

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with the requirements set out for the General Contractor.

1.2 APPLICATION

- .1 This Section applies to and is part of all Sections of divisions 26 and 27.

1.3 DEFINITIONS

- .1 Notwithstanding any definition elsewhere in the contract documents, wherever the term "Contractor" is used in divisions 26 and 27 Specifications, it means the firm having a contract with the "Owner" to perform supervise and coordinate all work.
- .2 Notwithstanding any definition elsewhere in the contract documents, wherever the term "Sub-Contractor" is used in divisions 26 and 27 Specifications, it means the firm having a contract with the "Contractor" to perform supervise and coordinate all work of that particular Division. This Sub-contractor shall be wholly responsible to the "Contractor" for all work of that Division.
- .3 Notwithstanding any definition elsewhere in the contract documents, wherever the term "Engineer" is used in divisions 26 and 27 specifications, it shall refer to Tower Engineering Group, 1 - 1140 Waverley Street, Winnipeg, Manitoba, R3T 0P4, Telephone: (204) 925-1150, Fax: (204) 925-1155.
- .4 INSPECTION AUTHORITY means agent of any authority having jurisdiction over construction standards associated with any part of electrical work on site.
- .5 ELECTRICAL CODE means Local Code in force at Project location.
- .6 INDICATED means as shown on contract drawings or noted in Contract Documents.
- .7 Notwithstanding any definition elsewhere in the contract documents, wherever the term "Provide" is used in relationship to equipment, wiring etc., in this Division, it means "Supply, Install and Connect, test, commission and put into working order".
- .8 Whenever "Drawings and Specifications" are referred to in these documents, it means "the Contract Drawings and Specifications" (including all addenda and post contract revisions) of all Disciplines (Architectural, Structural, Mechanical and Electrical).

1.4 TRADE DEFINITIONS

- .1 All work called for in the Contract Documents shall be considered to be within the scope of the Contract, and shall be the responsibility of the Contractor.

- .2 The arrangement of the Drawings and Specifications into Divisions, Sections, and Trades is purely arbitrary, with the sole intention of clarifying the scope and content of the work required to complete the project. The actual division of the work amongst the sub-contractors shall be the responsibility of the Contractor, and the actual division of the work between the sub-sub-contractors shall be the responsibility of the sub-contractors.
- .3 The Contractor, at his option and as per his contracts with the Sub-Contractors, may delegate responsibility to the Sub-contractors for the division of the work.
- .4 The Sub-contractors, at their option and as per their contracts with the sub-sub-contractors, may delegate responsibility to the sub-sub-contractors for the division of the work.
- .5 Sections of the Electrical specifications, and specific but arbitrary responsibility divisions noted in the Electrical Specifications, are not intended to delegate functions nor to delegate work to any specific trade, but may be useful to the Contractor or Sub-contractor when dividing the work amongst the Trades and Sub-trades.
- .6 In the event of a dispute regarding the responsibilities of the various trades and sub-trades, the Contractor and Sub-contractors may request information or a recommendation from the Engineers and/or Departmental Representative. However, the Contractor and Sub-contractor shall be responsible for determining the final division of work.

1.5 GENERAL SCOPE OF WORK

- .1 The Electrical work shall include all labour, materials, equipment, and tools required to install, test and place into operation a complete and fully operational Electrical System consisting of the various sub-systems as described in, but not necessarily limited to, the items in the following Specification Sections and Drawings:
 - .1 Section 26 00 05 Electrical General Provisions
 - .2 Section 26 05 01 Basic Electrical Materials and Methods
 - .3 Section 26 05 04 Miscellaneous Apparatus and Appliances
 - .4 Section 26 05 21 Wire and Cables
 - .5 Section 26 05 22 Connectors and Terminations
 - .6 Section 26 05 28 Grounding
 - .7 Section 26 05 29 Fastenings and Supports
 - .8 Section 26 05 31 Cabinets, Splitters, Junction and Pull Boxes
 - .9 Section 26 05 32 Outlet Boxes and Fittings
 - .10 Section 26 05 34 Conduit
 - .11 Section 26 05 37 Wireways
 - .12 Section 26 05 43 Underground Conduits & Cables
 - .13 Section 26 05 80 Mechanical Equipment Connections
 - .14 Section 26 05 94 Electric Heating and Cooling Controls
 - .15 Section 26 08 00 Electrical Commissioning
 - .16 Section 26 09 25 Lighting Contactor Panel
 - .17 Section 26 24 13 Main Distribution Switchboard
 - .18 Section 26 24 17 Panelboards
 - .19 Section 26 27 26 Wiring Devices
 - .20 Section 26 28 14 Fuses

.21	Section 26 28 21	Circuit Breakers
.22	Section 26 28 23	Disconnect Switches – Fused and Non-fused
.23	Section 26 29 01	Contactor
.24	Section 26 29 10	Motor Starters
.25	Section 26 32 14	Natural Gas Generator
.26	Section 26 50 00	Lighting
.27	Section 26 52 01	Unit Equipment for Emergency Lighting
.28	Section 26 52 01.10	Emergency Lighting Verification
.29	Section 26 60 00	Utilities Underground Service Entrance
.30	Section 26 60 10	Incoming Telephone Service
.31	Section 26 60 20	Incoming Cable TV Service
.32	Section 27 05 13	Voice Data Communication System
.33	Section 27 05 14	Communications System Raceways
.34	Section 27 05 15	Voice-Data-CATV Pathways
.35	Section 27 05 16	Cable TV Raceway System
.36	Section 27 05 18	Cable TV Riser
.37	Drawing List: See drawing E-1.0 for complete Electrical drawing list.	

1.6 DETAILED SCOPE OF WORK

- .1 The detailed Scope of Work includes, but is not limited to:
 - .1 Provision of all labour, new materials, tools, transportation, services and facilities for a complete electrical installation to the satisfaction of the Electrical Engineer or Owner.
 - .2 All other work as described herein or as shown on the drawings.
 - .3 Arranging for and coordination the utilities work for underground power, data, telephone and TV cable service for the new building. Provide underground conduits, trenching, back filling as required by Utilities and as shown or indicated on drawings.
 - .4 Connection of pad-mounted/pole mounted transformer/transformer bank, permanent main Electrical Service and metering.
 - .5 Provision of complete power distribution system including service entrance, metering compartments, metering equipment as required, transformers, sub-distributions, feeders and panelboards.
 - .6 Provision of a complete operational lighting systems including conduits, fixtures, lamps, wire, switches, boxes, termination, associated relays and contactors and interface with time clock and photocell control system.
 - .7 Provision of all Emergency and Exit lighting system including conduit, wire remote heads, batteries and battery charging system. Systems shall be complete in every respect.
 - .8 Provision of a complete Fire/CO Alarm System including coordination and allowance of all associated equipment connections indicated on design build

sprinkler drawings.

- .9 Provision of power supply to all mechanical equipment and controls. Provide motor control as indicated.
- .10 Provision of a complete receptacle system including conduits, wire, receptacle, boxes and termination.
- .11 Provision of a complete, effective grounding and bonding system.
- .12 Provision complete voice data system including conduit, cables, cable trays.
- .13 Provision of complete TV cable system.
- .14 Provision of complete Security system including but not limited to CCTV, door access, and intercom systems.
- .15 Electrical Contractor shall be responsible to coordinate, submit and facilitate all items related to Manitoba Power Smart program incentives. All rebates to be forwarded to the owner.

1.7 CASH ALLOWANCES

- .1 For information regarding Cash Allowances, refer to the Architectural Specifications.
- .2 For information regarding Cash Allowances, refer to the Specifications set out for the General Contractor.
- .3 Cash Allowances are to be carried by the General Contractor, not by the Electrical Contractor unless specifically noted otherwise.

1.8 SUPPLEMENTARY TENDER FORM

- .1 At tender close, submit a copy of the Electrical Supplementary Tender Form showing all requested information.
- .2 There will be no substitution of named Subtrades / Manufactures after tender close except as approved by the Engineer.

1.9 SITE EXAMINATION

- .1 Visit and inspect the site of the work to verify the location and elevation of existing items and services (such as piping, ductwork, lighting, conduit, ceilings, walls, columns, beams, etc.) which may affect the Tender and work of this Division, before submission of tender and proceeding with the work.
- .2 Make allowance to relocate all existing items/services as required, or to provide alternate locations/routings of new items/services as required. Confirm alternate locations/routings

with the Owner/Departmental Representative/Engineer prior to submitting Tender Pricing.

- .3 Claims for extra payments resulting from conditions which could have reasonably been foreseen during a pre-tender site examination will not be considered.

