work Section entitled Basic Electrical Materials and Methods.

**END OF SECTION**

## GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for disconnect switches and accessories.

## 2 PRODUCTS

### 2.01 DISCONNECT SWITCHES

- .1 Heavy-duty, CSA certified, front operated switches each in accordance with CAN/CSA – C22.2 No. 4, Enclosed Switches, each complete with a red handle suitable for padlocking in the “off” position, and a NEMA/ EEMAC enclosure. Fusible units are to be complete with fuse clips in accordance with CSA-C22.2 No. 39, Fuseholder Assemblies and to suit fuse types specified below.
- .2 **Fuses:** Unless otherwise scheduled or specified fuses are to be equal to English Electric Ltd. HRC fuses, Form I Class “J” for constant running equipment and Form II Class “C” for equipment that cycles on and off.
- .3 **Enclosures:** Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:
  - .1 all enclosures located in sprinklered areas – Type 2
  - .2 all enclosures exposed to the elements – Type 3R, constructed of stainless steel
  - .3 all enclosures inside the building in wet areas – Type 3R, constructed of stainless steel
  - .4 all enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application
  - .5 all enclosures except as noted above – Type 1
  - .6 all enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate
- .4 **Acceptable Manufacturers:** Acceptable manufacturers are:
  - .1 Rockwell Automation (Allen-Bradley)
  - .2 Eaton Canada
  - .3 Siemens Canada
  - .4 Schneider Electric Canada

### **3 EXECUTION**

#### **3.01 INSTALLATION OF DISCONNECT SWITCHES**

- .1 Provide all required disconnect switches in accordance with drawing plans, schedules, details, and requirements of the Specification.
- .2 Provide fuses for fusible disconnects.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for contactors and accessories. Product data is to include:
  - .1 enclosure rating
  - .2 short circuit withstand rating
  - .3 nameplate information and schematic wiring diagram
- .2 **Start-Up and Site Certification Reports:** Submit start-up and site certification reports as specified in Part 3 of this Section.

## 2 PRODUCTS

### 2.01 CONTACTORS

- .1 Modular design, factory assembled, electrically held (unless otherwise noted), full size contactors in accordance with requirements of CSA C22.2 No. 14, Industrial Control Equipment, and NEMA ICS2, Controllers, Contactors and Overload Relays, and drawing requirements. Unless otherwise shown or specified each contactor is to be complete with a nameplate, and the following:
  - .1 a padlockable enclosure with conduit knockouts and mounting screw holes conforming to requirements specified below
  - .2 enclosed contacts with closed contact indication
  - .3 unless otherwise indicated, two NC and two NC auxiliary plug-in contacts
  - .4 a continuously rated interchangeable coil
  - .5 side access, finger-safe field wiring terminals to suit conductors indicated
  - .6 a manual operator
  - .7 optional factory installed accessories consisting of:
    - .1 a hand-off-selector switch
    - .2 two identified pushbuttons, one green for power on, and one push-to-test
    - .3 a fuse and transformer kit
    - .4 a fused door interlock disconnect switch
- .2 **Enclosures:** Unless otherwise specified, contactor enclosures are to be in accordance with the following NEMA/IEE ratings:

- .1 all enclosures located in sprinklered areas – Type 2
- .2 all enclosures exposed to the elements – Type 3R, constructed of stainless steel
- .3 all enclosures inside the building in wet areas – Type 3R, constructed of stainless steel
- .4 all enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application
- .5 all enclosures except as noted above – Type 1
- .3 **Acceptable Manufacturers:** Acceptable manufacturers are:
  - .1 Rockwell Automation (Allen-Bradley)
  - .2 Eaton Canada
  - .3 Siemens Canada
  - .4 Schneider Electric Canada

### **3 EXECUTION**

#### **3.01 INSTALLATION OF CONTACTORS**

- .1 Provide contactors where shown and secure in place.
- .2 Connect each contactor with wiring in conduit in accordance with drawing requirements.
- .3 Do all required interlocking work in accordance with drawing control diagrams and control sequence requirements.
- .4 When contactor installation is complete, arrange and pay for the manufacturer to visit the site to check the installation, and to supervise all required testing and adjusting. Submit a copy of a report from the manufacturer which certifies that each contactor has been properly installed and connected, and has been checked and adjusted, as specified in Part 1 of this Section.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for products and accessories.

### **1.02 QUALITY ASSURANCE**

- .1 Fuses are to be CSA certified and marked in accordance with the following Standards:
  - .1 HRC fuses – CAN/CSA C22.2 No. 106, HRC – Miscellaneous Fuses
  - .2 plug and cartridge fuses – CSA 248-14, Fuses for Supplementary Overcurrent Protection (600 Volts, Maximum)

## **2 PRODUCTS**

### **2.01 GENERAL RE: FUSES**

- .1 HRC fuses are to have an interrupting capability of 200,000 amperes symmetrical.
- .2 Unless otherwise specified, fuses are to be the products of one manufacturer.
- .3 Fuse type references L1, L2, J1, R1, etc., have been adopted for use in this Specification.

### **2.02 FUSE TYPES**

- .1 Fuse types are to be as follows:
  - .1 HRC-J fuses (formerly Class J):
    - .1 type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum
    - .2 type J2, fast acting
  - .2 HRC-L fuses (formerly Class L):
    - .1 type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum
    - .2 type L2, fast acting
  - .3 HRCI-R fuses (formerly Class R – for UL Class RK1 fuses, peak let-through current and 12t values are not to exceed limits of UL 198E table 10.2):
    - .1 type R1 (UL Class RK1, time delay, capable of carrying 500% of its rated current for 10 s minimum to meet UL Class RK1 maximum let-through limits)
    - .2 type R2, time delay, capable of carrying 500% of its current for 10 s minimum

- .3 type R3 (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits

- .4 HRCII-C fuses (formerly Class C)

## 2.03 FUSE STORAGE CABINET

- .1 Wall mounting #12 gauge aluminium, 750 mm x 600 mm x 300 mm (30" x 24" x 12"), complete with a piano hinged and key lockable door, a black baked enamel exterior finish, and a 300 mm x 100 mm (12" x 4") black-white-black engraved "SPARE FUSES" Lamacoid nameplate as per the electrical work Section entitled Basic Electrical Material and Methods, secured to the door with stainless steel screws.

## 3 EXECUTION

### 3.01 INSTALLATION OF FUSES

- .1 Provide fuses for secondary distribution equipment in accordance with equipment specifications and drawing requirements. Ensure that the correct fuses are assigned to each electrical circuit.
- .2 Generally, fuses are to be as follows:
  - .1 **motor loads, elevators & transformers:** type J1 for up to and including 600 amperes and type L1 for ratings above 600 amperes
  - .2 **service entrance feeder circuits:** type J2 for up to and including 600 amperes and type L2 for ratings above 60 amperes
  - .3 **other service and equipment:** a type either indicated on the drawings, specified with the equipment, or required for the purpose
- .3 Ensure that circuit fuses are fitted to physically matched mounting devices. Provide Class R rejection clips for HRCI-R fuses.

### 3.02 INSTALLATION OF FUSE STORAGE CABINETS

- .1 Provide a spare fuse storage in each electrical room housing fused distribution equipment. Confirm exact locations prior to installation.

### 3.03 SPARE FUSES

- .1 Supply a complete set of spare fuses in original packaging for all fused secondary distribution equipment.
- .2 Unless otherwise specified, store the spare fuses in fuse storage cabinets.

**END OF SECTION**



## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for surge protection devices. Product data sheets must indicate that the SPD's are in accordance with the Codes and Standards listed below, and include certified wiring diagrams to indicate field connections, documentation to verify the following:
  - .1 short circuit current rating
  - .2 voltage protection rating for all modes
  - .3 maximum continuous operating voltage rating
  - .4 I-nominal rating
  - .5 device UL Type listing
- .2 **Field Inspection Report:** Submit a manufacturer's field inspection and test report as specified in Part 3 of this Section.
- .3 **Extended Warranty:** Submit the manufacturer's unlimited, signed, 10 year extended warranty covering the SPD against damage from transient voltages.

### 1.02 QUALITY ASSURANCE

- .1 **Codes and Standards:** Each SPD is to be listed and labelled in accordance with requirements of the following Codes and Standards:
  - .1 CSA C22.2 No.269, Surge Protection Devices
  - .2 UL 1449, Standard for Surge Protection Devices
- .2 **Acceptable Manufacturers:** Acceptable manufacturers are:
  - .1 Schneider Electric Canada
  - .2 Eaton Electric Canada
  - .3 Leviton Manufacturing Co. Inc.
  - .4 GE Industrial Solutions
  - .5 Phoenix Contact Ltd.

## 2 PRODUCTS

### 2.01 GENERAL RE: SURGE SUPPRESSORS

- .1 Maintenance free, 20 kA nominal discharge current rated, listed and labelled to indicate compliance with the latest edition of UL 1449, capable of operating without the need for an external or replaceable internal overcurrent device, capable of protecting all modes of the electrical system, each with a maximum continuous operating voltage of minimum 115% of the system nominal operating voltage, and equipped with:
  - .1 for externally mounted units, a NEMA/EEMAC 4 enclosure with, as required, internal safety barriers with lockout facilities to prevent contact with energized components
  - .2 a balanced suppression platform to equally distribute the surge current to all thermally protected metal-oxide varistors which are the core surge suppression component
  - .3 soldered internal components, hardwired with connections utilizing low impedance conductors
  - .4 protected status indicators consisting of red/green solid-state lights that report the status of the protection on each phase, designed such that the absence of a green light and the presence of a red light will indicate that damage has occurred on the respective phase or mode, and if power is removed from any phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes; in addition, for wye configured units, status indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes, as well as an additional green/red light that reports the status of the protection elements and circuitry in the N-G mode
  - .6 in addition, for delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes
- .2 Optional items to be provided are as follows:
  - .1 a fault condition audible alarm and alarm silence pushbutton
  - .2 a LCD to indicate how many surge events with a peak current magnitude of a minimum of  $50 \pm 20$  amperes have occurred, complete with reset button containing a mechanism to prevent accidental resetting of the counter via a single short duration button press, and if power is lost, the ongoing surge count is to be stored in non-volatile memory and displayed after power is restored

## **2.02 TYPE 1 SURGE SUPPRESSORS**

- .1 UL Type 1 service entrance rated, multi-stage parallel connected surge suppressor of modular design, each with a UL "in" rating (nominal discharge) of 20 kA, and the following:
  - .1 redundant status indicators on the front of the enclosure to monitor and indicate whether suppression capabilities have been comprised
  - .2 protective components that utilize thermally protected metal oxide varistors per mode
  - .3 dry contacts for remote monitoring capabilities
  - .4 an audible alarm with silence pushbutton and LCD surge counter

- .5 a proper mounting box and hardware where flush or semi-flush mounted in the distribution equipment enclosure

## **2.03 TYPE 2 SURGE SUPPRESSORS**

- .1 UL Type 2, multi-stage parallel connected, branch panelboard surge suppressor of compact non-modular design, each with a UL "in" rating (nominal discharge) of 20 kA, and the following:
  - .1 per phase status indicators on the front of the enclosure to monitor and indicate whether suppression capabilities have been comprised
  - .2 protective components that utilize thermally protected metal oxide varistors per mode
  - .3 Form C dry contacts for remote monitoring capabilities
  - .4 a high performance EMI/RFI noise rejection filter such that noise attenuation for electric line noise is up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220AS insertion loss test method
  - .5 in addition to the UL 1449 listing, a UL 1283 listing
  - .6 a NEMA/EEMAC 4 enclosure for external mounting, and a proper back box with hardware for flush or semi-flush mounting in the panelboard enclosure

## **3 EXECUTION**

### **3.01 INSTALLATION OF SURGE PROTECTION DEVICES**

- .1 Supply all required surge suppression devices.
- .2 Where the surge suppression device is indicated external to the equipment it protects, install the devices where shown, but confirm exact location prior to installation. Ensure adequate space for inspection and maintenance.
- .3 Where surge suppression devices are integral with the equipment they protect, supply the device(s) to the manufacturer of the distribution equipment for installation by the distribution equipment manufacturer.
- .4 Review all SPD manufacturer's installation information and verify all voltages prior to installation. Where the SPD is to be installed by the distribution equipment manufacturer, supply installation instructions with the SPD's.
- .5 Ensure that each SPD is installed with the shortest lead length possible, and avoid any unnecessary or sharp bends.
- .6 Ground resistance is to be 25 ohms or less.

- .7 When installation is complete but before the system is energized, arrange for the manufacturer's authorized representative to visit the site to inspect the installation, test operation, and, when the inspections and reports have been satisfactorily completed and the equipment operates as intended, submit a copy of the inspection and test certification letter.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for electric metering equipment.
- .2 **Sub-Metering Manufacturer's Inspection & Certification:** Submit a signed inspection and certification report from the sub-metering system manufacturer as specified in Part 3 of this Section.

### **1.02 QUALITY ASSURANCE**

- .1 All metering equipment is to be Measurement Canada approved, and in accordance with requirements of the following:
  - .1 CAN3-C17, Alternating-Current Electricity Metering
  - .2 the Ontario Electrical Safety Code

## **2 PRODUCTS**

### **2.01 STANDARD ENCLOSURE AND METER SOCKET**

- .1 CSA certified, surface mounting, standard Type 3R weather-proof enclosure and 13-jaw meter socket approved by the Utility and to suit the electric service arrangement.

### **2.02 UTILITY'S METER CABINET**

- .1 CSA certified minimum 915 mm x 915 mm x 300 mm deep (3' x 3' x 12") minimum #14 gauge enamelled steel cabinet, NEMA/EEMAC 2 inside the building in a sprinkler protected area, NEMA/EEMA 3R weatherproof with door stops where outside the building or where exposed to the elements, approved by the Utility and complete with:
  - .1 a removable minimum #12 gauge sheet steel interior mounting panel which is 80 mm (3 5/32") more narrow and shorter than the cabinet width and height, and mounted with a 15 mm (1/2") clearance behind the panel
  - .2 hinged double doors opening at the middle and equipped with a minimum of 3 latching points, and a non-locking latch and handle or latch-handle combination

## **3 EXECUTION**

### **3.01 INSTALLATION OF METER SOCKET AND ENCLOSURE**

- .1 Provide a meter socket with enclosure where shown. Confirm exact location prior to roughing-in.
- .2 Coordinate installation with the Utility who will provide the meter.
- .3 Clearly and permanently identify the meter cabinet.

### **3.02 INSTALLATION OF UTILITY'S METERING CABINET**

- .1 Provide a meter cabinet with meter socket for the Utility's meter where shown.
- .2 Unless otherwise specified or shown, mount the cabinet such that the top is maximum 1.8 m (6') above finished floor level or grade, with 900 mm (3') clearance around the front of the cabinet.
- .3 Provide a minimum 50 mm (2") diameter, maximum 30 m (100') empty conduit with nylon or polypropylene pull rope between the switchgear cubicle containing the metering transformers and the meter cabinet. The conduit is to contain a maximum of three 90° bends and is to be terminated at switchgear in accordance with the Utility's requirements.
- .4 Provide a bare #2/0 AWG copper ground conductor from the system ground to the exterior of the meter cabinet.
- .5 The Utility will provide the meter and connect to the metering cubicle of the switchgear.
- .6 Permanently identify the meter cabinet.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for outside lighting control products.
- .2 **Time Switch Enclosure Keys:** Submit 3 identified keys for the time switch lockable enclosure.