1.10 ELECTRICAL DRAWINGS

- .1 The Drawings for the Electrical work are performance drawings, diagrammatic and approximately to scale, intended to convey the scope of work and indicate the general arrangement and approximate location of devices, fixtures, panelboards and conduit / cable runs. These Drawings do not intend to show Architectural and Structural details.
- .2 Do not scale the Drawings. Obtain information involving accurate dimensions from dimensions shown on the Architectural and Structural drawings, and by site measurement.
- .3 Even though some conduit, cables and systems is not completely shown or is shown schematically, and all details are not shown or specified, it is expected that the contractors be familiar enough with their fields of work to complete the project to the standards generally adhered to by the local industry, including good workmanship and common sense. The Engineer reserves the right to furnish any additional detail drawings, which, in the judgement of the Engineer, may be necessary to clarify the work, and such drawings shall form a part of this contract. The work for such Clarifications shall be at no cost to the Owner.
- .4 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions, pipes, ducts, beams, columns etc, and to provide complete and adequate service clearance.
- .5 The exact location of the Electrical components may be changed by the contractors to suit site conditions, provided the changes are reviewed with the Engineer, the changes are duly noted on the 'Record' drawings, and the changes do not affect the operation or code-compliance of the system(s). Any such changes shall be at no cost to the Owner.

1.11 CHANGES TO THE SCOPE OF WORK

- .1 From time to time during construction, changes to the scope of work may be proposed by the Owner. These Proposed Changes are to be priced by the contractors in a timely manner. Only after the Owner has reviewed and accepted the pricing, will these Proposed Changes be added to the contract.
- .2 Pricing for the Electrical portions of these Proposed Changes shall be submitted by the Sub-contractor to the Contractor complete with price breakdowns as follows:
 - .1 Sub-sub-contractors' prices c/w labor, material and overhead prices broken out.
 - .2 Sub-contractor's price c/w labor, material and overhead prices broken out.

- .3 Pricing shall be submitted on an item-by-item basis. Each Proposed Change may contain more than one item.

1.12 PHASING

- .1 This project involves sequential construction in phases. Refer to the Architectural Drawings and Specifications for exact requirements.
- .2 Provide start-up, testing, verification and certification of the Electrical Systems at the Occupancy Stage of each construction phase.
- .3 Provide for partial fire alarm verification reports as required to accommodate phasing and occupancy requirements.

1.13 LIABILITY

- .1 Maintain all necessary insurance coverage to save and indemnify the Owner.
- .2 Protect and maintain the work until the project has been completed and turned over to the Owner. Protect the building and contents from damage during the construction period. Repair all damages without additional cost to the Owner.
- .3 Special care shall be taken to insure that any existing equipment, structures, components and property are not damaged during the construction period. Repair all damages without additional cost to the Owner.

1.14 WORK SCHEDULE

- .1 Unless otherwise noted, the work shall be scheduled for normal hours. The contractors shall be aware that off-hour work may be necessary for certain locations or types of work, and shall include the extra costs in the tender price.
- .2 Where the work requires the contractors to be in occupied areas, or where building services may be disrupted, the contractors shall closely coordinate the hours and areas of work with the Owners and occupants.
- .3 It shall be the responsibility of the Contractor to schedule the work to meet the Owner's completion date. The Contractor shall coordinate the sub-trades and adjust the workforce as required to meet the schedule.

1.15 SUPERVISION

- .1 Maintain at this job site qualified personnel and supporting staff with proven experience in supervising, installing and commissioning projects of comparable nature and complexity.
- .2 Supervision personnel and their qualifications are subject to the approval of the Engineer.

1.16 ENGINEERING SITE REVIEW

- .1 The Sub-Contractor's work will be reviewed periodically by the Owner, the Engineer, or their representatives, solely for the purpose of determining the general quality of the work. Guidance will be offered to the contractors in regard to interpretation of plans and specifications, to assist them in carrying out the work. Inspections, and directives given to the contractors, do not relieve the Contractor, and his agents, servants and employees, of his responsibility to provide the work in all of its parts, in a safe and workmanlike manner, and in accordance with the plans and specifications, nor impose upon the Owner, and/or Engineer or their representatives, any responsibility to supervise or oversee the erection or installation of any work.
- .2 The Engineer will issue inspection reports and deficiency lists from time to time. All deficiencies shall be cleared up to the satisfaction of the Engineer within a reasonably short time.

1.17 PATENTS

- .1 Pay all royalties and license fees, and defend all suits or claims, for infringement of any patent rights, and save the Owner and Engineer harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Contractor or anyone directly or indirectly employed by him, or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement on such letters patent or rights.

1.18 CONSTRUCTION DRAWINGS

- .1 Where requested, prepare drawings in conjunction with all trades concerned, showing sleeves and openings for passage through structures, and all inserts, equipment bases, sumps and pits, supports, etc.

1.19 UTILITY SERVICES

- .1 Coordinate, arrange, and pay for all utility relocations, terminations and connections as required and shown on the drawings, complete with all required metering.
- .2 Install all metering equipment in accordance with utility requirements.
- .3 Test all services and provide report(s) as required by the Authorities Having Jurisdiction.

1.20 CODES, PERMITS, FEES AND INSPECTIONS

- .1 Comply with the most stringent requirements of the latest editions of the applicable C.S.A. standards; NFPA70 and the requirements of the Authorities Having Jurisdiction; Federal, Provincial and Municipal Codes; and the applicable standards of the Underwriters' Association. These codes and regulations constitute an integral part of these specifications.

- .2 In case of conflict, the codes take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.
- .3 Before starting any work, submit the required number of copies of Drawings and Specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Engineer immediately of such changes, for proper processing of these requirements. Prepare and furnish any additional drawings, details or information as may be required. Information such as load calculations and other data that may be required can be obtained from the Engineer. Should the authorities require the information on specific forms fill in these forms by transcribing the information provided by the Engineer.
- .4 Apply for, obtain, and pay for all required permits, licenses, inspections, examinations, and fees.
- .5 Arrange for the inspection of all the work by the Authorities Having Jurisdiction over the work. On completion of the work, present to the Engineer the final unconditional certificate of approval of the inspecting authorities. When the Authorities Having Jurisdiction do not normally issue certificates, provide a declaration confirming that the Authorities have inspected and accepted the work.

1.21 SHOP DRAWINGS

- .1 Present a schedule of shop drawings within 2 weeks after the award of the contract, indicating the shop drawing submission and equipment delivery dates.
- .2 Shop Drawings submitted by the Contractor shall contain:
 - .1 Project Information such as Name and Address (17 Harbour Lane, Gimli, Manitoba).
 - .2 Contractor Information such as Name, Address, Phone Numbers
 - .3 Supplier Information such as Name, Address, Phone Numbers
 - .4 Equipment Identification using the same System Name and Identification Number as the Contract Documents.
 - .5 All Equipment Information required for the Engineer to assess the suitability such as:
 - .1 Make, Model, Size
 - .1 including schedules where numerous similar items are provided
 - .2 Physical Data such as:
 - .1 Dimensions
 - .2 Materials
 - .3 Weights
 - .4 Installation Requirements
 - .5 Installation Clearances
 - .3 Performance Data such as:

- .1 Volume
 - .2 Pressure
 - .3 Capacity
 - .4 Performance Curves (with specified performance clearly marked)
 - .4 Motor Data such as:
 - .1 Horse Power
 - .2 Voltage/Phases
 - .3 Efficiency
 - .5 Wiring and Control Diagrams
- .3 Equipment Information may contain standard manufacturer's brochures, catalogue sheets, schematics, diagrams performance charts, illustrations, etc., but must have:
 - .1 Information which is not applicable crossed off
 - .2 Available listed options which are being provided clearly marked
- .4 Shop Drawing Review:
 - .1 In addition to project identification, date, etc., the form of stamp used in shop drawing review shall contain the following format:
 - .1 Drawing:
 - .1 Reviewed
 - .2 Reviewed As Noted
 - .3 Revise and Re-Submit
 - .4 Not Reviewed
 - .2 This review by the Engineer is for the sole purpose of ascertaining conformance with the general design concept.
 - .3 This review shall not mean that the Engineer approved the detail design inherent in the shop drawings, the responsibility for which shall remain with the Sub-contractor submitting same, and such review shall not relieve the Sub-contractor of his responsibility for errors or omissions in the shop drawings, or of his responsibility for meeting all the requirements of the contract documents. The contractors are responsible for confirming and correlating dimensions 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, as well as compliance with codes and inspection authorities such as C.S.A., etc.
- .5 Bind one complete set of final shop drawings in each operating and maintenance instruction manual.
- .6 Refer to the Architectural General Specifications for additional information.

1.22 COORDINATION

- .1 The Contractor shall be responsible for the complete coordination amongst all trades, including timing, completion, deliveries, interference of building components and sequencing of the trades.
- .2 The Contractor shall coordinate the Mechanical and Electrical sub-contractors to ensure compatibility of the system components.
- .3 The Contractor shall coordinate the Mechanical and Electrical sub-contractors to ensure access to control panels on mechanical equipment for the purpose of completing fire alarm panel connections.
- .4 The Contractor shall coordinate all trades to ensure that access doors and panels are of the same manufacturer and of a style appropriate for the intended use.

1.23 EXPEDITING

- .1 Continuously check and expedite delivery of equipment and materials. If necessary, inspect at the source of manufacture.
- .2 Continuously check and expedite the flow of necessary information to and from all parties involved.
- .3 Immediately inform the General Contractor if information is required from him.

1.24 RECORD DRAWINGS

- .1 Obtain two sets of white prints and, as the job progresses; mark these prints to accurately indicate the installed work. Have the white prints available for inspection at the site at all times, and present for scrutiny at each job meeting.
- .2 At the completion of the work, submit these sets of "Record" drawings to the Engineer for review. Make changes as requested by the Engineer and resubmit. This process will continue until the "Record" drawings are deemed complete by the Engineer.
- .3 Arrange and pay for three copies of the final 'Record' Drawings to be produced and labeled 'As Constructed'.
- .4 Submit the "Record" and "As-constructed" drawings to the Owner.
- .5 For Additional Information, refer to the Architectural General Specifications.
- .6 For Additional Information, refer to the Specifications set out for the General Contractor.

1.25 CUTTING AND PATCHING

- .1 The cutting of openings not requiring lintels or other structural support will be the responsibility of the trade requiring the opening. The opening size shall be the minimum required. Patching will be the responsibility of the trades normally engaged in working

with the finishing materials required to restore the opening to the original or specified conditions.

- .2 Where openings require lintels or other structural support, or roofing work, such openings will be specified under other divisions of this specification.
- .3 Cutting, patching, and repairs to existing surfaces required as a result of the removal and/or relocation of existing equipment, piping and/or installation of new equipment in existing buildings is to be included in the tender price.

1.26 TEMPORARY SERVICES

- .1 Do not use any of the permanent Electrical systems during construction unless specific written approval is obtained from the Engineer.
- .2 The use of permanent facilities for temporary construction service shall not affect, in any way, the commencement date of the warranty period.
- .3 If the permanent Electrical systems are used during construction, the equipment and systems shall be cleaned and refurbished as required to bring them back to a new/unused condition.

1.27 TEMPORARY AND TRIAL USAGE

- .1 The Owner has the privilege of trial usage of Electrical systems, or parts thereof, for the purpose of testing and learning the operational procedures.
- .2 Assist in the trial usage over a length of time, as deemed reasonable by the Engineer, at no extra cost, and do not waive any responsibility because of trial usage.
- .3 Trial usage shall not be construed as acceptance by the Owner.
- .4 Provide and pay for all testing required on the system components where, in the opinion of the Engineer, Manufacturer's ratings or specified performance is not being achieved.

1.28 CLEANING

- .1 General Clean-up:
 - .1 The worksite shall be maintained in a condition of general cleanliness and tidiness.
 - .2 Provide, erect, maintain and remove temporary protective barriers and shelters. Use drop sheets, temporary walls or other means necessary to limit the spread of construction dirt and debris. Barriers shall be used to minimize the spread of dust, smoke, fumes and noise to other portions of the building.

- .3 For renovation work, and for phased work where part of the building is occupied, coordinate and cooperate with the occupants throughout the duration of the project to maintain the site in a usable condition.
- .4 For renovation work, and for phased work where part of the building is occupied, clean the site to the satisfaction of the occupants at the end of each work day, so as to neither inconvenience the occupants nor hinder the use of the facility.
- .5 For renovation work, at the end of the project, provide cleaning services to leave the site in as clean a condition as existed before the commencement of the work.
- .2 Electrical Systems Clean-up:
 - .1 At the completion of the project, leave all systems in full operation, the exterior of all new and renovated systems clean, and the work areas cleaned to the satisfaction of the Engineer, Owner and Occupants.
 - .2 Clean exposed surfaces of new and renovated electrical equipment, light fixtures, panelboards, control panels, etc.
 - .3 The level of cleaning shall be consistent with the intended use of the building and the electrical systems.
 - .4 The Owner reserves the right to inspect the Electrical Systems to determine the effectiveness of the cleaning. Where cleaning is deemed to be unacceptable, the cleaning shall be re-done at no extra charge to the Owner.

1.29 INSTRUCTIONS TO OWNERS

- .1 Prepare a Suitable List/Sign-off Sheet to indicate the Instructions and Materials provided.
 - .1 List shall include all Systems.
 - .2 List shall include all Materials.
 - .3 List shall include spaces for Sign-off Names and Dates for the Owner's Representative.
- .2 Instruct the Owner's representatives in all aspects of the operation of the systems and equipment.
- .3 Arrange and pay for the services of Manufacturers' representatives required for the instruction on specialized portions of the installation.
- .4 Assemble three Operation and Maintenance Manuals in three ring binders with index tabs, each containing:
 - .1 this Sub-contractor's and suppliers names and telephone numbers,
 - .2 a complete set of reviewed shop drawings,
 - .3 brochures,

- .4 data sheets,
 - .5 operating, maintenance, and lubricating instructions,
 - .6 wiring diagrams,
 - .7 controls 'As-Built' shop drawings,
 - .8 commissioning information,
 - .9 warrantee certificates.
- .5 Present all copies of the Operation and Maintenance Manuals to the Engineer for review. The Engineer will review the manuals and return them with comments. The Sub-contractor shall make all requested changes. This process shall continue until the Manuals are deemed complete by the Engineer. The Sub-contractor shall turn over the completed manuals to the Owner.
- .6 Present all copies of the Final Record Drawings to the Owner.

1.30 SPECIAL TOOLS AND SPARE PARTS

- .1 Prepare a Suitable List/Sign-off Sheet to indicate the Materials provided.
- .1 List shall include all Materials.
 - .2 List shall include spaces for Sign-off Names and Dates for the Owner's Representative.
- .2 Provide spare parts as follows:
- .1 Circuit breakers and fuse as indicated in panelboard schedules and single line drawings.
 - .2 Motor starters as indicated
 - .3 10 % spare lamps of each type and rating or a minimum of two
 - .4 Other systems as indicated
- .3 Identify spare parts containers as to contents and replacement parts number.
- .4 Provide one set of all specialized tools required to service equipment as recommended by the Manufacturers.

1.31 WARRANTIES

- .1 No certificate issued, payment made, or partial or entire use of the system(s) by the Owner, shall be construed as acceptance of defective work or material.
- .2 Include copies of all warranty and guaranty certificates and declarations in the Operating and Maintenance Manuals, in the appropriate sections.
- .3 Provide a certificate or declaration indicating the warranty and conditions.
- .4 Warranty satisfactory operation of all work and equipment installed under this contract. Repair or replace at no charge to the Owner, all items which fail or prove to be defective within the Warranty period, provided that the failure is not due to improper usage by the

- Owner. Make good all damages incurred as a result of the failure and of the repair of the system(s).
- .5 The warranty shall be for all parts and labour. Do not expect any participation from the Owner's personnel in the correction of warranty related work.
 - .6 For systems, equipment and components which are used continuously throughout the year, the normal warranty period shall be one calendar year from the date of Substantial Completion. For seasonal equipment, components and systems which are not normally used continuously throughout the year, the warranty period shall include at least one full season of satisfactory operation.
 - .7 When equipment or systems are put into use subsequent to the acceptance of the building, or a portion of the building, the warranty period for seasonally used equipment and systems shall be deemed to commence from the date of satisfactory operation, not from the date of final acceptance by the Owner.
 - .8 The Owner retains the right to demand, and to receive, an extension of the original construction warranty for any equipment, component or system which consistently fails to perform, or which requires repeated repair or adjustment.
 - .9 Wherever manufacturer's warranties in excess of the Contractor's warranty are provided, furnish the Owner with copies of the Certificates, dated and acknowledged, and inserted in the O and M Manuals. The Contractors Warranty shall include a list of the Manufacturer's extended warranties.
 - .10 Warranty work shall be carried out within a reasonable time period following the reporting of the problem. Should the repair time for any failed component be unreasonably long, as determined by the Owner, make alternate arrangements to have a temporary replacement component made available until such time that the original component is repaired and re-installed. There shall be no additional cost to the Owner for any temporary replacement component or for any labour required to implement the work.

1.32 DOCUMENTATION AND SYSTEM(S) ACCEPTANCE

- .1 The Contractor shall prepare a suitable document to be signed by the Owner or his representative, confirming:
 - .1 The Owner has received satisfactory instruction in the operation and maintenance of all equipment and systems.
 - .2 The Operation and maintenance manuals have been received and reviewed by the Owner.
 - .3 The "Record" and "As-constructed" drawings have been received and reviewed by the Owner.
 - .4 Specified spare parts, components, keys, removable handles, tools and the like, have been accepted by the Owner.