## **2 PRODUCTS**

### **2.01 PHOTO CELLS**

- .1 Intermatic Inc. K4100 Series, certified to CSA-C22,2 No. 55, Special Use Switches, 120 volt, weather-proof photo cells, designed such that the load remains on if the cell fails, and equipped with a hermetically sealed cadmium sulphide photo cell, colour coded wire leads, adjustable light level slide, swivel threaded pipe stem, a die-cast housing, and thermal inertia time delay to prevent switching by artificial light.
- .2 Acceptable manufacturers are:
  - .1 Intermatic Inc.
  - .2 Paragon Electric
  - .3 Tork Canada Ltd.

### **2.02 MECHANICAL TIME SWITCHES**

- .1 Intermatic Inc. V4547 Series with exact model number to suit the application, certified to CSA C22.2 No. 55, Special Use Switches, surface wall mounting, adjustable mechanical time switch, automatic adjustment for seasonal changes, equipped with astro dial, skipper to omit selected dates from the program, carryover to facilitate a minimum of 16 hours of preset schedule during power outages, 40 ampere rated switch contacts, and a EEMAC/NEMA 3R rain tight enclosure with lockable hinged door with 3 identified keys.
- .2 Acceptable manufacturers are:
  - .1 Intermatic Inc.
  - .2 Paragon Electric
  - .3 Tork Canada Ltd.

### **2.03 CONTACTORS**

- .1 As per the electrical work Section entitled Contactors.

## **3 EXECUTION**

### **3.01      INSTALLATION OF OUTSIDE LIGHTING CONTROL**

- .1 Provide a photo cell to switch designated outside lighting on, and relays and contactors to control connections to multiple loads. Refer to drawing details and notes for exact requirements. Do all required wiring work in conduit.
- .2 Provide a photo cell to switch designated outside lighting on and relays and contactors for programmed off control and override control via the mechanical work building automation system. Refer to drawing details and notes for exact requirements. Do all required wiring work in conduit, including the required hardware and wiring to the nearest building automation system panel for connection into the BAS as part of the mechanical work.
- .3 Provide a photo cell to switch designated outside lighting on and off. Refer to drawing details and notes for exact requirements. Do all required wiring work in conduit.
- .4 Mount the photo cell in the north exterior wall of the building at a height to permit cleaning/maintenance. Provide the required installation non-corrosive hardware, and confirm exact location prior to roughing-in.
- .5 When work is complete. Test operation of the system and make any required adjustments.

**END OF SECTION**



## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for occupancy sensors.

### **1.02 MOCK-UP**

- .1 Include for providing a sensor mock-up installation in a typical washroom to verify proper operation prior to installation of other sensors.

### **1.03 QUALITY ASSURANCE**

- .1 All occupancy sensors are to be solid-state design, UL/ULC listed and labelled and CSA certified in accordance with CAN/CSA C22.2 No. 184, Solid-State Lighting Controls, and designed specifically for energy conservation.

### **1.04 ACCEPTABLE MANUFACTURERS:**

- .1 Acceptable sensor manufacturers are:
  - .1 WattStopper/Legrand
  - .2 Pass & Seymour/Legrand
  - .3 Leviton Manufacturing Co. Inc.
  - .4 Lutron Electronics Co. Inc.
  - .5 Cooper Controls "Greengate"

## **2 PRODUCTS**

### **2.01 PASSIVE INFRARED SENSORS**

- .1 "WattStopper" passive infrared sensors are to be capable of detecting presence in the floor area to be controlled by detecting changes in the infrared energy, and small movements are to be detected such as when a person is writing while seated at a desk. The sensor turns the connected load on automatically when it detects occupancy, and when the space is vacant and a time delay expires, the sensor automatically turns the connected load off. Types of passive infrared sensors are as follows:

**wall switch sensor:** WS-250 Series for the line voltage as indicated, each complete with green LED that blinks upon occupancy, resets and blinks again when movement is detected, a manual ON/OFF button on the switch cover, adjustable time delay with walk test feature, multiple viewing segment Fresnel lens within opaque adhesive tape supplied loose to mask the lens to site eliminate coverage in unwanted areas, and a decorator style switch cover plate

- .2 **round ceiling sensor:** CI-200 Series dual-element, temperature compensated pyroelectric, 24 volt DC, 360° coverage, round, low profile sensor with LED indicator, user adjustable time delay from 15 seconds to 30 minutes in 2 minute increments, integral daylight filter to prevent short wavelength infrared waves such as sunlight from affecting the sensor, 30 segment Fresnel lens, alternate viewing patterns depending on mounting choice, adjustable 4 setting dip switch sensitivity, integral light level sensor (4 to 190 fc), isolated relay with N/C and N/O output contacts (1 A @ 24 volt AC/DC) for use with HVAC or other control equipment, application specific integrated circuit for reliability and to reduce false triggers, and mounting hardware to suit the ceiling construction
- .3 **rectangular ceiling sensor:** WPIR Series dual-element, temperature compensated pyroelectric, 24 volt DC, rectangular sensor with LED indicator, user adjustable time delay from 30 seconds to 30 minutes in 2 minute increments, optional on override through a logic key/on bypass, application specific integrated circuit for reliability and to reduce false triggers, and mounting hardware to suit the ceiling construction
- .4 **ceiling/wall sensor:** CX-100 Series dual-element, temperature compensated pyroelectric, 24 volt DC, pulse count processing, rectangular sensor with LED indicator, user adjustable time delay from 15 seconds to 30 minutes, integral daylight filter to prevent short wavelength infrared waves such as sunlight from affecting the sensor, multi-level Fresnel lens, integral bi-level light level sensor (3 to 200 fc), isolated relay with N/C and N/O output contacts (1 A @ 24 volt AC/DC) for use with HVAC or other control equipment application specific integrated circuit for reliability and to reduce false triggers, a swivel mounting bracket, and additional mounting hardware as required to suit the application

## 2.02 ULTRASONIC CEILING MOUNTING SENSORS

- .1 “W” Series ultrasonic ceiling mounting volumetric sensors which use the Doppler shift principal whereby motion in the controlled area causes a slight change in the reflected frequency and amplitude of the broadcast ultrasonic waves to detect occupancy and turn lighting and/or fans on and off. Each sensor is to be complete with 15 second to 15 minute adjustable time delay, 0 to 10 setting adjustable sensitivity, a by-pass setting to override a faulty or failed sensor, a LED indicator which blinks each time the sensor is triggered, and mounting hardware to suit the application.

## 2.03 POWER PACKS

- .1 CSA certified “B” Series, Model(s)..... line voltage/24 volt DC prewired power pack assemblies to provide 24 volt DC power to occupancy sensors.

# 3 EXECUTION

## 3.01 INSTALLATION OF OCCUPANCY SENSORS

- .1 Provide occupancy sensors, generally where shown but with exact locations in accordance with reflected ceiling plans and the sensor manufacturer’s instructions. Include for all required site assembly, and provide all required installation and support hardware.
- .2 Confirm exact locations prior to roughing-in.

- .3 Connect sensors to circuits indicated with wiring in conduit.
- .4 Provide power packs for 24 volt DC sensors and locate where accessible for maintenance. Ensure that panelboard breakers serving power packs are equipped with lock-on devices. Unless otherwise indicated install power packs in 150 mm x 150 mm x 100 mm (6" x 6" x 4") utility boxes painted white and identified with a Lamacoid nameplate, and connect to sensors with armoured cable with 1.5 m (5") of slack cable for location adjustment if required.
- .5 Assist the Owner's operating personnel in the location and adjustment of sensors to suit the location and application.
- .6 Include for a 4 hour on-site training session for the Owner's personnel to demonstrate operation and adjustments of sensors, and trouble-shooting procedures.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for the engine-generator set 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 be submitted for:
  - .1 the engine with make and model, weight, dimensions, and performance curves
  - .2 the generator (alternator) with make and model, weight, dimensions, electrical characteristics and all performance data
  - .3 the control panel, including a control wiring schematic, and a description of control panel sequences and integration with other building systems
  - .4 battery make and model, type and capacity
  - .5 battery charger make and model, and type
  - .6 voltage regulator and governor make, model and type
  - .7 cooling air and combustion air requirements lps and CDFM
  - .8 installation instructions and diagrams for wiring and piping
  - .9 engine-generator set sound pressure levels under full load
- .2 **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.
- .3 **Engine-Generator Set Vibration Analysis:** Submit an engine-generator set torsional vibration analysis and a critical vibration analysis prepared by the set manufacturer.
- .4 **Factory Testing and Test Report:** Include for all travel costs for a representative of the Owner to witness a successful factory test on the engine-generator set at rated load and power factor prior to shipment to the site. The factory test must also include all demonstration of proper operation of all operating and safety controls and sequences. Submit a dated and signed copy of the factory test report.

- .5 **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 four fuel oil filter elements with gaskets
  - .3 four lubricating oil filter elements with gaskets
  - .4 four air filters
  - .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
- .6 **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.
- .7 **Operation and Maintenance Training DVD:** When on-site maintenance and training is complete, supply and hand to the Owner a DVD outlining complete operation and maintenance procedures.
- .8 **Control Panel Keys:** Submit a minimum of 3 identified keys for the engine-generator set control panel door.

## 1.02 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. 1-07.2, Battery Chargers
  - .3 NEMA MG-1, Motors and Generators
  - .4 CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities

## 1.03 ACCEPTABLE MANUFACTURERS/SUPPLIERS

- .1 Acceptable generator set suppliers are:
  - .1 Generac
  - .2 Cummins
  - .3 Caterpillar
  - .4 Kohler
  - .5 T&T Power Group
- .2 Acceptable generator set instrument manufacturers are:
  - .1 Tyco Electronics/Crompton Technology
  - .2 Basler Electric Co.
  - .3 Yokogawa Canada Inc.
- .3 The manufacturer of the control panel main breaker manufacturer must be the same as the switchboard main breaker manufacturer.

#### **1.04 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 48 hours in advance of each site visit for service and maintenance procedures. One or more Owner's personal will accompany the service representative during each visit to gain further knowledge re: service and maintenance procedures.

#### **1.05 WARRANTY PERIOD TEMPORARY ENGINE-GENERATOR SET**

- .1 As part of warranty obligations, include all costs for providing at the site, within four hours of notification by the Owner and failure of a service technician to rectify and 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

### 2.01 ENGINE-GENERATOR SET

- .1 Factory assembled and tested, radiator cooled, propane engine driven electric generator set equipped with all required controls and accessories to comprise an automatic, continuous standby electric generating plant to perform under conditions specified below. The engine-generator set must be suitable in all respects for installation in the space provided.
- .2 **Performance Requirements:** The engine-generator set is to meet frequency and voltage requirements specified in the referenced CSA Standard. The engine-generator set is to automatically start in the event of commercial power failure, automatically stop when commercial power is restored, and be capable of operating with light loads for an extended period of time, and performance criteria is to include the following:
  - .1 radiator cooling system maximum airflow at rated speed for radiator arrangement: ..... m<sup>3</sup>/min.
  - .2 propane engine combustion air inlet flow rate at full speed: ..... m<sup>3</sup>/min.
  - .3 engine exhaust gas flow rate at full speed: ..... m<sup>3</sup>/min.
  - .4 heat rejection to atmosphere from generator at full load: ..... kW
  - .5 maximum fuel oil return pipe restriction: KPa
  - .6 fuel flow rate at rated load: ..... L/hr.
  - .7 coolant capacity with radiator: ..... L
  - .8 the engine-generator set is to be capable of operating at 10% of the nameplate rating at the rated RPM in an ambient temperature of 40° C (105° F) without overheating or any other harmful effects
  - .9 the engine-generator set is to be capable of operating with a single full load step for the nameplate kilowatt rating within the CSA Standard voltage and frequency regulation requirements without stalling and without a voltage drop below 60% of normal voltage
  - .10 engine-generator emissions: in accordance with MOE requirements and C of A
  - .11 The engine-generator sets are to be capable of operating in parallel and being synchronized to permit customized programmed load control as directed by the Consultant.

- .3 **Fabricated Requirements:** Engine-generator set fabrication requirements include the following:
- .1 if required by conditions, the set must be delivered to the site in sub-assemblies suitable for moving the set to the final location
  - .2 all moving parts such as flywheels, belts, etc., are to be protected by removable OSHA guards
  - .3 all "hot" parts of the set such as exhaust manifolds and the flexible exhaust connection which are located where they might be touched by personnel during normal service or maintenance procedures are to be protected by guards, or be factory insulated with minimum 50 mm (32") thick removable/replaceable insulating material
  - .4 the engine flywheel housing is to be connected to the generator housing with a SAE adaptor and the engine-generator set is to be aligned and secured to a common, rigid, welded, stress relieved, structural steel enamelled base capable of maintaining alignment of the engine-generator shafts and frames under all conditions including shipping, and the manufacturer/supplier is to obtain and submit torsional approval of the assembly from the propane engine manufacturer
  - .5 engine-generator mounting feet and steel base sole plates are to be machined parallel and true, and steel shims will be permitted only underneath the generator feet if required
  - .6 minimum 95% isolation efficiency cast iron housed steel spring vibration isolators with levelling bolts, oil-proof snubbers, minimum 6 mm (1/4") thick sound pads, and seismic restraints as required by Code are to be supplied with the engine-generator set
  - .7 engine mounted accessories are to be readily removable without dismantling any part of the assembly
- .4 **Engine:** Multi-cylinder, 4-cycle, propane engine manufactured to requirements of ISO 3046, capable of operating at a nominal 180 RPM when directly connected to the generator, and free from critical vibrations throughout the entire operating range. The engine is to be complete with inter-changeable cylinder heads special alloy steel exhaust valves, Deloro Stellite hard alloy faced exhaust valve insets, and the following:
- .1 **fuel system:** a fuel system with individual easily replaceable cylinder type fuel injectors, replaceable element fuel filters, an integral auxiliary fuel oil tank if required, suitable diameter two hour fire rated flexible braided stainless steel jacketed high pressure fuel lines with male swivel fittings, two 900 mm (36" ) long braided stainless steel fuel oil flexible connectors, and a water separator assembly with water sensor, gauge fuel restrictor sensor, filter, and alarm contact with relay



- .2 **oil lubrication system:** full pressure lubrication for main bearings, connecting rod bearings, and camshaft bearings, with internally mounted high capacity positive displacement gear type oil pumps with adjustable pressure regulators, lubricating oil cooler, full flow oil filters, an oil level gauge switch on the side of the oil pan in an accessible location, and:
  - .1 an oil fill pipe extended out beyond protective guards to permit easier access
  - .2 an engine oil drain piped out to the engine-generator base and equipped with a braided stainless steel drain hose clipped to the base and complete with a full flow brass or bronze ball type drain valve
- .3 **engine air intake:** replaceable element dry vortex type engine air intake filters, and air box drain canisters
- .4 **engine exhaust system:** engine exhaust system components designed to meet MOE C of A requirements are to be supplied loose with the set for site installation and are to include:
  - .1 a welded black steel pipe exhaust manifold "Y" fitting
  - .2 minimum 600 mm (24") long flexible stainless steel exhaust pipe sections
  - .3 a hospital grade super critical exhaust silencer
- .5 **engine coolant system:** the engine cooling system is to maintain the required engine temperatures at rated speed and load, and, except as specified, to be factory installed and complete with:
  - .1 a coolant radiator with mounting frame, duct connection adapter as required, protective screen, integral fuel cooler with connections, and coolant expansion tank
  - .2 a high performance static pusher type fan with motored, fan guard and shroud, and a fan hub grease fitting extended out beyond the hub housing for easier access
  - .3 coolant consisting of 50% automotive type polypropylene glycol with corrosion inhibitors and 50% clean water
  - .4 thermostatic controls
  - .5 208 volt, single phase, 6 kW (approx.) engine jacket coolant heaters equal to KIM "Hotstart", sufficiently sized to maintain the coolant in the engine at the engine manufacturer's rated temperature, arranged to automatically disconnect when the engine starts and runs, and complete with silicone rubber reinforced hoses, immersion type thermostats, pressure switches, and ball type isolating valves