1.33 COMPLETION

- .1 The Contractor shall be aware that it is the Engineer's intention to withhold recommendations for payment of progress claims totalling more than 92.5% of the electrical contract until the project is declared Substantially Complete.
- .2 The close-out procedure may entail a take-over and occupancy of the building in more than one stage, depending on the specified phasing and the Owner's timetable.
- .3 SUBSTANTIAL COMPLETION
 - .1 The project will be ready for a Substantial Completion inspection only when it is ready for the Owner to occupy and utilize the building for its intended purpose.
 - .2 At Substantial Completion, the Owner will realise that some deficiencies may still exist.
 - .3 In preparation for the inspection to determine Substantial Completion for all or a portion of the project, the Contractor shall ensure and declare in writing that:
 - .1 Except for seasonal deficiencies, the Start-up and Verification of the Commissioning Process has been completed, and all systems are fully functional.
 - .2 All systems and equipment have been cleaned.
 - .3 All systems and equipment have been identified and labelled.
 - .4 The preliminary Record drawings have been submitted for review.
 - .5 One set of preliminary O and M Manuals have been submitted for review.
 - .6 Instructions to the Owner's Representative have been given.
 - .7 Maintenance Materials and Spare Parts have been provided.
 - .4 When the Contractor is satisfied that the entire project is completed, and after making his own inspection, he shall apply, in writing, to the Owner and/or Engineer, for an inspection to determine if the project can be deemed to be Substantially Complete.
 - .5 In the letter of request, a date shall be specified upon which the project can be delivered and be Substantially Complete.
 - .6 During the inspection, a deficiency list will be compiled and a report will be issued. These deficiencies shall be corrected or completed in a satisfactory and timely manner.

- .7 Based on the inspection report, the Owner will retain a sum of money, sufficient in his estimation to cover the cost of completing the deficiencies.

.4 **TOTAL COMPLETION**

- .1 When the Contractor has determined that the deficiencies noted during the Substantial Completion inspection have been completed or corrected, he shall apply, in writing, to the Owner and/or Engineer, for a final inspection to determine if the project can be deemed to Totally Complete.
- .2 In the letter of request, a date shall be specified upon which the project can be delivered and be Totally Complete.
- .3 In preparation for the inspection to determine Total Completion for all or a portion of the project, the Contractor shall ensure and declare in writing that:
 - .1 All aspects of the Commissioning Process have been completed.
 - .2 The final Record and As-Constructed drawings have been submitted, reviewed and accepted.
 - .3 The final O and M Manuals have been submitted, reviewed and accepted.
 - .4 The deficiencies noted during the Substantial Completion inspection have been corrected or completed.
- .4 During the inspection, a deficiency list will be compiled and a report will be issued. These deficiencies shall be corrected or completed in a satisfactory and timely manner.
- .5 Based on the inspection report, the Owner will retain a sum of money, sufficient in his estimation to cover the cost of completing the deficiencies.
- .6 Final Payment will only be made after the project has been determined to be Totally Complete, with all deficiencies satisfactorily corrected.

2 PRODUCTS
Not Used

3 EXECUTION
Not Used

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Bidding & Contract Requirements Division 0
- .2 General Requirements Division 1
- .3 All Electrical Drawings and Division 26 and 27 specification sections.
- .4 All Mechanical Drawings and Mechanical specification sections.

1.2 QUALITY ASSURANCE

- .1 Do complete installations in accordance with local standard.
- .2 While not identified and specified by number in this Division, comply with CSA Electrical Bulletins in force at time of tender submission. Comply with the requirements of all Provincial and local laws, rules, ordinances and codes.
- .3 Electrical installation shall be in accordance with the current edition of the Electrical Code, Provincial and other codes, rules and regulations. Supply material and labour required to meet the requirements of these codes, rules and regulations even though the work is not shown on the drawings or mentioned in the specifications. Where the electrical installation calls for better quality materials or construction than the minimum requirement of these codes, rules and regulations, the electrical installation shall be as shown on the drawings and as specified.

1.3 PERMITS, FEES

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Additional drawings for approval will be provided by the consultant.
- .2 Obtain all necessary permits required for the electrical installation.
- .3 Pay all fees for permits and inspections as required for the electrical installation.

1.4 SUBMITTALS

- .1 Submit shop drawings and product data for review by the Consultant. All drawings must be in English with Imperial dimensions or in metric where indicated. Manufacturing of equipment must not commence until shop drawings have been reviewed.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.

- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .5 Submit samples in accordance with General Conditions. Samples shall be forwarded to the Consultant's office. Pay all transportation costs to ship samples to Consultant's office and return. Approved samples will be retained until after tender closing, then all samples will be returned except for the sample submitted by the manufacturer who has been listed by the successful Contractor in the Tender Documents. This sample will be used for comparison with the actual production run of successful manufacturer.
- .6 Required shop drawing section:
 - .1 26 05 04 Miscellaneous Apparatus and Appliances
 - .2 26 05 31 Cabinets, Splitters, J.B.'s
 - .3 26 05 94 Electric Heating Equipment
 - .4 26 09 25 Lighting Contactor Panel
 - .5 26 24 13 Main Distribution Switchboard
 - .6 26 24 17 Panelboards
 - .7 26 27 26 Wiring Devices
 - .8 26 28 14 Fuses
 - .9 26 28 21 Circuit Breakers
 - .10 26 28 23 Disconnect Switches
 - .11 26 29 10 Motor Starters
 - .12 26 50 00 Lighting
 - .13 26 52 01 Unit Equipment for Emergency Lighting

1.5 OPERATIONS AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into Maintenance Manuals.
- .2 Include details of design elements, construction features, component function and maintenance requirements and schedules to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .3 Include technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
- .4 Include wiring and schematic diagrams and performance curves.
- .5 Include names and addresses of local suppliers for items included in Maintenance Manuals.
- .6 Submit Maintenance Manuals to the Consultant for review. Manuals that are incomplete shall be returned to the Electrical Subcontractor for completion. Completed manuals must be submitted, to the satisfaction of the Consultant, before final payment may be considered to be due.

1.6 MAINTENANCE MANUALS

- .1 Provide maintenance materials and information as specified.
- .2 Turn materials over to Owner in an orderly fashion upon completion of installation.
- .3 Maintenance manuals shall contain a copy of the final verification report and certificate, as well as a copy of the electrical inspection certificate.

1.7 EXAMINATION OF SITE AND CONSTRUCTION DOCUMENTS

- .1 Attend pre-tender site meeting as scheduled and request further information or clarifications at that time.
- .2 Prior to submitting a tender, examine the site and local conditions which will affect the work. Claims for extra payments, resulting from conditions which could reasonably be foreseen during an examination of the documents and site, will not be recognized.

1.8 PRICING OF CHANGES AFTER TENDER

- .1 The consultant reserves the right to review costing using accepted Contractor's Pricing Standards.

1.9 OTHER TRADES

- .1 Include in cost all work by subtrades, such as painting, coring, plastering, access doors etc. to restore all finished areas to original finish.
- .2 Schedule execution of electrical work with associated work specified in other Divisions.
- .3 Coordinate electrical work to avoid conflicts with pipes, air ducts or other equipment.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Deliver all materials to site in an orderly fashion and in accordance with schedule.
- .2 Provide additional protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment and as directed by the Consultant.

1.11 PROJECT RECORD DOCUMENTS

- .1 The Electrical Contractor shall maintain one set of white prints on site to record all changes to the Contract Drawings, which affect electrical layouts of equipment. Record drawings shall indicate all circuit wiring and all conduit runs, circuit numbers and devices. All relocations of equipment shall be shown. At project completion, the Contractor shall transfer the record information to a clean set of white prints, using recognized drafting standards, and stamp drawings As-Built, including the company name, date and signature of site Supervisor.

2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide labour, materials, transportation, equipment and facilities, etc., required for the complete electrical installation as indicated or implied on the drawings and specifications.
- .2 Electrical equipment shall be new and of type and quality specified.
- .3 Equipment and material to be CSA certified, and manufactured to standards described. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the appropriate Inspection Departments.
- .4 All motors (including motors used for mechanical equipment) shall comply with the relevant appliance or equipment efficiency act or CAN/CSA-C390, article 4-10.

2.2 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

3 EXECUTION

3.1 INSPECTION

- .1 Furnish a Certificate of Acceptance from the Inspection Authorities on completion of work. Copies of Certificate to be included in Maintenance Manuals.
- .2 Certificate of Inspection and Approval must be submitted before final payment may be considered to be due.
- .3 During the course of the project construction, the Consultant will carry out periodic inspections and prepare a deficiency list for remedial action by the Electrical Subcontractor. When requested, the Electrical Contractor shall respond in writing to the Consultant, stating corrective action and completion date for each item listed as deficient. This response shall be in the hands of the Consultant within three working days of receipt of the Site Observation Report.

3.2 CARE, OPERATION AND START-UP

- .1 Instruct the Building Manager's personnel in the operation, care and maintenance of equipment. Arrangement of such instructional sessions to be done at a time convenient to

the Owner.

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

3.3 FINISHES

- .1 Clean and touch up surfaces of shop-painted equipment, scratched or marred during shipment or installation, to match original paint.
- .2 Clean, prime and paint exposed hangers, racks, fastenings to prevent rusting.