- .6 valved coolant drain piping of sufficient length to extend into the drain pan under the set
- .7 a disconnect switch with all electrical components factory pre-wired through the disconnect switch
- .6 **operating and control components:** engine mounted, vibration isolated components including:
  - .1 an electrical shock isolated emergency lock-out push button station
  - .2 an oil temperature gauge, oil pressure gauge, and engine coolant temperature gauge
  - .3 an electronic governor selected by the engine-generator set manufacturer, with speed control and magnetic pick-up assembly capable of maintaining engine speed and generator voltage regulation within specified limits
  - .4 Hardware and circuitry to connect and integrate into the synchronous and parallel operation specified below, with an electronic governor selected by the engine-generator set manufacturer, with speed control and magnetic pick-up assembly capable of maintaining engine speed and generator voltage regulation within specified limits, capable of synchronization and paralleling to permit load control sharing and shedding, kW and KVAR sharing in stand-alone operation and concurrent with other engine- generator sets, and complete with:
    - .1 control to facilitate isochronous (zero drop) operation, and adjustable droop control/operation
    - .2 a load sharing module with required current and potential transformers
    - .3 the ability to interface directly with auxiliary controls that ramp, at a user defined rate, between low idle and rated speed setting via a selector switch, where ramp time are adjustable from one to 22 seconds
    - .4 control adjustments, accessible from the front of the unit, including Gain, Reset, and Actuated Compensation
    - .5 integral failed signal detection circuitry to constantly monitor the signal from a magnetic pick-up unit
    - .6 frequency regulation adjustable between 0 and 5%, while steady state regulation bandwidth is not to exceed  $\pm 5\%$

- .7 additional functions and features which include automatic sequence and phase matching, speed bias circuit, an enable circuit, breaker close circuit, voltage comparator circuit, adjustable dynamics, frequency, phase and voltage matching, selectable match up time, automatic breaker closure, and selectable output impedance
- .5 sensors and safety devices with relays, contacts, etc., factory wired to the engine-generator control panel to shut-down the engine and initiate an alarm and monitor set operation in the event that conditions specific below in this Section occur
- .7 **engine starting system:** a 12/24 volt DSC electric starting motor with a pinion arranged to disengage automatically when the engine starts, with a cranking motor cut-out switch to limit engine cranking to 3 attempts with not less than 45 seconds and more than 75 seconds between each attempt, and the following:
  - .1 **batteries:** Exide, Delco, or Surette sealed, long life lead-acid batteries, sized to the engine and battery manufacturer's recommendations and published data, with sufficient capacity to, in an ambient temperature of 0° C (32° F), crank the engine at the engine manufacturer's recommended cranking speed for a period of 60 seconds, with voltage measured at the starting motor terminals at the end of the cranking period, with driving current flowing, being not less than 1.75 volts per cell
  - .2 **battery stand and accessories:** free-standing, corrosion resistant enameled steel stand with insulation board and suitably sized PVC floor mounting tray, and the following accessories:
    - .1 a battery heater
    - .2 a painted G1S painted plywood wall mounting backboard with hardware for mounting a digital hydrometer and test log book and a syringe
    - .3 braided copper battery jumper cables
  - .3 **battery charger:** remote wall mounting, totally enclosed, EEMAC 2, overload protected fully automatic, 120 volt, single phase, 60 Hz battery charger as recommended by the engine-generator set supplier and supplied with the set, capable of recharging batteries discharged by 2 30 second engine cranking attempts to 80% capacity within 4 hours and to full capacity within 12 hours, and equipped with:
    - .1 an AC switch and overload protection isolating voltage ratio transformer, silicon controlled rectifier assembly and DC protection, all suitable for both trickle charge rate and high charge rate, as required, after engine start
    - .2 2% accuracy DC ammeter and DC voltmeter

- .3 AC power on indicating LED
  - .4 AC power failure alarm
  - .5 float voltage adjustment
  - .6 Equalize circuit
  - .7 DC output protection'
  - .8 Contacts and associated hardware to connect a common alarm signal to the engine-generator set control panel
- .4 **Engine Drain Pan:** Soldered, water-tight, heavy-gauge G90 galvanized steel drain pan sized smaller than the foot print of the propane engine so as to mount on the concrete housekeeping pad between vibration isolators.
- .5 **Alternator:** Drip-proof,  $\frac{2}{3}$  pitch, single bearing alternator to meet or exceed requirements of CSA C22.2 No.100, Motors and Generators, and current IEEE Standards, sized as indicated and the drawings, and close coupled to the engine with a SAE housing. The alternator is to be designed to minimize radio frequency interference (RFI) under all operating conditions, and the balanced telephone influence factor (TIF) is not to exceed 50. Maximum total harmonic distortion of the voltage waveform is not to exceed 6% under any given load, The alternator is to be complete with:
- .1 excitation boost not less than 3 times rated current for 10 seconds
  - .2 direct connected brushless main exciter with permanent magnet pilot exciter to provide power via an automatic voltage regulator to the main exciter, and with a dynamically balanced rotor permanently aligned to the engine by a SAE flexible disc coupling
  - .3 full amortisseur Class H rated windings, and a temperature rise not to exceed 130° C (265° F), as measured by resistance in an ambient temperature of 40° C (105° F), and resistor temperature detector (RTD) type thermistors embedded in the windings and complete with associated relays and contacts to transmit a high winding temperature alarm signal to the engine-generator set control panel
  - .4 a Basler Type SR4 of Newage Stamford No. MX321 static voltage regulator with 3 phase sensing, radio suppression module, frequency choke to prevent damage to the voltage regulator engine in case of lower than nominal engine speed, an adjustable stability circuit, and manually adjustable voltage potentiometer

- .5 an electrical connection extension box sufficiently sized for installation of a current sensor for ground fault protection as per control panel requirements specified below, and connection of "Corflex II" cable (with non-ferrous ground bushings) and isolation of the cable from the set as indicated on the drawings
- .6 a ground connection to sit the ground system, extended out to the alternator base
- .6 **Engine-Generator Set Control Panel:** Set mounted (at eye level), dead front, vibration isolated, enameled steel control panel with an EEMAC and/or CSA enclosure rating to suit the locating, and equipped with a piano hinged door with key lock and a minimum of 3 identified keys. The panel is to be pre-wired and factory tested with the engine and alternator, and is to be complete with a microprocessor controller with LDCD digital displays featuring multiple metering displays and graphics with specified features and options. Controls and monitoring features are to be compatible with the building automation system and include but not be limited to the following:
  - .1 main circuit breaker, generally as specified with a setting such that the generator short circuit output will trip the breaker, and with exact breaker type and exact settings as recommended by the engine-generator set manufacturer to suit the application
  - .2 load bank breaker, moulded case, non-automatic type of the same frame size as the main breaker, interconnected to the system to permit connection of a load bank during regular testing of the engine-generator set, with shunt trip and relays connected such that if the load bank breaker is closed when a power failure occurs the load bank breaker will open and the main breaker will close
  - .3 fire pump breaker, moulded case type with solid-state trip unit, with exact frame size and type as indicated on the drawings
  - .4 auxiliary automatic breaker for connection of ventilation damper controls, fuel oil pumps, etc., generally 30A-3P but with exact type and size to suit the application
  - .5 controls to monitor engine characteristics including oil and fuel temperature and pressure, engine elapsed time running, air temperature, battery voltage, and engine over-speed
  - .6 under frequency/over frequency voltage control module with adjustable relay to trip the main breaker on settings of  $\pm 12\%$  of normal
  - .7 an ammeter and a voltmeter, both with  $\pm 1\%$  accuracy
  - .8 a power factor meter

- .9 a frequency meter, an elapsed time meter, and a kW meter, all with  $\pm 1\%$  accuracy
- .10 gauges for engine oil temperature, oil pressure, and coolant temperature
- .11 a control system to initiate engine-generator set starting and stopping sequences and annunciate (local and remote) any fault condition
- .12 an electronic control module to monitor engine-generator set functions with an operator interface alpha-numeric display for viewing set data and setup, controls and adjustments
- .13 a selector switch for "ON-OFF-Manual" operation, with circuitry such that operation with the switch is in the manual position by-passes the automatic control system and initiates an alarm, with the switch in the off position initiates an alarm, and with the switch in either the manual or off position illuminates a "NOT IN AUTO" amber warning light
- .14 an alarm horn with silencing switch or push button, and an alarm light and circuitry to cause the alarm light to flash until the alarm initiating device is reset or returns to normal
- .15 LED type shut-down and warning indicating lights (brilliant cluster type for LED's that are continuously illuminated for the following:
  - .1 high oil temperature – red for shut-down, amber for warning
  - .2 high coolant temperature – red for shut-down, amber for warning
  - .3 low oil pressure – red for shut-down, amber for warning
  - .4 over crank shut-down – red
  - .5 over speed shut-down – red
  - .6 over voltage shut-down – red
  - .7 selector switch "NOT IN AUTO" warning – amber
  - .8 low DC voltage warning – amber (c/w DC voltage sensor)
  - .9 engine cool-down period indication - white
  - .10 reverse power shut-down – red
  - .11 under voltage shut-down – red
  - .12 low frequency shut-down – red

- .13 high frequency shut-down – red
- .14 low coolant level warning – amber
- .15 low fuel level warning – amber
- .16 battery charger failure warning – amber
- .17 water in fuel warning – amber
- .18 emergency power bus alive indication – blue
- .19 generator bus alive warning – amber
- .20 ECS not in auto warning – amber
- .21 low engine temperature warning - amber
- .22 audible alarm silence warning – amber
- .23 alternator winding/bearing high temperature warning – amber
- .24 fuel leakage warning – amber
- .25 ground fault warning – amber
- .26 auxiliary building alarms as specified and/or shown
- .27 two spare lights for future use
- .16 generator set synchronizing and paralleling components as required, including:
  - .1 synchronizer and synchroscope
  - .2 solid-state sync check relay
  - .3 synchronizing switch and controls
  - .4 synchronizing indicating LED's
  - .5 reverse power relay and accessories
  - .6 PLC with software for a complete automatic synchronization system as specified below in this Section
- .17 an auxiliary remote control connection terminal block assembly, clearly identified and including:
  - .1 contacts for engine alarm signal for remote annunciation of engine faults, failure, and alarms

- .2 four Form C contacts for signal engine run
- .3 five Form C contact for shut-down to engage the room exhaust fan starter
- .4 one Form C contact for shut-down to engage the room exhaust fan starter
- .18 permanently affixed, suitably sized, engraved Lamacoid nameplates for all control panel devices, switches, meters, lights, and other items, with wording approved by the Consultant
- .19 all required relays, contacts, and similar hardware required for connections to the building automation system as per the automation system points list, all to suit BAS protocol
- .7 **Emergency Power Off Push Button:** Equal to Rockwell Automation/Allen-Bradley 800T Series 55 mm (2¼") diameter head push button with shroud, thrust washer, and aluminum faceplate with "EMERGENCY POWER OFF" identification wording, housed in a flip-open polycarbonate tamper-proof cover.
- .8 **Structural Steel Mounting Base:** Structural steel reinforced and welded base of sufficient rigidity and strength to protect the assembly from stress or strain during transportation to the site, installation, and during operation. The base is to be factory cleaned, primed, and painted.

### 3 EXECUTION

#### 3.01 INSTALLATION OF ENGINE-GENERATOR SET

- .1 Ensure that the factory tests have been satisfactorily performed and documented prior to delivery of the set to the site.
- .2 Provide a new emergency power engine-generator set where shown. Secure the set in place, level and plumb, on a concrete housekeeping pad on vibration isolators supplied with the set and strategically placed such that each isolator will support an equal portion of the weight and the pressure exerted on the structure by each isolator does not exceed 345k kPa (50 psi).
- .3 Check engine-generator alignment after installation on the housekeeping pad and realign if necessary.
- .4 Provide a drain pan under the engine on the housekeeping pad and between the isolators.



- .5 Carefully coordinate installation of the engine-generator set with the trades installing the flexible fuel oil connection and piping, the flexible exhaust connection, silencer and exhaust piping, and site applied thermal insulation. Ensure that the exhaust piping diameter is in accordance with the engine supplied and that the location and height of the exhaust stack meets local air and noise limitations.
- .6 Provide starting batteries, battery rack, and jumper cable to connect the batteries together and to the engine starting system. Provide a wall mounted storage cabinet adjacent the battery rack and containing a hydrometer, syringe, and other accessories.
- .7 Wall mount the battery charger adjacent to the battery rack and connect to the batteries. Test charger operation and adjust as required.
- .8 Fill the engine cooling system within a 50% water-50% automotive type ethylene glycol solution. Check the specific gravity of the coolant to confirm proper percentages.
- .9 Check and test operation of the engine starting system and engine jacket coolant heaters.
- .10 Check the level of the engine lubricating oil and add oil if required.
- .11 Surface wall mount an "Emergency Power Off" push button station where shown and connect to the generator set control panel to shut-down the set when the push button is activated. Confirm exact location prior to roughing-in.
- .12 Do all required control wiring in conduit between the generator set control panel and associated equipment as per the control wiring schematic and the wiring requirements of the electrical work. Check and test all such control functions.
- .13 Carefully coordinate building automation system connections to the control panel with the trade performing the building automation system work.

### **3.02 SITE TESTING, START-UP AND COMMISSIONING**

- .1 When installation of the engine-generator set is complete and initial inspections by the set 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 below. Notify the Owner and Consultant ten working days in advance of the site testing, and arrange and pay for the set 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:
  - .1 **Operational Tests:** With the engine in a "Cold Start" condition and load bank(s) the size of the emergency load at its normal operating level, simulate a power failure but do not interrupt existing services. Continue the operational test for 1 hour after which time simulate restoration of normal power and demonstrate satisfactory transfer of the load and shut-down of the engine. During the operation test, observe and record the following:
    - .1 time delay on start
    - .2 cranking time until the engine starts and runs
    - .3 time required for the engine to come up to full speed
    - .4 time required to achieve a steady-state conditions with all switches transferred to the emergency position
    - .5 engine oil pressure, coolant temperature, and battery charge rate at 5 minute intervals for the first 15 minutes, and at 15 minute intervals thereafter
    - .6 time delay on re-transfer for each transfer switch
    - .7 time delay for engine cool-down and shut-down
  - .2 **Full Load Test:** Following the successful operational test, perform a 4 hour full load test. Provide load banks as required. The full load test may be initiated by any method that will start the engine and immediately upon reaching full speed, pick-up the full load in one step. Record data for items as listed above for the operation test at full load acceptance and every 15 minutes thereafter until completion of the test period.
  - .3 **Cycle Crank Test:** Prevent the engine from running by any means recommended by the set supplier. Put the control switch in the 'RUN' position to engage the starting system and cause the engine to attempt to start for cranking cycle of 30 seconds of continuous cranking or 3 10 second crank attempts separated by 10 seconds. Repeat the crank cycle a second time to demonstrate that the batteries have sufficient capacity for total cranking time of 60 seconds, then demonstrate the time required to re-charge the batteries.
  - .4 **Safety Shut-Down and Alarms:** Demonstrate that all safety shut-downs and alarms as well as all mounting points are fully operational.

- .5 **Ventilation:** During the full load tests, demonstrate that sufficient Generator Room ventilation is provided in accordance with requirements of CAN/CSA-C282.
- .6 **Voltage and Frequency:** Perform voltage and frequency tests in accordance with requirements of CAN/CSA-C282 or CAN/CSA-Z32, as applicable.
- .7 **Oil Analysis:** Perform oil analysis tests in accordance with requirements of CAN/CSA-C282 or CAN/CSA-Z32, as applicable.
- .8 **Synchronization and Paralleling:** Modify testing specified above to properly demonstrate the operation of multiple engine-generator sets and their synchronization and paralleling.

### 3.03 MINISTRY OF ENVIRONMENT TESTING

- .1 Arrange for the Owner's specialist Air Emissions Consultant to perform testing to confirm that the installed and operational engine-generator equipment meets requirements of the MOE Certificate of Air. Obtain a copy of the successful test report and include with operating and maintenance manual data.

### 3.04 ON-SITE TRAINING

The engine-generator set manufacturer/supplier is to provide a minimum 8 hour on-site training session for 4 members of the Owner's designated personnel on generator set operation and maintenance procedures. The Operating and Maintenance Manuals are to be used during this training, and a DVD recording of the session is to be handed to the Owner upon completion.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

.1 **Product Data:** Submit the following:

- .1 the name and licence number of the Environmental Consultant specified below
- .2 a copy of the Environmental Compliance Approval issued by the Ontario Ministry of the Environment and Climate Change

### **1.02 ENVIRONMENTAL CONSULTANT**

- .1 Retain the services of an Environmental Consultant (P. Eng.) licenced in Ontario to prepare and submit an application for Environmental Compliance Approval for the engine-generator set from the Ontario Ministry of the Environment and Climate Change. This work is to include:
  - .1 preparation and assembly of all data required including engine-generator data, drawings, specifications, venting location, and location of adjacent structures/buildings
  - .2 prepare dispersion calculations as per Regulation 346 under the EPA
  - .3 prepare a Noise Assessment which meets requirements of the Ministry's Municipal Noise Bylaw, and NPC documents
  - .4 payment of all associate fees
  - .5 distribution of copies of the complete application package, including fees, to the Ministry's Approvals Branch and the Regional Office
  - .6 act as the technical contact to the Ministry on behalf of the Owner to expedite and follow up on the application status, and obtain any required authorization from the Owner to act as liaison on the Owner's behalf
  - .7 submit any additional information that the Ministry requests

## **2 PRODUCTS**

N/A

## **3 EXECUTION**

N/A

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Shop Drawings/Product Data:** Submit shop drawings and product data sheets for the engine-generator set enclosure. Shop drawings/product data sheet must include all accessories, and enclosure design, weight (with tank loaded with fuel), dimensions, and features including the fuel tank sub-base.
- .2 **Enclosure Design Engineer:** The enclosure must be designed by a registered structural engineer licenced in the Province of the work. Enclosure shop drawings and product data sheets with design data must be stamped and signed by the design engineer to indicate conformance with applicable Codes and Standards.
- .3 **Enclosure Acoustical Design and Certification:** Submit with the enclosure shop drawings a letter stamped and signed by a registered acoustical engineer licenced in the Province of the work to indicate and certify the engine-generator set sound pressure levels outside the enclosure with the engine under full load. Refer to site acoustic performance and testing requirements specified in Parts 2 and 3 of this Section.
- .4 **Enclosure Door Keys:** Submit a minimum of 3 identified keys for the enclosure doors.
- .5 **Enclosure Finish Colour Chart:** Submit a chart to indicate the available wall and roof colours available for final selection by the Consultant.
- .6 **Identification & Signage:** Submit proposed identification product details with wording for the Consultant's review.
- .7 **Environmental Compliance Approval:** Apply for, pay for, obtain and submit an Environmental Compliance Approval Certificate in accordance with requirements specified in the electrical work Section entitled Engine-Generator Set Environmental Approval.

### **1.02 REFERENCES**

- .1 Refer to the following electrical work Sections:
  - .1 the Section entitled Engine-Generator Set
  - .2 the Section entitled Emergency Power Transfer Switch

### **1.03 QUALITY ASSURANCE**

- .1 The engine-generator set enclosure is to be in accordance with requirements of the following:
  - .1 CAN/ULC-S602, Aboveground Steel Tanks for Fuel Oil and Lubricating Oil
  - .2 CAN/ULC-S604, Standard for Factory-Built Type A Chimneys
  - .3 CSA C22.2 No. 5, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit Breaker Enclosures
  - .4 CSA C22.2 No. 46, Electric Air-Heaters

## 2 PRODUCTS

### 2.01 WALK-IN TYPE ENGINE-GENERATOR SET ENCLOSURE

- .1 Factory fabricated, assembled, outdoor, weatherproof, non-combustible, 2 hour fire rated, sound attenuated, corrosion resistant steel enclosure, generally as indicated on the drawings, supplied with the engine-generator set, designed for mounting on and securement to a concrete base and ready for external wiring connections and engine exhaust piping.
- .2 The maximum sound pressure level at a distance on grade 7 m (22') from any side of the enclosure with the engine-generator set operating under full load is to be 72 dB.
- .3 The enclosure is to be arranged with 1 m (3') clearance around the engine-generator, and is to be complete with:
  - .1 **floor:** security type 6.4 mm (1/4") thick galvanized checker plate steel with a minimum R32 insulation and a galvanized steel bottom liner, a minimum 150 mm (6") sealed curb around the entire enclosure perimeter, floor mounted distribution equipment, and all floor openings to contain any liquid spills, 2 coats of epoxy equipment enamel over proper primer, and rubber mats on all exposed flooring
  - .2 **floor leak detection:** dual float discriminating sensor leak detection and alarm system to monitor within the curbed floor for liquid leaks, equipped with an alarm panel with alarm horn, alarm silence, and reset pushbuttons, an exterior weatherproof audible/visual alarm panel with flashing red indicating light, alarm horn, alarm horn silence pushbutton, reset pushbutton, and auxiliary contacts pre-wired to a junction box on the exterior wall for site connection to facilities inside the building
  - .3 **walls:** minimum #26 gauge, factory pre-finished, vertical exterior steel siding applied over building wrap and thermal and acoustic insulation, with taped and finished fire rated gypsum board and a perforated minimum #22 gauge galvanized steel liner, with galvanized steel plate reinforcement behind all wall mounted devices
  - .4 **roof:** factory finished steel roofing panels secured to as galvanized steel roof framing structure, sloped for positive drainage, with building wrap, acoustic and thermal insulation, perforated liner, and steel plate reinforcement for roof mounted devices as specified for walls, and drip shields over each door
  - .5 **doors:** a minimum of two 1065 mm x 2133 mm (42" x 84") high exterior grade, insulated, 2 hour fire rated steel doors with frames, 1 on each side of the enclosure, each prime coat painted and finished with epoxy enamel to match the siding, and equipped with:
    - .1 a heavy-duty door closer with retaining chain
    - .2 a mortised, latched, keyed alike lockset with lever and trim, and a panic bar
    - .3 3 tamper-proof heavy-duty stainless steel hinges

- .4 a magnetic door contact, with wiring in conduit extended to a junction box for site extension into the building
- .6 **sub-base fuel tank:** double wall steel tank with a capacity sufficient to operate the engine-generator set under full load for a minimum of 8 hours, and complete with:
  - .1 an exterior fill connection with cap
  - .2 a level control switch with visual indication and a contact for connection to a low fuel oil level alarm
  - .3 CSA certified and ULC listed and labelled 2 hour fire rated, flexible, wire braided, jacketed, high pressure fuel oil lines from the tank to the engine fuel pump
  - .4 vacuum leak detection gauge with vacuum switch for leak detection and alarm for the interstitial space of the double wall tank
- .7 **enclosure and engine ventilation:** factory installed and connected supply and exhaust air ventilation system for engine combustion air, engine cooling, and enclosure ventilation, sized to suit requirements and equipped with:
  - .1 for both the supply and exhaust air ventilation openings, an extruded aluminium alloy, 100 mm (4") deep, fixed blade, weatherproof acoustic storm louvre with stainless steel securing hardware, framed aluminium mesh bird screen, and a factory applied anodized finish to match the enclosure finish colour
  - .2 a factory installed galvanized steel silencer to ASHRAEW and SMACNA Standards, selected to meet enclosure noise criteria
  - .3 for both the supply and exhaust air openings, an extruded aluminium, insulated, opposed blade, low leakage damper with spring stainless steel side seals, self-lubricating bronze bearings, end stops, stainless steel linkage, and 120 volt or 24 volt spring return, normally open damper motor with weather-proof enclosure to suit the mounting location
  - .4 for both supply and exhaust air wall openings, a sound attenuated galvanized steel snow/rain hood, finished to match the enclosure finish and supplied loose for field installation over the ventilation openings
  - .5 a wall mounted, direct drive propeller exhaust fan with fan blade and motor guards, motor starting switch, and insulated sheet steel wall mounting enclosure
- .8 **ventilation controls and sequence:** factory installed and wired in conduit, and factory tested control system designed and connected such that:
  - .1 the air intake damper is to fully open when the engine starts
  - .2 the exhaust fan and motorized damper is to modulate according to the controller, engine temperature sensor, and enclosure ambient temperature
- .9 **enclosure unit heater:** ceiling mounted CSA certified and labelled electric unit heater sized to maintain an enclosure temperature of minimum 15° C (60° F) with an outside temperature of -40° C (-40° F), and factory connected to a wall mounted dual scale thermostat with thermometer and an adjustable low temperature alarm contact

- .10 **engine exhaust stack:** CAN/ULC-S604 Type A chimney, complete with all required installation and termination accessories
- .11 **engine exhaust silencer insulation:** Semi-rigid, 50 mm (2") thick mineral fibre "rock wool" insulation with a lagged canvas jacket meeting flame spread and smoke developed ratings of CAN/ULC-S102
- .12 **transfer switch:** in accordance with the electrical work Section entitled Emergency Power Transfer Switch, factory installed or site installed and connected to the control panel
- .13 **electrical work:** factory installed and pre-wired in accordance with wiring standards specified in this Division of the Specification, and consisting of:
  - .1 a circuit breaker panelboard with bolt-on breakers sized to accommodate all enclosure loads plus a minimum of 3 spare 15A-1P breakers, and a typed circuit directory under plastic on the panelboard door
  - .2 high output, totally enclosed fluorescent fixtures with electronic ballasts for a minimum of 500 lux average maintained illumination, controlled by a 3-way illuminated handle switch at each door
  - .3 a wall mounted 24 volt DC battery emergency lighting unit with charger and remote heads to provide a minimum 359 lux generally distributed for 2 hours
  - .4 an exterior, weatherproof and vandal proof LED lighting fixture located over each entrance door, with photocell and motion sensor ONN/OFF control
  - .5 3 Specification Grade, Premium Quality, duplex, 20 ampere, 125 volt U-ground receptacles with stainless steel faceplates, 1 located adjacent to the emergency lighting battery unit, and 1 on each side wall in an accessible location with 1 being adjacent to the engine start system battery charger
  - .6 weatherproof and vandal-proof, exterior dome type "ENGINE RUNNING" strobe light fixtures, each with red lens and equal to Federal Signal Corp. Model FP24PST, one located adjacent to each enclosure door and connected to the engine-generator set control panel
  - .7 weatherproof, exterior, emergency power off pushbuttons equal to a Rockwell Automation "Allen-Bradley" 800T Series, each with a red, 55 mm (2¼") diameter mushroom head pushbutton with shroud, thrust washer, and aluminium faceplate with "EMERGENCY POWER OFF" red identification in a break glass cover with locking handle operator, 1 located adjacent to each enclosure door and connected to the engine-generator set control panel
  - .8 weatherproof and vandal-proof, exterior dome type "TROUBLE" strobe light fixtures, each with an orange lens and equal to Federal Signal Corp. Model FP24PST, one located adjacent to each enclosure door and connected to all alarms such as the enclosure temperature alarm, fuel leak alarm, etc.
  - .9 all required wiring work with EMT and galvanized steel boxes where inside the enclosure, rigid galvanized steel with FS/FD boxes where outside the enclosure, and a minimum of 450 mm (18") of liquid-tight flexible conduit for all connections to motorized or vibrating equipment



- .14 **communications conduit and boxes:** empty EMT with fish wire and galvanized steel boxes inside the enclosure for future installation of a fire alarm system detector, pull station, and audible/visual alarm signals, and an outlet box with EMT and fish wire for future installation of a telephone, all terminated in identified FS/FD boxes on the exterior of the enclosure
- .15 **grounding and bonding:** properly sized electrical grade copper ground bus with connection lugs and all required ground connections as per Code requirements inside the enclosure, terminated for site connection to a ground grid outside the enclosure
- .16 **fire extinguishers:** ULC listed and labelled 10 B:C 6.8 kg (15 lb.) carbon dioxide extinguishers, each with a wall mount bracket and 1 located inside the enclosure at the strike side of each door
- .17 **stairs and landing:** factory fabricated galvanized steel stair and railing assembly at each entrance door, with slip-resistant stair treads, and, for assemblies more than 2 steps high, a 1.2 m x 2.4 m (4' x 8') slip-resistant landing with railing, all in accordance with Code requirements
- .18 **hinged door for cable connection:** weatherproof hinged access door of enclosure wall construction located as required for site connection of exterior cable such as load bank cable
- .19 **identification and signage:** factory installed, as per the electrical work Section entitled Basic Electrical Work Materials and Methods, but UV resistant with red lettering on a white background and permanently secured in place with stainless steel screws, generally as follows but with exact wording approved by the Consultant:
  - .1 on the exterior of each enclosure door, "AUTHORIZED PERSONNEL ONLY"
  - .2 on an exterior wall in a visible location at the engine-generator set, "WARNING – KEEP OFF – GENSET MAY START AUTOMATICALLY AT ANY MOMENT"

### 3 EXECUTION

#### 3.01 INSTALLATION OF ENGINE-GENERATOR SET ENCLOSURE

- .1 Provide an enclosure for the engine-generator set where shown.
- .2 Secure the enclosure in place, level and plumb, on a concrete base.
- .3 Provide all required engine chimney with termination.
- .4 Do all required power, control, and communication wiring from the engine-generator set to the building as indicated and/or specified. Test all connections and functions.
- .5 Connect the enclosure/tank leak detection wiring to the engine-generator control panel as a control panel alarm.
- .6 Provide a ground grid outside of the enclosure and connect to the enclosure ground bus or ground connection, as applicable.

- .7 Fill the fuel tank with diesel fuel. After engine-generator set testing and commissioning is complete, re-fill the tank.
- .8 When the entire engine-generator set installation is complete, arrange and pay for an acoustical P. Eng. to perform, in the presence of the Consultant, an acoustical performance field test as specified with the engine operating at full speed under load. Take test readings at 10 different locations around the enclosure. Supply an appropriate load bank for performance and acoustic testing. Submit the acoustic performance test report as specified in Part 1 of this Section.

**END OF SECTION**

## GENERAL

### 1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings and product data sheets for the transfer switch and all accessories. Include the following:
  - .1 load classification
  - .2 tungsten lamp load, ballast load, and motor load, all in kW
  - .3 a single line diagram indicating controls and relays
  - .4 a complete description of switch operation
- .2 **Factory Test Report:** Submit a copy of the factory test report documenting all test procedures and the results.
- .3 **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.

### 1.02 QUALITY ASSURANCE

- .1 The transfer switch is to be in accordance with requirements of the following, applicable:
  - .1 UL 1008, Standard for Safety Transfer Switch Equipment
  - .2 CSA C22.2 No. 178, Automatic Transfer Switches
  - .3 CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

## 2 PRODUCTS

### 2.01 AUTOMATIC TRANSFER SWITCH

- .1 ASCO Power Technologies Canada 7000 Series automatic closed transfer and by-pass isolation switch, sized as indicated, rated for continuous duty, double-throw, electrically operated and mechanically held by a single solenoid mechanism energized from the power source to which the load is to be transferred, fully protected, complete with voltage sensing relays, a manual transfer feature incorporating spring handles, and arc chutes, magnetic blow-out coils, and all components necessary for proper performance and operation. The switch is to be mechanically interlocked so that only 1 of the 2 positions (normal or emergency) is possible at one time.