3.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with lamacoid nameplates.
- .2 Provide lamacoid nameplates, 1/8" (3 mm) thick plastic engraving sheet, mechanically attached (screwed or rivetted) unless specified otherwise. Sizes as follows:

Size 0	3/8" x 1 1/2"	(10 x 38 mm)	1 line 1/8" (3 mm) high letters
Size 1	3/8" x 4"	(10 x 100 mm)	1 line 1/8" (3 mm) high letters
Size 2	1/2" x 3"	(13 x 75 mm)	1 line 3/16" (5 mm) high letters
Size 3	1/2" x 3"	(13 x 75 mm)	2 lines 1/8" (3 mm) high letters
Size 4	3/4" x 3"	(19 x 75 mm)	1 line 3/8" (10 mm) high letters
Size 5	3/4" x 4"	(19 x 100 mm)	2 lines 3/16" (5 mm) high letters
Size 6	1" x 4"	(25 x 100 mm)	1 line 1/2" (13 mm) high letters
Size 7	1" x 4"	(25 x 100 mm)	2 lines 1/4" (6 mm) high letters
- .3 Wording on nameplates to be approved prior to manufacture. Submit schedule of nameplates and wording to owner (where existing systems are modified or added to) and to the Consultant for new construction.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification to be English and French on separate nameplates.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system, circuit, loop numbers.
- .7 Use red nameplates with white lettering for fire alarm equipment and emergency power circuits. Use blue nameplates with white lettering for UPS power circuits. Use white nameplates with black lettering for all other systems.
- .8 Use heat shrink type markers or CAB-3 cable marking system (Pass & Seymour) for all conductors and cables. Mark cables at both ends, see detail 1/E2. Mark fire alarm, card

access and LAN cables. Confirm labels with consultant.

3.5 LOCATION OF OUTLETS

- .1 Change location of outlets at no extra cost or credit, providing distance does not exceed 10'-0" (3 m) and information is provided before installation.

3.6 MOUNTING

- .1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.
- .2 Refer to Architectural elevations and details for mounting heights.
- .3 If mounting height of equipment is not indicated, verify with Engineer and Departmental Representative before proceeding with installation.
- .4 Install electrical equipment at the following heights unless indicated or directed otherwise (to bottom of outlet).
 - .1 Outlets above counters: 6" (150 mm); splashbacks: 4" (100 mm).
 - .2 General receptacles, telephone and television outlets: 16" (400 mm).
 - .3 Receptacles in mechanical and shop areas: 40" (1 m).
 - .4 Switches, dimmers, push buttons, Luxo bracket: 47" (1.2 m) above the finished floor level measured from the centre of the device box.
 - .5 Fire alarm pullstations, intercoms, thermostats: 47" (1.2m) above the finished floor level measured from the centre of the device box.
 - .6 Audible signal silencing means/devices (separately installed or incorporated in the audible signal device) in Suites of residential occupancy: 47" (1.2m) above finished floor level measured from the centre of the silencing means.
 - .7 End of line resistors: 64" (1.6 m).
 - .8 Fire alarm bells, horns, speakers: 88" (2.2 m).
 - .9 Panelboards, annunciators, etc.: 78" (2.0 m) to top.
 - .10 Clock outlets: 84" (2.15 m).
 - .11 Handicap suite switches, dimmers, pushbuttons: 40" (1 m).
 - .12 Handicap suite receptacles, television, telephone: 24" (600 mm).
 - .13 Handicap suite thermostats: 40" (1.0 m).

- .14 Power door operator for person using wheel chair to be located and operated with two heights: one with its centre located 35 1/2" (900mm) from the finished floor level; and the other with its centre located 9" (225mm) from the finished floor level.
- .15 As per Architectural elevations.
- .16 Heights as above or at bottom of nearest block or brick course.
- .17 Wall mounted telephone: 60" (1525mm).
- .5 All transformers, motor control centres and floor-mounted distribution panels shall be mounted on 4" (100 mm) concrete housekeeping pads. The Electrical Contractor shall be responsible for provision of these pads. Where ceiling heights will not allow housekeeping pads to be installed below distributions, and where pre-approved by the Consultant, 1 1/2" (38 mm) galvanized cantruss shall be provided in place of the pad.

3.7 CONDUIT SLEEVES AND HOLES

- .1 Make necessary arrangements for cutting of chases, coring of holes and other structural work required to install electrical conduits, cables, pullboxes and outlet boxes.
- .2 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 The contractor shall satisfy himself by X-Ray or other acceptable means that coring through the floor slab will not disturb existing conduit or cables. The contractor will be responsible for resulting disruptions and required refurbishments.

3.8 FIREPROOFING

- .1 Where cables or conduits pass through floors, block or concrete walls and fire rated walls, provide fire stop to maintain rating.
- .2 Refer to Architectural drawings and specifications, and conform with all requirements therein.
- .3 Acceptable manufacturers (where Architects specifications do not provide details) are Dow Corning Firestop, A/D Fire Barrier Silicone Sealant, Ener Stop - Ancron Corporation. Install fire stop with strict attention to manufacturer's directions. Include directions in maintenance manuals.
- .4 Fireproofing of electrical cables, conduits, trays, etc., passing through fire barriers shall conform to local codes and inspection authorities.

3.9 TESTS

- .1 Conduct and pay for tests including, but not limited to, the following systems:

- .1 Systems: new electrical distribution system, fire alarm system(s), card access system, parking lot demand controls, mechanical system controls, voice/data infrastructure, emergency lighting system.
- .2 Furnish Manufacturer's Certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions. Include letters in maintenance manuals.
- .3 Carry out tests in presence of Consultant where directed.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results in Maintenance Manuals.

3.10 CLEANING

- .1 Do final cleaning in accordance with Section 01100.

3.11 CUTTING AND PATCHING

- .1 Include the costs of all cutting and patching required for the installation of electrical work.
- .2 Obtain the approval of the Consultant, Building Manager and Owner before arranging for any cutting. Patching shall restore the affected area to the original condition; materials and methods used for patching shall match existing.

3.12 WORKMANSHIP

- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Consultant. Install conduit and cable runs parallel and perpendicular to building lines in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.
- .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearances and accessibility for same.
- .3 Include, in the work, all requirements shown on the shop drawings or manufacturer's installation instructions.
- .4 Replace work unsatisfactory to the Consultant without extra cost.

3.13 ACCESS DOORS

- .1 Access doors to be a minimum #12 gauge prime coat painted bonderized steel. Each to be complete with a heavy flush frame and anchor, concealed hinges, positive locking

screwdriver lock, and mounting and finishing provisions to suit the finish material for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc. shall be U.L.C. listed and labelled and of a rating to maintain the fire separation integrity.

- .2 Refer to Architectural drawings and specifications for requirements and conform there to.
- .3 Where access doors are located in surfaces where special finishes are required, they shall 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.
- .4 Supply access doors in inaccessible construction to give access to all concealed junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Wire and Cables | Section 26 05 21 |
| .3 | Outlet Boxes and Fittings | Section 26 05 32 |
| .4 | Conduit | Section 26 05 34 |
| .5 | Wiring Devices | Section 26 27 26 |

1.2 SYSTEM DESCRIPTION

- .1 Make all required electrical connections to devices, equipment, appliances, etc., furnished by other trades or Owner, as indicated or implied on the drawings or in the specifications.
- .2 Provide and install miscellaneous electrical components where required.

1.3 COORDINATION

- .1 Verify electrical supply characteristics of all equipment prior to rough-in. Report any discrepancies immediately. Revise wire sizing, device type, connection type, breaker size, etc., as required to accommodate the electrical supply characteristics of the equipment supplied by other trades.

2 PRODUCTS

2.1 GENERAL

- .1 Provide all required electrical devices, components, conduits, fittings, wiring, disconnects, and miscellaneous equipment to make all connections to equipment.
- .2 Be familiar with the apparatus being supplied and carefully coordinate and cooperate with the supplier/installer to ensure a proper and complete installation.

2.2 RECEPTACLES

- .1 Where equipment has line cord and plug, ensure cap is compatible with receptacle. Provide cordsets to equipment where required.

2.3 HEAT TRACING CABLES

- .1 Heating tracing cable for pipes to be self-limiting type rated at 10 watts/foot.
- .2 Voltage and length as indicated.
- .3 Provide cold lead connection kit and locate as indicated.

- .4 Supply and install Ground Fault circuit Interrupters for all power and branch circuits of the heat tracing cables.
- .5 Electrical Contractor shall supply and install cables to manufacturer's recommendations.
- .6 Acceptable manufacturer: Thermon.

3 EXECUTION

3.1 EQUIPMENT SUPPLIED BY OTHER TRADES OR OWNER

- .1 Wire and connect all equipment requiring an electrical connection. Install disconnect switches where required.
- .2 Provide a direct connection or receptacle and cord set to suit hook-up requirements of each piece of equipment. Confirm connection method with Owner or General Contractor.