- .2 The transfer switch is to be housed in a free-standing EEMAC 2 enclosure finished in ANSI 61 grey enamel and equipped with gasketed doors and openings, and ventilation louvers to protect from ingress of water from overhead fire protection system activated sprinklers.
- .3 The transfer switch is to be equipped with the following features:
  - .1 a power module and a control module interconnected for complete automatic operation
  - .2 main contacts to transfer in 70 milliseconds or less, protected by separate arcing contacts with arc barriers between poles, with inspection of the contacts (movable and stationary) and coils to be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors, by means of a manual maintenance handle to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts as required
  - .3 a microprocessor based control panel with LCD display, sensing and control logic on printed circuit boards, and plug-in type industrial grade interfacing relays with dust covers, supplied loose with a protective cover for site mounting adjacent to the transfer switch, equipped with an interconnecting wiring harness and keyed disconnect plug to enable the control panel to be disconnected from the transfer switch for routine maintenance
  - .4 time delay 1, adjustable from 0.5 to 6 seconds and initially set at 1 second, to override momentary normal source of power outages to delay transfer switch operation and engine start signals
  - .5 time delay 2B, adjustable from 0 to 8 minutes and initially set at 0 minutes, for controlled time of load transfer to emergency power
  - .6 time delay 2E, adjustable from 0 to 30 minutes and initially set at 5 minutes, for unloaded cool-down operation of the engine-generator set
  - .7 time delay 3A, adjustable from 0 to 30 minutes and initially set at 5 minutes, to automatically by-pass re-transfer to the normal power source if the emergency source fails and the normal source is available
  - .8 an engine start contact which closes to initiate engine start when normal power fails
  - .9 a "TEST" – "OFF" – "AUTO" – "ENGINE START" selector switch with pilot lights to indicate switch position
  - .10 connection hardware for the conductors indicated on the drawings
  - .11 a frequency relay to prevent emergency load transfer until the frequency of the emergency power source has reached its set value

- .12 in-phase monitoring of the motor load with generator for transfer from normal to emergency and vice-versa, by means of a monitor to sample the relative phase angle and frequency difference and signal the transfer switch to close when the 2 voltages are at the required phase angle
  - .13 overlapping neutral contacts as required
  - .14 a minimum of 2 NO and 2 NC auxiliary contacts to operate connected equipment/systems such as alarms
  - .15 indicators to show the transfer switch position, and a pilot light to indicate that the load is connected to the emergency power source
  - .16 a momentary contact switch to permit built-in time delay on re-transfer to normal power to be by-passed
  - .17 engraved Lacamoid nameplates to identify the transfer switch and all components
  - .18 a by-pass isolation switch to manually permit convenient electrical by-pass and isolation of the automatic transfer that could not otherwise be tested and maintained without interrupting the load, and by-pass of the load to either the normal or emergency powered source with complete isolation of the automatic transfer switch is to be possible regardless of the status of the automatic transfer switch – the by-pass isolation to permit proper operation by 1 person through the operation of a maximum of 2 handles at a common dead front panel
- .4 The sensing and control panel logic is to utilize solid-state sensing to initiate the emergency mode of operation upon a reduction of nominal voltage of the normal power source to below 90%, and re-transfer to normal when the voltage is 90% and above. The pick-up voltage is to be adjustable from 85% to 100% and the drop-out voltage is to be adjustable from 75% to 98%.
- .5 Acceptable manufacturers are:
- .1 Emerson Electric Co., - ASCO Power Technologies Canada
  - .2 Eaton
  - .3 Russelectric Inc.
  - .4 General Electric

### **3 EXECUTION**

#### **3.01 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 Wall mount the control panel adjacent to the switch and connect the wiring train.
- .3 Do all required power and control connections in accordance with certified power and control wiring schematics and the switch manufacturer's instructions.
- .4 Extend conductors for elevator control interlocking to the Elevator Machine Room and terminate, coiled, taped, and identified for connection to the elevator controller as part of the elevator installation work.
- .5 Carefully coordinate any building automation system connections to the control panel with the trade performing the building automation system work.

### **3.02 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 state-up reports.
- .3 In addition to testing and verification requirements specified in the Sections entitled Electrical Work Commissioning and Electrical Work Testing, perform the testing work as specified below. Notify the Owner and Consultant 10 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.

### **3.03 ON SITE TRAINING**

- .1 The transfer switch manufacturer/supplier is to provide a minimum of 6 hour on-site training session for 4 members of the Owner's designated personnel on transfer switch operation and maintenance procedures. The operating and Maintenance Manuals are to be used during this training, and a DVD recording of the session is to be handed to the Owner upon Substantial Performance.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for lighting fixtures. Include certified fixture photometric data which includes total input watts, candlepower summary, candela distribution zonal lumen summary, CIE type coefficient of utilization, and lamp type and lumen rating in accordance with CSA IESNA testing procedures.
- .2 **Lighting Fixture Colour(s):** For all lighting fixtures where the colour is to be selected after award of the Contract, submit colour charts and obtain fixture colour information in writing prior to ordering.
- .3 **Spare Lamps:** Submit spare lamps as specified in Part 3 of this Section.

### 1.02 QUALITY ASSURANCE

- .1 All lighting fixtures are to be ULC listed and/or CSA certified and labelled.

## 2 PRODUCTS

### 2.01 GENERAL RE: LIGHTING FIXTURES AND LAMPS

- .1 Lighting fixtures and lamps are scheduled on the drawings.
- .2 **Lighting Fixture Construction:** Unless otherwise specified the following requirements apply to lighting fixture construction:
  - .1 bodies are to be constructed of minimum #20 gauge cold rolled prime coat steel, of rigid construction and complete with knockouts as required
  - .2 fixtures are to be suitable in all respects for the mounting locations indicated on the drawings, and are to be complete with all required mounting hardware
  - .3 any fixture located in a high humidity area, i.e. swimming pool areas, must be gasketed and corrosion-resistant, regardless of what is selected on the fixture schedule
  - .4 unless otherwise specified, any fixture operated by means of a ballast must be equipped with its own ballast
- .3 **Lighting Fixture Finish:** Unless otherwise specified, lighting fixtures are to be finished in two coats of spray applied baked white enamel applied to chemically degreased and neutralized surfaces. Reflecting surfaces are to be white with a reflectance of minimum 85%. Confirm exact colour and finish of fixtures at the submittals stage and prior to ordering.
- .4 **Lamps:** Unless otherwise specified, lamps are specified/scheduled with the fixtures they are associated with. Lamps are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

- .5 **Lenses/Louvres:** Unless otherwise specified, lenses/louvres are scheduled with the fixtures they are associated with. Lenses/louvres are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

### 3 EXECUTION

#### 3.01 INSTALLATION OF LIGHTING FIXTURES

- .1 **General Installation Requirements:** Provide lighting fixtures and lamps where shown. Include for all required site assembly, and provide all required installation and support hardware. Additional requirements are as follows:
  - .1 confirm exact lighting fixture locations prior to roughing-in
  - .2 in finished areas, refer to architectural reflected ceiling plans and/or wall elevations
  - .3 in equipment rooms, shafts, and similar unfinished areas, install fixtures after the equipment is roughed-in, and shelving and similar items are installed, and do not suspend fixtures from piping, ductwork, conduit equipment, or similar items
  - .4 prior to roughing-in for lighting fixture installations, examine drawings and site conditions to determine that suitable space is available for the fixture installation as shown. If sufficient space is not available, notify the Consultant immediately and, if required, relocate the fixtures within reasonable distances without additional cost
  - .5 locate recessed downlights, troffers, and surface mounted fixtures in or on suspended tile ceilings in or on full tiles, and where ceiling tile openings are cut for fixtures, cut to exact sizes so that there are no gaps, and fixture trim completely covers the perimeter of the opening
  - .6 provide plaster frames for fixtures in suspended plaster or drywall ceilings
  - .7 use clean gloves when handling reflector cones, louvres, halogen lamps, glass sconces, and all exposed surfaces of fixtures

#### 3.02 SUSPENDED LIGHTING FIXTURES

- .1 Support all lighting fixtures in suspended ceilings from the slab or building construction above, independent of the suspended ceiling construction. Support 1.2 m (4') fluorescent fixtures with a minimum of 2 aircraft type cable supports or 2 #3 Tenso Chains. Support HID or incandescent fixtures with 1 #3 Tenso Chain or 1 aircraft type cable. All supports are to be in accordance with requirements of governing Codes and Regulations.
- .2 Support continuous rows of fixtures at minimum 1.2 m (48") centres.



### **3.03 LIGHTING FIXTURES IN FIRE RATED CEILING CONSTRUCTION**

- .1 Where lighting fixtures penetrate a fire rated ceiling they are to be enclosed in an enclosure with a rating to match that of the ceiling. The enclosure is to be constructed by the trade constructing the ceiling. Ensure that conductors connecting the fixtures are fire rated type and that ceiling penetrations for conductors are properly sealed with fire stopping and smoke seal material. Fixtures installed in the fire rated enclosures are to be equipped with thermal overload protection.

### **3.04 LIGHTING FIXTURES ALIGNMENT**

- .1 Align lighting fixtures mounted in continuous rows to form straight uninterrupted lines. Alignment variation is not to exceed 6 mm (1/4") in any 5 m (15') run.
- .2 Align lighting fixtures mounted individually parallel and/or perpendicular to building lines.
- .3 Aim accent and spot lighting as indicated and/or as directed by the Consultant, and secure the fixture positions after the Consultant's approval.

### **3.05 LAMPS**

- .1 Provide new lamps for each lighting fixture.
- .2 Include a full listing of lamps in O & M Manuals.
- .3 At Substantial Performance, replace all lamps used for construction lighting.

### **3.06 LIGHTING FIXTURES CIRCUIT WIRING**

- .1 Connect lighting fixtures to circuits indicated with wiring as shown/specified.
- .2 Minimize the number of splices required.

### **3.07 CLEANING**

- .1 When all lighting fixture installation work is complete, clean all fixtures and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the fixture installation work.
- .2 If wall and ceiling surfaces are damaged as a result of the fixture installation, replace the wall or ceiling surface to the Consultant's approval.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

**.1 Product Data:** Product data submittal requirements are as follows:

- .1 submit product data sheets for lighting fixtures, and include certified horizontal and vertical beam spread, beam lumens, beam efficiency, complete photometric data which includes total input watts, candlepower summary, candela distribution zonal lumen summary, CIE type, coefficient of utilization, and lamp type and lumen rating in accordance with CSA IESNA testing procedures
- .2 for floodlighting fixtures, computer printout for aiming angles
- .3 for pole mounted fixtures, submit documentation to confirm that the poles proposed are suitable for the steady wind velocity and wind gust velocity data for the area of installation, and for the total weight and project area of the fixtures
- .4 submit complete design and construction shop drawings for pole mounted fixture concrete bases, prepared, stamped and signed by a Professional Structural Engineer registered in the place of the work

**.2 Lighting Fixture and Accessory Colour(s):** For all lighting fixtures and accessories where the colour is to be selected after award of the Contract, submit colour charts and obtain fixture and accessory colour information in writing prior to ordering.

**.3 Spare Lamps:** Submit spare lamps as specified in Part 3 of this Section.

### **1.02 QUALITY ASSURANCE**

- .1** All lighting fixtures and lamps are to be ULC listed and/or CSA certified and labelled.

## **2 PRODUCTS**

### **2.01 GENERAL RE: LIGHTING FIXTURES AND LAMPS**

- .1 Lighting fixtures and lamps are scheduled on the drawings.
- .2 All lighting fixtures are to be completely weatherproof, non-corrosive, suitable in all respects for the mounting locations indicated on the drawings, and are to be complete with all required mounting hardware.
- .3 Unless otherwise specified, any fixture operated by means of a ballast must be equipped with its own ballast.
- .4 Confirm exact colour and finish of lighting fixtures at the submittals stage and prior to ordering.

## 2.02 LAMPS

- .1 Lamps are scheduled with the lighting fixtures and are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

## 2.03 POLES

- .1 **Concrete Poles:** Reinforced, pre-stressed, round, tapered, spun concrete pole, plain grey finish, designed for underground wiring and for direct bury, sized as indicated on the drawings, and complete with an access hand hole with frame and cover for wiring connections 450 mm (18") above grade, and a suitably sized grounding lug.
- .2 **Steel Poles:** Hot dipped galvanized, minimum 4.5 mm (  $\frac{1}{8}$  ") thick steel, round or octagonal monotube style poles sized as indicated on the drawings, designed for underground wiring and mounting on a concrete base. Unless otherwise specified poles are to be tapered and complete with an access hand hole with frame and cover for wiring connections 450 mm (18") above grade, a minimum of four non-corrosive anchor bolts and nuts with shims and tamper-proof covers, and a suitably sized grounding lug.
- .3 **Aluminium Poles:** G063-T6 aluminium, minimum 3 mm (3/16") thick, round or octagonal monotube style poles sized as indicated on the drawings, designed for underground wiring and mounting on a concrete base. Unless otherwise specified poles are to be tapered and complete with an access hand hole with frame and cover for wiring connections 450 mm (18") above grade, a minimum of four non-corrosive anchor bolts and nuts with shims and tamper-proof covers, and a suitably sized grounding lug.

## 2.04 LIGHTING FIXTURE MOUNTING BRACKETS

- .1 Corrosion-resistant metal brackets, cantilevered without under-braces, of sizes and styles specified with the fixtures they are required for, and complete with all required non-corrosive mounting and connection hardware.

## 3 EXECUTION

### 3.01 INSTALLATION OF EXTERIOR LIGHTING FIXTURES

- .1 Provide exterior lighting fixtures where shown and in accordance with the drawing schedule. Include for all required site assembly, and provide all required installation and support hardware.
- .2 Confirm exact lighting fixtures locations prior to roughing-in.
- .3 Secure grade mounted building floodlighting fixtures to concrete pads set flush with finished grade.

### 3.02 INSTALLATION OF LIGHTING FIXTURES POLES

- .1 Provide poles with mounting brackets for pole mounted lighting fixtures. For direct bury concrete poles, backfill the excavation around the pole with concrete.

- .2 Secure metal poles to reinforced concrete bases. Install pole anchor bolt support hardware in the base concrete during the pour, and ensure that the hardware is properly positioned and remains properly positioned until concrete has set. Provide vandal-proof anchor bolt covers.

- .3 Refer to pole concrete base detail indicated on the drawings.

- .4 Ensure that all poles are true and plumb.

### **3.03 CONCRETE, EXCAVATION AND BACKFILL WORK**

- .1 Carefully coordinate concrete and excavation and backfill work with the trades performing the work.
- .2 Perform all required concrete and excavation and backfill work in accordance with requirements of Division 03 and Division 31.

### **3.04 LIGHTING FIXTURES ALIGNMENT**

- .1 Aim and align building floodlighting and/or spotlighting during evening hours under the direction and to the approval of the Consultant, and secure the fixture positions after the Consultant's approval.

### **3.05 LAMPS**

- .1 Provide new lamps for each lighting fixture.
- .2 Include a full listing of lamps in O & M Manuals.
- .3 At Substantial Performance, replace all lamps used for construction lighting.

### **3.06 LIGHTING FIXTURES CIRCUIT WIRING**

- .1 Connect lighting fixtures to circuits indicated with wiring as specified. Install wiring in conduit.
- .2 Minimize the number of splices required.
- .3 Connect metal parts of poles with ground conductors connected to the building grounding system.

### **3.07 CLEANING**

- .1 When all lighting fixtures installation work is complete, clean all fixtures and lamps, and surfaces soiled as a result of the fixture installation work.
- .2 If building surfaces are damaged as a result of the fixture installation, repair the surface to the Consultant's approval.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for emergency lighting. Include complete battery charger data, battery charger and discharge voltage/time characteristics, and, where required, certified wiring diagrams.
- .2 **Battery Warranty:** Submit a copy of the battery warranty specified below, and include a copy in the O & M Manual.
- .3 **Letter of Certification:** As per Part 3 of this Section, submit a letter from the representative of the emergency lighting manufacturer to certify that the installation has been tested and adjusted and operates as intended.

### **1.02 QUALITY ASSURANCE**

- .1 All emergency lighting is to be CSA certified in accordance with:
  - .1 CSA C22.2 No. 141, Unit Equipment for Emergency Lighting
  - .2 UL 924, Standard for Emergency Lighting and Power Equipment
  - .3 CSA C22.2 No. 107.2, Battery Chargers

### **1.03 WARRANTY**

- .1 For batteries, the Contract warranty is to be extended to ten years with no-charge replacement during the first five years, and a pro-rate charge during the last five years. Submit a signed copy of the warranty in the name of the Owner.

## **2 PRODUCTS**

### **2.01 SELF-CONTAINED EMERGENCY LIGHTING UNITS**

- .1 Lumacell Inc. Model RG123S200 solid-state, factory assembled and tested, 120 volt AC input, 12 volt DC output, battery operated emergency lighting units, each capable of supplying the specified load for the length of time indicated, and to automatically shut-off. Each unit is to be complete with:
  - .1 a white enamelled steel cabinet suitable for shelf or direct wall mounting, with conduit knock-outs and a removable or hinged front panel for battery access
  - .2 white enamelled steel mounting and support hardware to suit installation locations indicated
  - .3 a sealed, maintenance-free battery in a high-impact, heat resistant translucent plastic casing

- .4 a multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected pulse type battery charger with a regulated output of  $\pm 0.01$  volts for  $\pm 10\%$  input variations, transfer circuit, solid-state modular low voltage disconnect to operate at 80% battery output voltage, and a suitable length of 3-wire power cord with "twist-lock" plug
- .5 signal lights for "AC POWER ON" and red "HIGH CHARGE", an ammeter and a voltmeter, a test switch, time delay relay, battery disconnect device, RFI suppressors, and AC input and DC output terminal blocks inside the cabinet
- .6 cabinet mounted, dual, adjustable (345° horizontal and 180° vertical) lamp heads, integral with the cabinet and/or remote mounting as indicated, each complete with a 13 watt tungsten-halogen glare-free lamp
- .7 where indicated, a wire guard
- .2 Acceptable manufacturers are:
  - .1 Thomas & Betts
  - .2 Beghelli Canada
  - .3 Stanpro
  - .4 Hubbell Inc. "Dual-Lite"

### **3 EXECUTION**

#### **3.01 INSTALLATION OF SELF-CONTAINED EMERGENCY LIGHTING UNITS**

- .1 Provide self-contained emergency lighting units where shown. Include for all required site assembly, provide all required installation and support hardware, and plug the assemblies into adjacent receptacles. Confirm exact locations prior to installation.
- .2 Where remote lamp heads are indicated, install and connect to the battery unit with conductors (sized as indicated) in conduit. Ensure that panelboard breakers serving battery units are equipped with lock-on devices.
- .3 Connect exit light 12 volt DC lamp holders to battery units with wiring in conduit as indicated.
- .4 Provide all required lamps.
- .5 Aim all adjustable lamp heads to the Consultant's approval.
- .6 When all installation work is complete, clean all battery units, lamp heads, and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the installation work.
- .7 If wall and ceiling surfaces are damaged as a result of the installation, replace the wall or ceiling surface to the Consultant's approval.

- .8 Test operation of each battery unit, including charge rate after discharge, in the presence of the manufacturer's representative, and submit a letter from the manufacturer's representative to certify that all battery units and lamp heads have been tested and operate as intended.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for exit lighting fixtures.

### **1.02 QUALITY ASSURANCE**

- .1 All exit lighting fixtures are to be in accordance with requirements of, as applicable:
  - .1 CAN/CSA- C22.2 No. 141, Unit Equipment for Emergency Lighting
  - .2 CAN/CSA- C860, Performance of Internally-Lighted Exit Signs
  - .3 CAN/ULC-S572, Photoluminescent and Self-Luminous Signs and Path Marking Systems, including Appendix A as applicable
  - .4 National and Provincial Building Codes
- .2 **Acceptable Manufacturers:** Acceptable manufacturers are:
  - .1 Thomas & Betts
  - .2 Beghelli Canada Inc.
  - .3 Stanpro
  - .4 Hubbell Inc. "Dual-Lite"

## **2 PRODUCTS**

### **2.01 GENERAL RE: EXIT LIGHTS**

- .1 Exit lights are to be pictogram type, illuminated in both normal and emergency modes, and complete with:
  - .1 an extruded aluminum frame and aluminum mounting bracket with a satin or clear anodized finish, an aluminum or clear polycarbonate faceplate, and stainless steel fasteners, all to suit the mounting arrangement indicated
  - .2 an overall green film background with a green "running man" pictogram on a white background segment
  - .3 where required and as indicated, white, single only directional arrows

### **2.02 INTERNALL ILLUMINATED TYPE EXIT LIGHTS**

- .1 As above but continuously internally illuminated by an AC and/or DC electrical circuit (as indicated), and white LED's.



### **3 EXECUTION**

#### **3.01 INSTALLATION OF EXIT LIGHTS**

- .1 Provide exit lights where shown. Include for all required site assembly, and provide all required installation and support hardware.
- .2 Confirm exact exit light locations prior to roughing-in, and in any case, ensure that exit lights are not less than 2 m (6½') from the underside of the fixture to the finished floor.
- .3 For ceiling mounted exit lights in areas with unfinished ceilings, mount the fixture alongside a junction box, with or without canopy, and connect the fixture laterally with conduit (or with embedded conduit where permitted or specified) or by using the exit light canopy as a junction box where permitted.
- .4 Connect AC and/or DC exit lights to circuits indicated with wiring as specified. Install wiring in conduit. Ensure that panelboard breakers serving exit lights are equipped with lock-on devices.
- .5 Connect emergency power sockets to the emergency power source as indicated and/or specified.
- .6 When all exit light installation work is complete, clean all fixtures.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems.

## **2 PRODUCTS**

### **2.01 DESCRIPTION**

- .1 Empty telecommunications pathway systems consist of outlet boxes, cover plates, terminal and distribution cabinets, conduit cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts, all as indicated.

### **2.02 MATERIALS**

- .1 **Conduit:** EMT and/or rigid PVC in accordance with the electrical work Section entitled Conduit Systems.
- .2 **Raceways:** In accordance with the electrical work Section entitled Surface and Lighting Fixture Raceway, and the Section entitled Wireways and Auxiliary Gutters.
- .3 **Junction Boxes, Pull Boxes & Outlet Boxes:** In accordance with the electrical work Section entitled Splitter, Junction and Pull Boxes, and the Section entitled Outlet Boxes, Conduit Boxes and Fittings.
- .4 **Fish Wire:** Polypropylene type.
- .5 **Cable Tray:** Legrand Cablofil wire mesh series or equal.
- .6 **Backboards:** Unless otherwise specified, G1S 20 mm ( $\frac{3}{4}$ ") thick Fir plywood painted on both sides with fire ULC Class A retardant flat white, intumescent alkyd paint.

## **3 EXECUTION**

### **3.01 INSTALLATION**

- .1 Provide empty pathways, fish wires, boxes, cover plates, conduit, backboards, miscellaneous and positioning material for a complete system for communications systems wiring, all as indicated on the drawings.
- .2 Identify pathways and boxes in accordance with the electrical work Section entitled Basic Electrical Materials and Methods.
- .3 Ground and bond pathway systems in accordance with requirements of the electrical work Section entitled Communications Systems Grounding and Bonding.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 **Product Data:** Submit product data sheets for products specified in this Section
- .2 **Test Reports:** Submit signed test reports for all testing work specified.

### **1.02 QUALITY ASSURANCE**

- .1 Communication system grounding and bonding is to be in accordance with the following Standards:
  - .1 ANSI J-STD-607- A, Joint Standard-Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - .2 CSA C22.2 No. 41, Grounding and Bonding Equipment

## **2 PRODUCTS**

### **2.01 GROUND BUS**

- .1 Pre-drilled copper bus bars to ANSI J-STD-607-A, suitable for wall or backboard mounting, 6 mm (¼") thick, 100 mm (4") wide with lengths as required, electro-tin plated with 8 mm (5/16") diameter holes for use with standard sized lugs and complete with all required fittings and mounting accessories.

### **2.02 GROUNDING AND BONDING CONDUCTORS**

- .1 3/0 AWG insulated (green colour), soft annealed copper conductors marked to ANSI J-STD-607-A.

### **2.03 GROUNDING AND BONDING CONNECTIONS**

- .1 Compression type connectors with zinc-plated fasteners and external tooth lock washers.

### **2.04 WARNING LABELS**

- .1 Non-metallic warning labels to ANSI J-STD-607-A with English and French wording to read: "If this connector is loose or must be removed, please call the Building Telecommunications Manager".

## **3 EXECUTION**

### **3.01 GENERAL COMMUNICATIONS GROUNDING AND BONDING REQUIREMENTS**

- .1 Perform all required communication systems grounding and bonding complete with bus, bonding backbones, and bonding conductors. Unless otherwise specified, grounding and bonding work is to be in accordance with requirements of ANSI J-STD-607-A, 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 the communications grounding and bonding system
- .3 Include for ground connections to all communication system racks.
- .4 When ground conductors are installed in metal conduit longer than 3 m (10'), bond to each end of the conduit.

### **3.02 GROUND BUS**

- .1 Provide main ground bus in communications entrance rooms and install on insulated supports 50 mm (2") high close to the electrical power panel if there is one installed in the room.
- .2 Provide telecommunications ground bus as for main bus in all telecommunications rooms.

### **3.03 WARNING LABELS**

- .1 Apply warning labels to telecommunications bonding and grounding conductors at connections.

**END OF SECTION**

## 1 GENERAL

### 1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings and product data sheets for the fire alarm system. Include the following:
  - .1 identified wiring schematics with component identification and product/catalogue numbers for the central facility and all associated components
  - .2 a complete, zoned block riser diagram identifying all components and circuits
  - .3 a complete sequence of operation cross-referenced to the riser diagram
  - .4 a sample of graphic command centre screen displays
- .2 **Submittals To Fire Authority:** Submit to the local fire authority at the same time as submittal to the Consultant, all items required by subparagraphs of paragraph .1 above.
- .3 **System Review and Confirmation:** As specified in Part 3 of this Section, submit a letter from the system manufacturer/supplier which confirms that the system has been properly installed in accordance with issued installation instructions, and an inspection and test report in accordance with CAN/ULC-S536.
- .4 **Panel/Enclosure Keys:** Submit a minimum of 3 identified keys for any panel or enclosure with a keyed lock door.
- .5 **Spare Parts:** Prior to Substantial Performance, supply, in identified original packaging and hand to the Owner at the site where directed, the following spare parts:
  - .1 pull stations, 10% of the number installed, minimum three, and, if pull stations use glass rods, 20 glass rods
  - .2 smoke detectors, 10% of the number installed for each type, minimum 2
  - .3 thermal detectors, 5% of the number installed for each type, minimum 1
  - .4 control switches, 2 for each type used
  - .5 indicating lamps, 5 for each type and colour used
  - .6 amplifier, 1
  - .7 EVC speaker assemblies, 5% of the number installed for each type, minimum 2
  - .8 visible and audible signals other than speakers, 2 for each type used

- .9 modular control board, 1 for each type used
- .10 power supply unit, one for each type used
- .11 fuses, 3 for each type used
- .12 end-of-line resistors, 5
- .13 isolators, 5
- .8 **As-Built Record Drawing Requirements:** In addition to all other “as-built” conditions, indicate on as-built record drawings the locations of all end-of-line resistors and all line isolation modules.
- .9 **Independent Third Party Testing and Verification Agency:** Submit the name, qualifications, and certification of the independent third party testing and verification agency proposed for the project.
- .10 **Certificate of Insurance:** As specified in Part 3, submit a Certificate of Insurance covering testing and verification of the fire alarm system.
- .11 **Extended Warranty:** Submit a signed extended warranty in the name of the Owner covering the entire fire alarm system for a period of 2 years after the Contract warranty expires. The terms of the extended warranty are to be full parts and on-site labour as for the Contract warranty.

## 1.02 QUALITY ASSURANCE

- .1 The fire alarm system and its installation is to be in accordance with requirements of applicable CSA and CAN/ULC Codes and Standards.
- .2 CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities
- .2 **System Components:** All system components are to be ULC listed and labelled in accordance with standards listed above, and, unless otherwise specified, are to be supplied by a single manufacturer. All components must be suitable in all respects for conditions of the installation location.
- .3 **System Software:** System software is to be open protocol and full custom programmed with the system sequence of operation.

## 1.03 MAINTENANCE PERIOD REQUIREMENTS

- .1 Include for a 1 year no cost (to the Owner) maintenance period to commence at notification of Substantial Performance and which is to include 2 site inspections of the system with reports. Inspections are to be scheduled with the Owner and Consultant.
- .2 Where the work is phased, and completed phases will be accepted and occupied by the Owner, include for requirements of paragraph .1 above for each such phase.

#### **1.04 SOFTWARE REVISIONS**

- .1 After successful testing, verification and commissioning of the system, but prior to Substantial Performance, obtain a list of final room, area, and, if applicable, building names and revise system software to incorporate all required revisions.
- .2 Include for an additional software update to suit any requirements of governing authorities.
- .3 In addition to programming revisions specified above, include for, after Substantial Performance, another site visit to make any supplementary software revisions requested by the Owner.

#### **1.05 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with requirements specified in the Section entitled Basic Electrical Materials and Requirements.