3.2 TUBS, TUB LIFTS, WHIRLPOOLS, HYDROMASSAGE, ETC. (Where Applicable)

- .1 Wire and connect all components and controls. Provide timer-switch for equipment heat lamps.
- .2 Supply and install Ground Fault circuit Interrupters for all power and branch circuits (as required by Canadian Electrical code 68-300 regulations and local authority having jurisdiction.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

.1	Conduits, Conduit Fastenings	Section 26 05 34
.2	Connectors and Terminations	Section 26 05 22
.3	Communication Systems	Section 27 05 13
.4	Data Cable Raceway System	Section 27 05 14

2 PRODUCTS

2.1 BUILDING WIRES

- .1 Copper conductors: size as indicated, with 300V or 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .2 All wiring in conduit.
- .3 Minimum wire size #12 AWG, copper.
- .4 Use #10 for runs longer than 45m (15A branch circuits).
- .5 Use of #14 BX, Cu is permitted only in residential suites.
- .6 Use of Teck/AC90 Cu or NUAL is permitted for residential suites feeders (above 100A).

2.2 ALUMINUM SHEATHED CABLE

- .1 Conductors: copper, size as indicated.
- .2 Insulation: type RA90 rated 600V.
- .3 Sheath: aluminum applied to form continuous corrugated sheath.
- .4 Outer jacket of pvc applied over sheath. Jacket to have LFS/LGE rating FT-4 in accordance with CSA 22.2 No. 0.3-M1985, FT-6 rating if cable installed in plenums .
- .5 Fastenings for aluminum sheathed cable:
 - .1 One hole aluminum straps to secure surface cables 25 mm and smaller. Two hole aluminum straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
 - .2 Channel type supports for two or more cables at 1.5 mm centers.
 - .3 Nine mm diam threaded rods to support suspended channels.

3 EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.
 - .2 Only cables/wires in totally enclosed noncombustible raceways are permitted to penetrate a fire rated/fire-resistance assembly.

3.2 INSTALLATION OF ALUMINUM SHEATHED CABLE

- .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 22 - Connectors & Terminations.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Wires and Cables Section 26 05 21
- .2 Grounding Section 26 05 28

1.2 SHOP DRAWING AND DATA

- .1 Submit product data in accordance with section 26 05 01.

1.3 INSPECTION CERTIFICATE

- .1 Obtain Inspection Certificate of Compliance covering high voltage connections from inspection authority and include in Maintenance manuals.

2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel compression connectors as required, sized for conductors.
- .2 Heat shrink termination kits for connectors.

3 EXECUTION

3.1 INSTALLATION

- .1 Install terminations in accordance with manufacturer's instructions.
- .2 Bond and ground as required

END OF SECTION

1 GENERAL

1.1 RELATED WORK

.1	Basic Electrical Materials and Methods	Section 26 05 01
.2	Wire and Cable	Section 26 05 21
.3	Conduit	Section 26 05 34
.4	Main Distribution	Section 26 24 13
.5	Panelboards	Section 26 24 17

1.2 REFERENCES

- .1 Ground equipment to: CSA C22.2 No.41.
- .2 Copper grounding conductors to: CSA G7.1.

2 PRODUCTS

2.1 EQUIPMENT

- .1 Grounding conductors system, circuit and equipment, grounding to be bare standard copper, sized in accordance with the Canadian Electrical Code.
- .2 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to;
 - .1 grounding and bonding bushings
 - .2 protective type clamps
 - .3 bolted type conductor connectors
 - .4 thermit welded type conductor connectors
 - .5 bonding jumpers, straps
 - .6 pressure wire connectors.

3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous, system and circuit, grounding systems including electrodes, conductors, connectors and accessories to conform to requirements of local authority having jurisdiction over installation.
- .2 Install connectors to manufacturer's instructions.

- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs. Soldered joints not permitted.
- .6 An artificial grounding electrode shall be provided to suit the requirements of the local inspection authorities.
- .7 Install bonding wire for flexible conduit, connected to both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor, to exterior pole mounted luminaries.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armored cables to cabinet at supply end, and provide non-metallic entry plate at load end and run separate ground conductor.
- .11 Provide separate ground conductors in PVC conduit, plastic or fibreglass raceways, metal conduit and EMT.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral points of 600V and 208V systems.
- .2 Connect isolated ground buses as indicated to “Y” point of transformer immediately upstream of panel. Connection shall be via insulated green ground wire in conduit. Minimum Size #2/0.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to: service equipment, transformers, frame of motors, motor control centers, starters, control panels, building steel work, generators, elevators distribution panels, outdoor lighting.

3.4 COMMUNICATION SYSTEM

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
 - .1 provide telephone grounding system in accordance with the utilities requirements
 - .2 sound, fire alarm, intercommunication systems, as indicated.

3.5 TESTS

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the local inspection authority. A report shall be submitted to the consultant from the testing agency.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator, if provided, during tests.
- .5 A ground electrode with an unsatisfactory resistance test result shall be altered as necessary until the required resistance reading is achieved.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|----------------|------------------|
| .1 | Wires & Cables | Section 26 05 21 |
| .2 | Conduits | Section 26 05 34 |

2 PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended as indicated.

3 EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to masonry with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.
- .5 Support 2 or more cables or conduits on channels supported by 9 mm dia. threaded rod hangers at 1.5m OC where direct fastening to building construction is impractical.
- .6 Group conduits on support channels in all corridor ceilings.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support

except with permission of other trade and approval of Engineer.

- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Conduits | Section 26 05 34 |
| .3 | Fastenings and Supports | Section 26 05 29 |

2 PRODUCTS

2.1 LOCATION

- .1 Locate splitters, junction and pullboxes as indicated or as needed for each system.

2.2 SPLITTERS

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

2.3 JUNCTION AND PULLBOXES

- .1 Sheet steel construction with screw-on flat covers for surface or recessed mounting.
- .2 Covers with 1" (25 mm) minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Cast-type with gasketed covers where exposed to weather.

2.4 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface-mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 3/4" (19 mm) GIS fir plywood backboard. Cabinets to be flush or surface-mounted as indicated.
- .3 Provide other systems' cabinets as specified in Divisions 26, 27 and 28 and located on the electrical drawings.

3 EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Install splitters as indicated and mount plumb, true and square to the building lines.

- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.
- .3 Use splitters only where indicated on the drawings.

3.2 JUNCTION PULLBOXES AND CABINETS

- .1 Install pullboxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 74" (1.9 m) above finish floor.
- .3 Install terminal blocks, as indicated.
- .4 Provide pullboxes in conduit runs as described in Section 26 05 34.
- .5 Boxes and cabinets to be installed plumb and square with building lines.
- .6 Install junction and pullboxes clear of all mechanical ductwork and piping.

3.3 IDENTIFICATION

- .1 Identify splitters with Size 5 nameplates.
- .2 Identify junction and pullboxes with Size 1 nameplates.
- .3 Identify cabinet with Size 5 nameplates.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Wiring Devices Section 26 27 26

1.2 REFERENCE STANDARDS

- .1 CSA C22.1 Canadian Electrical Code, Part 1.

2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.

2.2 CONDUIT BOXES

- .1 Cast FS or FD ferrous alloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.3 FITTINGS GENERAL

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

3 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

- .3 Provide correct size of openings in boxes for conduit and aluminum sheathed cable connections. Reducing washers are not allowed.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Fastenings and Supports Section 26 05 29

1.2 LOCATION OF CONDUIT

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Electrical Subcontractor to produce layout sketches of conduit runs through mechanical and electrical service areas in order to pre-avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

2 PRODUCTS

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT), with couplings: size as indicated. Minimum size 3/4" (19mm).
- .2 Liquid-tight flexible metal conduit: size as indicated, for equipment with vibrational aspects only.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 1 1/4" (32 mm) and smaller. Two hole steel straps for conduits larger than 1 1/4" (32 mm).
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 U-channel type supports for two or more conduits at 60" (1.52 m) intervals (surface-mounted or suspended). 4 1/4" (6 mm) diameter threaded rods to support suspended channels. One rod shall be non-ferrous.

2.3 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduit specified.
- .2 Manufacturer elbows where 90° bends are required for 2" (53 mm) and larger conduits.
- .3 Die cast set screw connectors and couplings. Insulated throat liners on connectors.
- .4 Raintight connector fittings, complete with O-rings, for use on weatherproof or sprinklerproof enclosures. Raintight couplings to be used for surface conduit installations exposed to moisture or sprinkler heads. Raintight connectors shall be used for all top entries to panels, contactors and motor control centres.

3 EXECUTION

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use electrical metallic tubing (EMT) except where noted otherwise.
- .4 Wiring home runs to panels and main branch wiring runs in ceiling spaces to be run in conduit. Wiring drops from conduit systems into boxes for wiring devices in steel stud partitions may be wired with AC-90. AC-90 drops to light fixtures shall not run horizontally more than 5' (1.5 m) from conduit system junction boxes in ceiling space. AC-90 drops from conduit system in the ceiling space to feed outlets in steel stud partitions shall not run more than 5' (1.5 m) horizontally from the ceiling outlet box to the point where the AC-90 drops vertically into the partition. Where the total length of AC-90 is greater than 3m in the ceiling, provide conduit to a junction box closer to drop location.
- .5 Use liquid-tight flexible metal conduit for connection to motors, transformers and equipment subject to movement or vibration. Provide a separate insulated grounding conductor within flexible conduit.
- .6 All wiring under computer floors shall be in liquid-tight flexible metal conduit, or teck cable, where indicated.
- .7 Motor connections (use liquid-tight flexible metal conduit only) shall not exceed 6' (1.83m) except where expressly allowed by the Consultant.
- .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Install polypropylene fish cord in empty conduits.
- .10 Install two 1" (25 mm) spare conduits to tenant ceiling space from each panelboard, cabinet, annunciator, etc. Terminate these conduits in 6" x 6" x 4" (150 x 150 x 100 mm) junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in a flush concrete-type box with extension ring.
- .11 Where conduits become blocked, remove and replace blocked section.
- .12 The length of any conduit run shall not exceed 150' (45 m) and no conduit run shall have more than four 90° bends (or equivalent) before a pullbox is installed. Pullboxes shall be installed in accessible ceiling spaces. Conduits shall be supported within 12" (300 mm) of entering any junction box, pullbox, cabinet, or panelboard.