#### **1.06 ACCEPTABLE MANUFACTURERS**

- .1 Acceptable fire alarm system manufacturers are:
  - .1 Honeywell Notifier
  - .2 Simplex Grinnell (Tyco International Canada Ltd.)
  - .3 Siemens Building Technologies
  - .4 GE (UTC Fire and Security)
  - .5 Gardia Industries Inc. "Mircom"

### **1 PRODUCTS**

#### **2.01 TWO-STAGE FIRE ALARM SYSTEM COMPONENTS**

- .1 **General Description:** Modular, central data communications and processing type, fully supervised, 2-stage, zoned, addressable, non-coded, multiplexed, field programmable fire alarm system with emergency voice communication and firefighter's communications, using digital techniques for data control and digital and multiplexing techniques for data transmission, designed such that each data communication link is limited to only 80% of its total capacity at initial installation, The system is to be as indicated on the drawings and is to be complete with:
  - .1 a central alarm and control panel with power supply and standby batteries, central processor with microprocessor and logic interface, main system memory, input and output interfaces for alarm receiving, annunciation/display and program controls/signalling, master fire fighter's telephone, paging microphone, and all required switches and controls

- .2 remote annunciator(s)
- .3 network nodes/transponders
- .4 a manual control station for control of building services
- .5 paging system microphone(s)
- .6 alarm initiating devices
- .7 alarm signals
- .8 door hold open/release hardware
- .9 all required wiring including end-of-line resistors and addressable circuit I isolators
- .10 interconnections to other building systems
- .2 **Sequence of Operation – Trouble Alarm:** Trouble alarm initiating devices, other than circuit isolators and similar devices, will generally be supplied and installed as part of the mechanical work. The devices are as indicated on the drawings and include fire protection system supervised shut-off valves, fire protection system piping mains pressure switches for low pressure indication, fire protection pump loss of power indicating devices, dry sprinkler system air compressor loss of power indicated device, emergency power generator fail to start contact, emergency power generator starting battery low voltage indicating device, and fire pump start contact., Unless otherwise specified, activation of a trouble alarm device is to initiate the following sequence of operation:
  - .11 audible and visual trouble alarm signals to be activated at the control panel
  - .12 audible and visual trouble alarm signals to be activated at all connected remote annunciators
- .3 **Sequence of Operation – First Stage Alarm:** Activation of any of the fire alarm devices indicated on the drawings, including fire protection system alarm valves and devices, is to initiate the following:
  - .1 fire alarm signal tone to sound a first stage alarm at the rate of 20 strokes per minute throughout all zones as indicated on the drawings for 5 minutes, after which the signal may be manually silenced
  - .2 fire signs in the alarm zone to illuminate
  - .3 visual alarm signals in the alarm zone to flash
  - .4 the address and zone of the alarm to be registered at all annunciators and displayed on the CPU
  - .5 the colour graphic to indicate the layout of the floor, the zone, and the device(s) in alarm



- .6 the outside monitoring company or the Fire Department (as connected) to be automatically notified
  - .7 the assigned message and activated control-by-event functions with time and date for the monitored point in alarm to be printed at the CPU printer
  - .8 smoke and fire doors with hold-open devices to release and close the doors
  - .9 locked doors equipped with electric locks to unlock and remain unlocked until the fire alarm system is reset
  - .10 activation of all assigned control points through control-by-event functions
- .4 **Sequence of Operation – General Evacuation Alarm:** If an investigation of the 1<sup>st</sup> stage alarm zone by building personnel indicates the need to evacuate the zone, insertion and operation of a special key into the key switch in a manual pull station or operation of the control panel evacuation switch will cause a general evacuation alarm signal of 120 pulses per minute to sound on all audible signals for a minimum of 20 minutes in the zones as indicated on the drawings. All visual signals are also to operate, and the general evacuation alarm condition can be cleared only after the activated alarm initiating devices on both stages of alarm have been restored to normal and the control panel has been reset.

## 2.02 CENTRAL ALARM CONTROL PANEL

- .1 The panel for control and monitoring of the system is to be a modular, programmable, configurable, and field expandable without the need for special tools, EPROM programmers, or PC based programmers, and replacement of memory IC's. The panel is to support up to 20 logic equations including "and", "or" and "not", or time equations to be used for advanced programming, and logic equations are to require the use of a PC with a software utility designed for programming. The panel is to be equipped with Form C alarm, trouble, supervisory, and security relays rated at minimum 2 amperes at 30 volts DC, signal circuits programmable to be synchronized with the signals installed, and operator interface control and annunciation panel with a backlit LCD display, individual colour coded system status LED's, and an alphanumeric keypad with rubber keys for field programming and control of the system.
- .2 The panel is to be complete with 2- stage alarm controls with the following features:
  - .1 drift compensation to extend detector accuracy of the life of the device, and which includes a smoothing feature to permit transient noise signals to be filtered out
  - .2 an automatic smoke detector sensitivity test function in accordance with requirements of CAN/ULC-S527
  - .3 smoke detector excessive dirt or dust accumulation 2-level maintenance alert (maintenance alert/maintenance urgent)

- .4 9 smoke detector sensitivity alarm level ranges selected by detector, 0.5 to 2.35% per foot for photoelectric detectors, 0.5 to 2.25% per foot for ionization detectors
  - .5 the ability to support sensitive advanced detection laser detectors with an alarm level range of 0.03 to 1.0% per foot
  - .6 a minimum of 9 levels of pre-alarm selected by detector to indicate impending alarms to maintenance personnel
  - .7 the ability to display and/or print system reports
  - .8 alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times
  - .9 PAS pre-signal, to permit delay of a fire alarm up to 180 seconds after start of alarm processing
  - .10 rapid manual station reporting (less than 3 seconds) for activation of signal circuits within 10 seconds of device activation
  - .11 period detector tests conducted automatically by system software
  - .12 self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks
  - .13 cross-zoning with the capability of counting, 2 detectors in alarm, 2 software zones in alarm, or 1 smoke detector and 1 thermal detector in alarm
  - .14 walk test, with a check of 2 detectors set to the same address
  - .15 control-by-time for non-fire operations, with holiday schedules
  - .16 day/night automatic adjustment of detector sensitivity
  - .17 detector device blink control for sleeping areas
  - .18 the ability to communicate on a local area network (LAN), with a firmware package that utilizes a peer-to-peer inherently regenerative communication format and protocol
- .3 **Panel Enclosure:** EEMAC 2, steel, surface or semi-flush wall mounting enclosure as indicated, fully corrosion protected with a prime coat, and a finish coat of the panel assembly manufacture's standard enamel finish. The back box is to be complete with top and side conduit knock-outs, and the piano hinged door is to be complete with a glass or other transparent opening for viewing all indicators.

- .4 **Microprocessor:** The panel microprocessor is to be a state-of-the-art high speed, 16-bit RISC device which is to communicate with, monitor, and control all external interfaces. The microprocessor is to include an EPROM for system program storage, flash memory for building-specific program storage, and a “watch dog” timer circuit to detect and report microprocessor failure. The microprocessor is to contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected. Control-by-event equations are to be held in non-volatile programmable memory which is not to be lost even if there is a failure of both primary and secondary system power. The microprocessor is also to be complete with:
- .1 the ability to receive analogue information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector, with software to automatically maintain the detector’s desired sensitivity level by adjusting for the effects of environmental factors, and the ability to use the analogue information for automatic detector testing and maintenance requirements
  - .2 a real-time clock for time annotation of system displays, print, historical files, and control of non-fire functions at programmed time-of-day, day-of week, and day-of-year, and the time-of-day is not to be lost if failure of both primary and secondary system power occurs
  - .3 a special program clock to detect common operator errors
  - .4 an auto-program (self-learn) function to quickly install initial functions and make the system operational
  - .5 as per CAN/ULC-S537 requirements, a Windows based program utility to off-line program the system with batch uploads/downloads, with the ability to upgrade the manufacturer’s (flash) system code changes, the ability to compare old program files to new ones and identify the differences in the 2 files to permit complete testing of any system operating changes, and to act as a verification utility which scans the program files identifying possible errors
- .5 **System Display:** The panel 640 character liquid crystal display (LCD) is to annunciate status information and custom alphanumeric labels for all detectors, addressable modules, internal panel circuits, and software zones as well as provide all the controls and indicators used by the system operator including ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST. The LCD is also to be complete with:
- .1 LED’s for indication and status of AC POWER, FIRE ALARM, PRE-ALARM WARNING, SECURITY ALARM SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, OTHER EVENTS, CPU FAILURE, and CONTROLS ACTIVE, and BATTERY CHARGING CURRENT/VOLAGE

- .2 a QWERTY type keyboard, similar to a PC keyboard, with 2 different password levels for system access, and capable of commanding the system functions, entry of any alphabetic or numeric information, and field programming
- .3 ten “soft” keys for screen navigation or to accomplish dedicated programming functions, with full programming access requiring the use of a laptop computer and the proper programming utility
- .6 **Data Communication Loop (DCL):** The control panel is to support up to 2 DCL's with each DCL interface to provide power to and communication with up to 159 intelligent smoke and/or thermal detectors, and 159 intelligent monitor or control modules for a loop capacity of 318 devices per loop. Each DCL is to be capable of Class A or Class B wiring as required.
- .7 **Serial Interfaces:** The control panel is to be complete with interface connection hardware as follows:
  - .1 an EIA232 interface to connect a ULC listed 40 or 80 column printer
  - .2 an EIA232 interface to connect a ULC listed CRT terminal, with the connection hardware to include special protocol methods that permit off-site monitoring of the control panel over standard dial-up telephone lines for remote readout of all status information including analogy values, remote ACKNOWLEDGE, RESET and SIGNAL SILENCE, remote adjustment of detector sensitivity, and readout of the history file without affecting control panel operation in any regard
  - .3 an EIA485 port for serial connection of remote annunciator(s) and LCD display(s), and, if required, for network connection to a proprietary receiving unit
- .8 **Utility Power Supply Connection Facilities:** Suitable for a minimum of 6 amperes of 120 volt AC, 60 Hz power for the panel and peripheral devices, with provisions to permit audio-visual power to be increased as required by adding modular expansion audio-visual power supplies. The power supply connection facility is to continuously monitor all field wiring for earth ground conditions, and is to be equipped with a Ground Fault LED, and AC Power Failure LED, and notification appliance circuit on LED (4).
- .9 **Field Power Supply:** Continuous duty, filtered and regulated 24 volt DC supply sized for present requirements plus a minimum of 20% future requirements, power limited within a range of from 20.4 to 32 volts DC, and with automatic “Brownout” transfer to standby batteries when the supply voltage falls below the set limit

- .10 **Standby Power:** Sufficient standby power is to be provided to operate the entire system in a normal supervisory mode for a minimum of 24 hours upon loss of normal utility power, and immediately followed by system operation under full power for a minimum of 2 hours. Batteries are to be sealed, maintenance free lead-acid, nickel-cadmium, or gel-cell batteries supervised such that a low battery power condition or disconnection of the batteries will activate an audible and visual trouble alarm at the central control facility. The batteries are to be complete with an automatic charger capable of re-charging the batteries to 70% of ultimate capacity within 12 hours, and a transient voltage surge protection device as recommended by the system supplier is to be provided.
- .11 **Operator Controls:** Panel mounted operator controls are to include:
- .1 **acknowledge switch,** which, when activated in response to new alarms and/or trouble will silence the panel and remote annunciator audible signals and change the alarm and trouble LED's from a flashing mode to a steady-on-mode, and if multiple fire or trouble alarm conditions exist, depression of the switch will advance the LCD display to the next alarm or trouble conditions to be acknowledged with a single depression of the switch
  - .2 **signal silence switch:** which, when depressed, will cause all programmed alarm signals and relays to return to the normal condition, and selection of the signal circuits and relays that can be silenced by the switch are to fully field programmable, and the panel software is to include silence inhibit and auto silence timers
  - .3 **drill switch:** which, when depressed, will activate all programmed signal circuits, and the drill function is to latch until the panel is silenced or reset
  - .4 **system reset switch:** which, when depressed, will return all electronically latched alarm initiating devices to their normal condition, while active initiating devices are to still report, active signalling device circuits are not to silence upon reset, Control-By-Event equations are to be re-evaluated after the reset sequence is complete if the initiating condition has cleared, but non-latching trouble conditions are not to clear and again report upon request
  - .5 **lamp test switch:** which when operated, will illuminate all local system LED's, light each segment of the liquid crystal display and display the panel software revision for service personnel

- .12 **Command Centre:** The command centre is to be suitable in all respects for the mounting location shown and is to be complete with a master telephone control module for processing 2-way communication functions between the command centre and remote telephones. The control module is to include an audible "Sonalert" for call and trouble signalling, a trouble silence switch with ring back, an LED trouble indication, a supervising monitor circuit, and electrically supervised phone (talk) modules with "call-in" indication and 2-position switch for 2-way voice communication. The master telephone is to be a black handset with a minimum of 1.5m (5') of flexible self-winding cord recessed in a command centre enclosure.
- .13 **Remote Fireman's Telephones:** Fully electrically supervised, surface or recessed wall mounting as indicated, each complete with a heavy-gauge steel enclosure finished with red enamel with a white silk-screened telephone icon and a keyed lock door with breakable glass, and a red high impact plastic handset attached to a cradle with switch hook assembly with retractable coiled cord. Phone assembly circuitry is to produce a distinct zone call-in signal when the handset is removed from the cradle, and is to be complete with surge suppression and in-out terminals for supervised wiring.

#### **1.03 LCD FLAT PANEL DESK/CONSOLE MOUNTING ANNUNCIATOR**

LCD flat panel high resolution colour monitor and terminal with tilt/swivel base and detachable keyboard to provide English language display of fire alarm system events with time and date of occurrences.

#### **1.04 REMOTE LCD/LED WALL MOUNTING ANNUNCIATOR**

- .1 LCD/LED flat panel high resolution colour monitor complete with all required mounting hardware.

#### **1.05 FIRE ALARM GRAPHIC**

- .1 Passive fire alarm graphic: Provide passive graphic display, to be mounted adjacent to the main fire alarm control panel and remote annunciator panel(s). Plastic laminate type, black artwork on white background with a different colour for each zone, framed under glass, approximate size: 24" x 24".

#### **1.06 PRINTER(S)**

- .1 Desk top, 120 volt, 60 Hz AC, thermal head, 80 column printer to provide a hard copy of fire alarm system event, capable of receiving English language text from the control panel in ASCII format via an EIA RS-232-C connection and other standard communications protocols. Each printer is to include the following features:
  - .1 the dates and time on all printed information
  - .2 180 characters per second
  - .3 3 kilobytes buffer capacity

- .4 cartridge type ribbon
- .5 friction feed for cut forms, tractor feed for continuous 240 mm (9 7/16") wide pin-to pin fanfold paper

#### 1.07 TROUBLE ALARM INITIATING DEVICES

- .1 Generally, trouble alarm initiating devices other than those associated with fire alarm system equipment problems, will be supplied and mounted as part of the mechanical work.