- .13 Conduit to be sized as per Canadian Electrical Code or as shown on drawings. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit at no extra cost.
- .14 Provide and install separate ground wire in all conduits.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not locate conduits within 78" (2 m) of infrared or gas-fired heaters.
- .3 Group conduits wherever possible on suspended or surface channels.
- .4 Do not pass conduits through structural members, except as indicated.
- .5 Do not locate conduits less than 6" (150 mm) to steam or hot water lines.

3.3 CONCEALED CONDUITS

- .1 Do not install conduit home runs horizontally in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings, unless otherwise indicated.

3.4 CONDUIT IDENTIFICATION

- .1 Color code coverplates of junction boxes in conduit systems shall match owner/facility standard or if none exists as per the color code list below.
- .2 Color code by spray painting the coverplate on each junction box in the conduit run.
- .3 In addition to color coding coverplates on junction boxes with power wiring, the circuits being run in the box shall be identified on the inside coverplate with permanent felt marker.
- .4

120/250V Normal Power	yellow
120/250V Emergency Power	fluorescent red
347/600V Normal Power	orange
347/600V Emergency Power	fluorescent orange
Fire Alarm	red
Data/Voice	blue
Security	white
Controls	brown

Provide 50mm wide colour coded tape on all conduits at 3.5m centres.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Basic Electrical Materials and Methods Section 26 05 01

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 26 05 01.

2 PRODUCTS

2.1 WIREWAYS (TELEPHONE DISTRIBUTION)

- .1 Sheet steel with hinged cover to give uninterrupted access.
- .2 Cross-section dimensions: 2 1/2" x 2 1/2" (64 x 64 mm) or 4" x 4" (100 x 100 mm) or or 6" x 6" (150 x 150 mm) as indicated.
- .3 Finish: baked grey enamel.
- .4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.
- .5 Acceptable manufacturers: Pursley, Square D, and Pilgrim.

2.2 WIREWAYS (POWER AND COMMUNICATION)

- .1 Formed steel with snap-on cover to give uninterrupted access.
- .2 Cross-section dimensions: 1 3/4" x 4 1/4" (45 x 107 mm).
- .3 Finish: standard grey.
- .4 Inside elbows, tees, couplings, clips, device plates and fittings manufactured as accessories to wireway supplied.
- .5 Barriered, as indicated, for power wiring and communication wiring. Non-barriered, as indicated, for power only or communications only.
- .6 Telephone outlets in wireways to have a 1/2" (13 mm) I.D. grommet hole.
- .7 Receptacle outlets in wireways to be one piece with mounting straps taped for standard devices.
- .8 Acceptable manufacturers: Wiremold.

3 EXECUTION

3.1 INSTALLATION

- .1 Install wireways in lengths and configurations as indicated.
- .2 Install power and telephone feed-in connections as indicated.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers in the full length of wireways, where required.
- .5 Install devices, wire and make connections.
- .6 Install device plates and snap-on cover.
- .7 Provide wire markers on individual wires in power wireways indicating circuit number.
Markers to be installed every 40" (1 m).
- .8 Provide Lamacoid nameplates on all system Wireways.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Wire and Cable | Section 26 05 21 |
| .3 | Conduits | Section 26 05 34 |

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 26 05 01.

2 PRODUCTS

2.1 CONDUIT

- .1 Heavy wall rigid PVC conduits, size as indicated.
- .2 FRE duct, size as indicated.
- .3 Provide pull boxes as required. Install underground pull box minimum every 200 feet unless otherwise approved. Coordinate location of pull boxes before rough-in.

2.2 FITTINGS

- .1 Rigid PVC opaque solvent welded type watertight couplings, bell end fittings, plugs, caps adaptors, as required to make complete installation.
- .2 Expansion joints as required.
- .3 FRE duct couplings, bends, adapters, caps, etc., as required.

2.3 GROUNDING

- .1 Provide a separate insulated ground wire in each PVC or FRE conduit run.

2.4 DIRECT BURIED SINGLE AND MULTI-CONDUCTOR CABLES

- .1 Single conductor and multi-conductor direct buried cables to Section 26 05 21.

2.5 WIRE

- .1 Wire in conduit to Section 26 05 21.

3 EXECUTION

3.1 INSTALLATION

- .1 Conduits and multi-conductor cables to be laid out and spaced appropriately.
- .2 Single conductor cables to be spaced 6" (150 mm) apart.
- .3 Install sand 6" (150 mm) below and 6" (150 mm) above cables and conduits.
- .4 Install conduit with watertight couplings. Make transitions, offsets and changes in direction using 5° bend sections. Do not exceed a total of 20° with conduit offset. Clean conduits before laying. Cap ends of conduits during construction and after installation to prevent entrance of foreign materials. Install pull cords in empty conduits.
- .5 Install continuous overlapping cuprinol-treated planking 6" (150 mm) above cables and conduits before backfilling. Install continuous yellow marker tapes 6" (150 mm) above treated planking.

3.2 INSPECTIONS

- .1 Advise Consultant that he may inspect cable and conduit installation prior to backfilling.

3.3 AS-CONSTRUCTED DRAWINGS

- .1 Include on As-Constructed Drawings, exact dimensioned position and routing of all underground cable feeders, pullboxes, etc.

3.4 COORDINATION

- .1 Coordinate underground installations with Utilities (including underground work of other trades) before commencing any work.
- .2 Coordinate underground installation with other trades before commencing any work.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Mechanical Specifications
- .2 Basic Electrical Materials and Methods Section 26 05 01
- .3 Wire and Cable Section 26 05 21
- .4 Outlet Boxes and Fittings Section 26 05 32
- .5 Conduits Section 26 05 34

1.2 SYSTEM DESCRIPTION

- .1 Provide complete electrical power and control connections for mechanical equipment, except as noted herein, or as noted on the drawings.

2 PRODUCTS

2.1 MATERIALS

- .1 Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.
- .2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical, line voltage temperature/humidity control systems.
- .3 Unless otherwise noted, motors and control devices shall be supplied by Mechanical Division/Contractor. Motor horsepower ratings shall be as shown in the Mechanical Division specifications. Motor voltage and phase ratings shall be as shown on the Electrical Division drawings.
- .4 Provide the Mechanical Contractor with a copy of the Motor Schedule and ensure conformance with voltage shown. Additional prints of Motor Schedule will be made available by the General Contractor.

3 EXECUTION

3.1 POWER WIRING

- .1 Install power feeders, starters, disconnects, and associated equipment and make connections to all mechanical and pool equipment.
- .2 Install branch circuit wiring for mechanical system control panels, time clocks, and control transformers.

- .3 Install main power feeders to starter/control panels furnished by mechanical Divisions. Install branch wiring from starter/control panels to controlled equipment such as motors, electric coils, etc.
- .4 Flexible connections to motors shall not exceed 6 feet (1.83 m), unless approved by Consultant.

3.2 CONTROLS

- .1 Install all electrical controls in accordance with Motor Schedule Equipment list.
- .2 Wire and connect float switches, pressure switches, alternators, alarms, etc. for sump pumps, sewage pumps, domestic hot water, recirculating pumps, booster pumps, jockey pumps and compressors.
- .3 Wire and connect line voltage remote thermostats and P/E switches for furnaces, condensing units, force flows, gas-fired unit heaters, electric heaters and rooftop units.
- .4 In general conduit, wire, devices and fittings required to wire and connect low voltage controls which are an integral part of the trade supplying the packaged unit, unless otherwise indicated. Control wiring shall be installed in conduit.

In general: conduit, wire, devices and fittings required to wire and connect low voltage temperature control systems, shall be supplied and installed by the trade supplying the temperature control system. Control wiring shall be installed in conduit.

3.3 COORDINATION

- .1 Refer to Mechanical Drawings for the exact location of motor control devices, and mechanical equipment requiring an electrical connection.
- .2 Obtain full information from Mechanical Divisions, regarding wiring controls, overload heaters, equipment ratings and over-current protection. Notify the Mechanical Subcontractor, at once, if any information provided is incorrect or unsatisfactory.
- .3 Coordinate control wiring requirements with Mechanical Divisions and provide all control wiring and connections as required to make the control systems operate as specified.
- .4 Refer to Mechanical Division specifications for any further electrical requirements.
- .5 Review both electrical and mechanical drawings and specifications and coordinate all controls with Mechanical Subtrades through General Contractor. Report all discrepancies to both Mechanical and Electrical Consultants before close of tender. No additional money will be justified for assumptions made on any duplication of information.