#### 1.08 FIRE ALARM INITIATING DEVICES

- .1 Fire alarm initiating devices are to be as indicated on the drawings and as follows:
  - .1 **Manual Pull Station:** Dual-action, non-coded, 2-stage addressable manual pull stations in accordance with requirements of CAN/ULC S528, semi-flush or surface mounted as required and/or shown, constructed of red polycarbonate material, designed with a key operated reset lock such that they may be tested and, after actual emergency operation, they must be reset by use of a special key. Each station's address will be set at the time of installation, and stations are to be complete with:
    - .1 clearly visible bilingual (English-French) operating instructions on the cover and minimum 25 mm (1") high "FIRE" white identification
    - .2 a steel back box for surface mounting stations
    - .3 3 sets of 2 reset keys
    - .4 auxiliary contact(s) as required to connect to items such as fire door release mechanisms
    - .5 where indicated or required, a ULC listed clear Lexan hinged cover with, if required by Code or local authorities, a tamper alarm (include for supply of 20 covers)
    - .6 for pull stations where indicated, explosion-proof facilities
  - .2 **Sensor Bases:** Addressable analogue smoke and thermal detectors specified below are to be complete with a white, surface mounting base to which the sensor twist-lock mounts to provide digital transmission of analogue sensor values via 2-wire communicating wiring. The base electronics are to constantly monitor the status of the detachable sensor, and each sensor's output is to be digitized and transmitted to the fire alarm control panel every 4 seconds. Bases are to mount to a standard 100 mm (4") square or octagonal box and are to be complete with:
    - .1 an address which remains with its programmed location

- .2 automatic identification which provides default sensitivity if sensor types are substituted
  - .3 an integral red LED which pulses to indicate a normal condition and power on, and remains on to indicate an alarm or trouble
  - .4 a supervised LED relay which is activated when the base LED is on steady indicating local alarm or trouble, connected to a remote wall mounting LED alarm indicator with LED alarm and stainless steel faceplate
- .3 **Alarm sensors:** Alarm sensors are to be sealed against rear air flow entry, are to twist-lock mount to any of the sensor bases, and are to be complete with EMI/RFI shielded electronics. Alarm sensors are to be as follows:
- .1 **heat sensors:** programmable self-restoring sensors with a rate compensating fixed temperature setting as indicated on the drawings
  - .2 **photoelectric smoke sensors:** stable, selectable sensitivity, 360° smoke entry design head with pulsed infrared LED light source and silicon photodiode receiver for constant and accurate low power smoke sensing, a 3 mesh insect screen, and, where indicated, an auxiliary contact for connection to an associated device
  - .3 **ionization smoke detector:** selectable sensitivity, 360° smoke entry design head with single radioactive source with outer sampling ionization chamber and inner reference ionization chamber for stable operation under fluctuations in ambient temperature and humidity, designed such that the presence of particles of combustion cause a change in voltage ratio between chambers which is measured by the sensor electronics and digitally transmit to the control panel for processing, and equipped with 30 mesh insect screen, and, where indicated, an auxiliary contact for connection to an associated device
  - .4 **duct mounted smoke detectors:** addressable photoelectric type smoke detectors in an air-tight duct mounting housing and complete with:
    - .1 an air sampling tube of suitable length for insertion into the duct
    - .2 a test switch, or, for duct detectors in locations not easily accessible, a remote test station
    - .3 status LED's
    - .4 Form C auxiliary alarm relays
    - .5 a remote wall mounting alarm indicator with LED and stainless steel faceplate



- .6 for detectors in ductwork as indicated on the drawings, and for air intake ductwork, a ULC listed and labelled weatherproof housing with electric heater, thermostat control, and low temperature trouble alarm contact
- .5 **Combined Fire-Smoke Detectors:** Multi-criteria sensors for twist-lock mounting to a sensor base as described above, complete with advanced algorithms to interpret and respond to the multiple inputs, 6 levels of sensitivity, twin LED indicators for 360° visibility and which can be control panel controlled to blink, latch-on, or latch-off, an integral test switch, and the following 4 separate sensing elements:
  - .1 electrochemical cell technology that monitors carbon monoxide produced by a smouldering fire
  - .2 infrared sensing to measure ambient light levels and flame signatures
  - .3 photoelectric smoke detection
  - .4 thermal detection for temperature monitoring
- .6 **Reflected Beam Smoke Detectors:** Equal to BEAM1224A(SA), ULC listed single-ended reflected design beam smoke detector with a 5 m to 100 m (16' to 330') protection range,  $\pm 10^\circ$  horizontal and vertical adjustment angles with optical gun sight and integral signal strength indication with 2 digit display, 6 user selectable sensitivity levels, local red LED and remote alarm indication, local yellow LED and remote trouble alarm, local flashing green normal condition LED, integral sensitivity test filter, sensitivity filter, local alarm test switch, local alarm reset switch, remote test and reset switch with test station, and all required mounting and connecting accessories.

## 2.13 AUDIBLE ALARM SIGNALS

- .1 In accordance with CAN/ULC-525 and as follows:
  - .1 **Finished Area Recessed EVC Cone Speakers:** Wall or ceiling mounting assembly with a steel enclosure, 15 watt fire retardant and moisture-proof 115 mm (4½") diameter cone speaker, painted steel baffle, 25 volt matching transformer with ¼, ½, 1 and 2 watt taps, a 220 gram magnet, 80 Hz to 13,000 Hz frequency response, and capable of producing 94 dB at 1.2 m (4') with a 1 watt input.
  - .2 **Exterior and Unfinished Area Horn Speakers:** Surface mounting 100 mm (4") diameter horn speaker assemblies pre-tapped at 1 watt, each equipped with a die-cast metal housing and vandal-proof grille, high efficiency driver, 25 volt matching transformer with ¼, ½, 1 and 2 watt taps, 400 Hz to 4,000 Hz frequency range, an output of 90 dB at 3 m (10') at 1 watt input, and for weatherproof speakers, a weatherproof box.

- .3 Device colour to be white with red lettering

## 1.09 VISUAL ALARM SIGNALS

- .1 In accordance with CAN/ULC-S526 and as follows:

- .1 **Strobe Lights:** Wall or ceiling mounting as indicated, low current design, synchronized, with the input polarized for standard reverse polarity supervision by the fire alarm control panel, complete with a universal mounting plate suitable for mounting on a standard 100 mm (4") square outlet box, and equipped with:
  - .1 a flash rate of 1 flash per second over the regulated voltage range, with a Xenon flash tube enclosed within a Lexan lens
  - .2 a minimum of 4 field selectable strobe intensities of 14, 30, 75 and 110 candela, with tamper-proof selector switch
  - .3 synchronization modules that will not permit the strobes to drift out of synchronization at any time during operation, and if the sync module fails to operate the strobe is to revert to non-synchronized flash rate
  - .4 a cover plate for strobes located in finished area
  - .5 for strobe lights in non-climate controlled areas, a weatherproof back box and weatherproofing for the light assembly
  - .6 Device colour to be white with red lettering
- .2 **Beacon Lights:** Surface mounting LED beacon light assemblies, each approximately 165 mm (6 1/2") diameter by 150 mm (6") high and complete with a polycarbonate base, amber, red or blue colour as selected by the Consultant, ten selectable "strobing" flash patterns which completely fill the lens, a synchronization or alternate flash feature, and a mounting plate and hardware to suit the application.
- .3 **Fire Signs:** Illuminated, LED, flashing, 24 volt DC "FIRE DO NOT ENTER" sign with a black face and red letters which are not visible until the sign is energized. Each sign is to be complete with a satin finish aluminium housing, 2 rows of long life LED's rated for minimum of 100,000 hours of life, a flasher, and Lexan guard. FIRE lettering is to be 50 mm (2") high. DO NOT ENTER lettering is to be 40 mm (1 1/2") high.

## 1.10 END-OF LINE RESISTORS

- .1 Sized to ensure correct supervisory current flows in alarm signal circuits, and secured to a stainless steel plate for mounting to a single gang outlet box.

## 1.11 SHORT CIRCUIT ISOLATORS

- .1 Addressable short circuit isolator with input and output wiring terminals, designed to automatically isolate wire-to-wire short circuits on a SLC loop, send an address to the control panel, and only disconnect devices connected to the short circuit loop while all other devices connected to the isolator loops will remain in operation. Each isolator is to mount in a standard 100 mm (4") outlet box and is to be equipped with an identified stainless steel faceplate with LED that flashes when all circuits are normal and remains illuminated when a short circuit condition has been detected and isolated.

#### 1.12 FIREMAN'S MANUAL SWITCHING STATION

- .1 Flush wall mounting manual switching station with a brushed stainless steel faceplate and identified toggle switches for manual on/off or start/stop control of building equipment and systems associated with a fire alarm condition, i.e. smoke control fans and dampers, door locks, elevators, etc.

#### 1.13 DOOR HOLD OPEN/RELEASE HARDWARE

- .1 ULC listed hardware to suit the door type(s) and locations(s).

#### 1.14 WIRING

- .1 In accordance with CSA C22.2 No. 208, CAN/ULC-S524, and governing Codes and Regulations, all electrically supervised, and as follows:
  - .1 **power wiring to control panel and between panel and transponders, annunciators, etc.:** Tyco "Pyrontenax" type MI 2 hour fire rated, mineral insulated, copper sheathed, copper conductor cable
  - .2 **risers between network transponders:** to include single #18 AWG twisted shielded cable for each riser, in Class A style 6/7 identified loops, in addition to other fire rated conductors
  - .3 **all other wiring unless otherwise specified:** minimum 105° C (220° F) rated with copper conductors and colour coded insulation, and, unless otherwise shown or specified, sized in accordance with the fire alarm system manufacturer's instructions but in any case, minimum No. 16 AWG

### 3 EXECUTION

#### 1.01 INSTALLATION OF FIRE ALARM SYSTEM

- .1 Provide a complete fire alarm system in accordance with the Contract Documents, and requirements of CAN/ULC-S524 and governing authorities.

- .2 Generally, install components where shown but confirm exact locations prior to roughing-in. In finished areas with suspended ceilings, refer to architectural reflected ceiling plans but do not support devices from the suspended ceiling. Ensure that all devices in “wet” non-climate controlled areas and all exterior devices are weatherproof.
- .3 **Power Connection Requirements:** Ensure that all system control panels, annunciators, and transponders are connected with fire rated power conductors sized for the application and extended from a dedicated fused disconnect circuit which is supervised such that any power failure will be audibly and visually alarmed at the transponder(s) and remote annunciator(s).
- .4 **“Head End” Equipment:** Locate the control panel and communication system control panels, annunciators, displays, and other “head end” equipment where shown and carefully coordinate installation with adjacent work. Wall mount transponders so as to be accessible and ensure that each transponder is properly identified.
- .5 **Manual Pull Stations:** Install pull stations in standard outlet boxes, galvanized steel for recessed stations. “Condulet” type cast metal boxes for surface mounted stations. Comply with governing mounting height requirements, including barrier-free height requirements.
- .6 **Alarm Initiating Detectors:** Install the base for each alarm initiating detector to an outlet box, galvanized steel recessed type for devices in finished areas, surface mounted cast metal “Condulet” type boxes for devices in unfinished areas. Secure detector heads to the base.
- .7 **Duct Smoke Detectors:** Carefully coordinate installation of duct smoke detectors with the trade installing the ducts. The sheet metal trade will drill a hole for the sampling tube. Install the tube and secure the detector to the duct. Provide stand-off mounting for detectors on insulated ducts. Provide remote LED indicator assemblies for duct detectors which are not clearly visible from the floor.
- .8 **Patient Room/Area Detectors:** Interconnect patient room/area detectors with annunciator to the local Nurse’s Station and to the room/area nurse call dome light.
- .9 **Computer Room Detectors:** In the Computer Room(s) where shown and/or specified, cross-zone connect detectors and remote indicating devices as indicated.
- .10 **Audible Alarm Signal Devices:** Audible device locations are indicated on the drawings, however, the exact quantity and locations of audible signal devices is to suit the results of a site audibility coverage test performed by the system supplier using approved instrumentation and experienced test personnel. Relocate audible signal devices and/or provide additional audible signal devices as required by results of the test. Additional audible signal device installation requirements are as follows:

- .1 **Cone Speakers:** Secure ceiling mounted flush cone speakers to back boxes that are supported from the structure and not from the suspended ceiling. Corridor and/or patient room speakers are to be equipped with dual zone speaker circuits. Connect speakers to the specified taps and ensure that sound levels are in accordance with requirements. Synchronize all cone speakers.
- .2 **Horn Speakers:** Unless otherwise indicated secure horn speakers to wall mounted cast metal boxes located for optimum sound distribution. Synchronize horn speakers.
- .11 **Visual Alarm Signal Devices:** Visual alarm signal device locations are indicated on the drawings. Unless otherwise indicated, locate wall mounted devices 2.4 m (8') above the floor and ceiling mounted devices 300 mm (12") below the finished ceiling. Provide a minimum of 2 circuits per floor and connect the devices in an alternating scheme.
- .12 **Fire Signs:** Confirm exact location of fire signs prior to roughing-in and connect such that activation of the fire alarm system illuminates the sign, and, when the fire alarm system is reset, the sign is de-energized.
- .13 **Door Hardware:** Carefully coordinate wiring connections to door hold-open hardware or electrical door locks with the installation of the hardware such that hold-open devices release the doors and electric locks are de-energized upon fire alarm system activation as specified.
- .14 **Wiring Connections to Other Building Systems and Equipment:** Provide supervised wiring connections from fire alarm system components to building systems as shown and/or specified on the drawings.
- .15 **Wiring Requirements:** Do all system wiring. Except for fire rated cable, install wiring in minimum 20 mm ( $\frac{3}{4}$ ") conduit. Conform to the following requirements:
  - .1 connect all wiring to colour code, identified and numbered terminal strips in junction boxes or at equipment
  - .2 ensure that colour coding is consistent for the entire length of each run
  - .3 provide all wiring in accordance with requirement of governing Codes and Regulations
  - .4 install alarm indicating circuits and alarm receiving circuits in separate conduit
  - .5 provide end-of-line resistors to electrically supervise all wiring
  - .6 ground and bond all system cabinets and other work to the building grounding system

## 1.02 SYSTEM PROGRAMMING

- .1 Arrange for all required system programming to be done by the system manufacturer's technical representatives.

### 1.03 SYSTEM TESTING CERTIFICATION, AND VERIFICATION

- .1 The system manufacturer and an independent third party testing company are to test and verify the completed system. The independent third party testing company is to have primary responsibility for testing and verification.
- .2 **System Manufacturer's Testing and Verification:** Accompanied by qualified personnel of the system manufacturer, visually inspect the system for completeness, then test system operation, including all alarm initiating devices, signal devices, and all other system operation and functions. When the system manufacturer confirms that the system is operating as intended, obtain from manufacturer and submit copies of signed test and inspection sheets, and a signed letter from the system manufacturer certifying that the system has been checked, tested, operated, adjusted, and is operating as intended, all as per CAN/ULC-S536. Qualified personnel system manufacturer's personnel are also to be available on-site to accompany independent third party personnel testing and verification.
- .3 **Independent Third Party System Testing and Verification:** Retain and pay all cost for independent third party testing and verification of the system in accordance with CAN/ULC S537. The independent third party is to be a qualified and experienced testing agency with personnel trained in accordance with the Fire Alarm Technology Program of the Canadian Fire Protection Association, or Certified Fire Alarm Electricians certified by the Electrical Contractors Association of Ontario. All such personnel are to carry identification cards at all times while on-site. Third party independent testing and verification is to be responsible for:
  - .1 coordinating attendance at the site of all required fire inspection personnel so as to obtain their approval of testing and verifying work
  - .2 coordinating attendance at the site of system manufacturer's technical personnel to advise as required
  - .3 written confirmation that all alarm initiating devices, signals, paging, telephone, and all other components have been tested and operate properly
  - .4 written confirmation that all supervised wiring is properly installed and operating and is in accordance with all applicable requirements
  - .5 written confirmation that the overall system and sequences of operation, including operation of communication equipment, mechanical equipment, elevators, similar equipment as specified, battery power and charging have been tested and are in accordance with all requirements and meet with the approval of local governing authorities
  - .6 submittal of signed test report sheets and a signed Verification Certificate and approval documentation issued by the local Fire Authorities

#### **1.04 SYSTEM MONITORING**

- .1 Monitoring of the fire alarm system shall be in accordance to CAN/ULC-S561. Fire alarm system shall be complete with all equipment and programming to provide signal to off-site monitoring equipment.
- .2 The owner shall be responsible to make all arrangements with the municipal fire department or off-site monitoring company.

#### **1.05 LIABILITY INSURANCE POLICY**

- .1 Within 15 days of written notification of award on contract, submit a Certificate of Insurance for a Commercial General Liability Insurance Policy from an insurer licensed to do business in the Province of the work and signed by an officer of the insurer covering public liability and property damage in a minimum amount of 2 million dollars inclusive in Canadian funds and insuring all services, operations, products, and fire alarm system work. The policy is to be extended to include bodily injury, property damage, personal and advertising injury, products and completed operations, contractual liability, Owners and Contractors protective liability and to a limit of not less than 2 million dollars Canadian per occurrence.
- .2 The policy is to:
  - .1 include a cross liability clause and be endorsed to include the Owner
  - .2 include non-owned automobile insurance to a limit of not less than 2 million dollars Canadian
  - .3 include automobile insurance (OAP1) for both owned and leased vehicles with inclusive limits of 2 million dollars Canadian
  - .4 be non-contributing with and will apply only as primary and not excess to any other insurance of self-insurance available to the Owner
  - .5 contain and undertaking by the insurers to notify the Owner in writing not less than 30 days before and material change in coverage or cancellation of coverage

**END OF SECTION**