- .6 Submit to General Contractor, as part of the tender submission, a list of controls and wiring to be provided in the Electrical Contract.

END OF SECTION

1 GENERAL

1.1 SCOPE OF WORK

- .1 All equipment specified in Section 26 05 94 to be provided, wired and installed by Electrical Contractor, unless otherwise noted.

1.2 PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Product data to include:
 - .1 Element replacement data.
 - .2 Mounting methods.
 - .3 Auxiliary controls.
 - .4 Finish.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Controls.

2 PRODUCTS

2.1 MINIMUM REQUIREMENTS FOR SPACE HEATERS (UNIT AND FORCE FLOW HEATERS)

- .1 Built-in overheat protection.
- .2 18 gauge steel construction. (16 gauge front cover).
- .3 Heater assembly to be easily removable.
- .4 Finish in white.
- .5 Wall mounted. (Approx. 7" above finished floor).
- .6 Front inlet and outlet. (Sloped outlet for Dura convector).
- .7 Architectural style, rounded corners.
- .8 Elements: stainless steel, free floating.
- .9 347 volt, 208 volt, single phase, as noted on drawings.

- .10 Size as indicated on drawings.

2.2 BASEBOARD HEATERS

- .1 Standard watt density.
- .2 347V, 208V, single phase, as noted on drawings.
- .3 Built in thermostats. Tamperproof in public areas.
- .4 Refer to drawings for quantity and wattage of each unit.
- .5 Equal to Chromalox BN series.

2.3 ACCEPTABLE MANUFACTURERS

- .1 Chromalox
- .2 Westcan.
- .3 Stelpro.
- .4 Ouellet.
- .5 Qmark

2.4 WARRANTY

- .1 Replace any heater, relay or thermostat which malfunctions within one year from project acceptance by Owner.

3 EXECUTION

3.1 INSTALLATION

- .1 Mount electric heaters on wall as indicated. Provide additional supports or braces as required to suit application.
- .2 Provide power connection.
- .3 Commission, test and demonstrate operation.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements for commissioning of electrical equipment systems.
- .2 Related Sections:
 - .1 Section 019113 General Commissioning
 - .2 Section 220800 Commissioning of Plumbing
 - .3 Section 238000 Commissioning of HVAC

1.2 INTENT

- .1 Provide commissioning of electrical equipment and systems in accordance with this, Section 019113 and related sections.

1.3 MANUFACTURER'S SERVICE ON SITE

- .1 Arrange and pay for qualified Manufacturer's representatives to supervise starting and testing of following electrical equipment and systems:
 - .1 Telephone Equipment System
 - .2 Security System
- .2 Use manufacturers factory trained personnel where required to maintain manufacturer's warranty.
- .3 Maintain documentation of all equipment start-up and commissioning and provide to Commissioning Agent.

1.4 REFERENCE DOCUMENTS

- .1 Perform tests in accordance with:
 - .1 These Contract Documents.
 - .2 Requirements of authorities having jurisdiction.
 - .3 Manufacturer's published instructions.
 - .4 Applicable CSA, IEEE, IPCEA, EEMAC, NEMA and ASTM standards.

1.5 CONTRACTOR AND MANUFACTURER REPORTS

- .1 Arrange for Manufacturer to submit copies of all production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment to the Consultant prior to shipping.

1.6 TESTING QUALIFICATIONS

- .1 Arrange and pay for services of testing agent(s) to perform tests and verifications specified in this Section that are not within the capabilities of the Contractor.
- .2 Required Testing Qualifications:

- .1 Minimum of five years experience in the maintenance and testing of electrical equipment and systems at all voltage levels up to and including 25 kV class.
- .2 The Contractor will be responsible for appointing a verification agent to direct verification of fire alarm system in accordance with:
 - .1 CAN/ULC-S537, "Standard for Verification of Fire Alarm System Installations"
 - .2 Requirements of authority having jurisdiction in the province of Saskatchewan.

2 PRODUCTS

- .1 None

3 EXECUTION

3.1 GENERAL

- .1 Commission all equipment and systems installed as part of this contract. Typical required information or actions are listed below for each equipment or system.
- .2 Provide check sheets for equipment not listed in this section.
- .3 Document the commissioning process by completing the Component Verification Forms, System Tests and Integrated System Tests.

3.2 MAIN DISTRIBUTION SWITCHGEAR

- .1 Enclosure:
 - .1 Visually inspect.
 - .2 Torque all bus connections to Manufacturers requirements and seal with red lacquer.
 - .3 Megger test main bus at 1000 V.
 - .4 Check phasing and continuity of horizontal and vertical bus. This includes phasing and phase rotation of two incoming services or supplies.
- .2 Wiring Checks:
 - .1 Check all control, relaying and instrumentation wiring against vendor wiring schematics, three line diagrams, and project specifications.
 - .2 Test each circuit for continuity using a buzzer or similar device.
 - .3 All current circuits shall be injected, all voltage circuits shall be powered at 120 Volts, all devices functioned and checked against control schematic diagram.
 - .4 Check polarity and verify phase relationships on all three phase metering circuits.
 - .5 Where errors are discovered and changes are required, mark up and note required corrective action on vendor prints.
- .3 Instrumentation:
 - .1 Test and calibrate all meters in accordance with Manufacturers bulletins.

- .2 Check calibration on all ammeters using 5 Amp secondary injection test.
- .3 Perform wiring checks as listed above.
- .4 Breakers - Industrial Air Circuit Breakers:
 - .1 Visually inspect.
 - .2 Clean and lubricate.
 - .3 Contact resistance (ductor) test and adjust contacts.
 - .4 Insulation resistance (Megger) test.
 - .5 Mechanical function test.
 - .6 Electrical function test.
 - .7 Test and calibrate, to settings provided, all elements of solid state trip unit as follows:
 - .1 Inspect and test in accordance with Manufacturer's most recent installation and maintenance brochure.
 - .2 Perform tests using Manufacturer's relay test unit as applicable, with corresponding test instruction.
 - .3 If the Manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.
 - .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.
 - .5 Check C/T and P/T ratios.
- .5 Fused Disconnect Switches:
 - .1 Visually inspect and clean.
 - .2 Ductor test across switch blade contact surfaces.
 - .3 Megger test.
 - .4 Mechanical function test.

3.3 DISTRIBUTION PANELS

- .1 Enclosure:
 - .1 Visually inspect.
 - .2 Torque all bus connections.
- .2 Breakers:
 - .1 Visually inspect.
 - .2 Ductor test.
 - .3 Megger test.
 - .4 Mechanical function test.
 - .5 Set all units with adjustable magnetic trip units.
 - .6 Where solid state protection is provided with large breakers, test units as follows:
 - .1 Inspect and test in accordance with Manufacturer's most recent installation and maintenance brochure.
 - .2 Perform tests using Manufacturer's relay test unit as applicable, with corresponding test instruction.

- .3 If Manufacturer's tester is not available, use an approved relay tester unit with the proper test data and test accessories.
- .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.
- .5 Check C/T and P/T ratios.

3.4 PROTECTIVE RELAYING

- .1 Set and test protective relays according to Manufacturer's instructions.
- .2 Perform tests using Manufacturer's relay test unit as applicable, with corresponding test instructions.
- .3 If Manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.
- .4 Test all possible combinations of distribution failure and confirm that protective relaying logic is functioning properly.
- .5 Ensure logic diagrams are provided for the Commissioning Binder.

3.5 ELECTRICAL START-UP AND TESTING

- .1 Energizing Main Electrical System:
 - .1 Prior to energizing main electrical system:
 - .1 Verify supply authority voltage and phase rotation.
 - .2 Ensure all testing as specified in Section 26 05 01 has been completed and deficiencies have been corrected.
 - .3 Megger test all feeders and record results on approved test report forms.
- .2 Testing of Wiring and Wiring Devices:
 - .1 Test conductors at distribution centres and panelboards for insulation resistance to ground (megger test).
 - .2 Test service grounding conductors for ground resistance.
 - .3 Test all wiring devices for correct operation and circuitry.
- .3 Ground Resistance Testing:
 - .1 Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4-1982 and Canadian Electrical Code.
- .4 Load Balance Testing:
 - .1 Perform load tests with as many building loads on as possible prior to Interim Acceptance.
 - .2 Test load balance on all feeders at distribution centres, motor control centres and lighting panelboards.
 - .3 If load unbalance exceeds 15%, reconnect circuits to balance loads. Revise panelboard directories and wiring identification accordingly.
- .5 Power Factor Testing:

- .1 Record power factor readings at 15 minute intervals for full 72 hour period during a normal work week, once during summer with HVAC operating and once during winter.
- .2 Take readings at the following locations on power distribution system:
 - .1 Main Breaker.
 - .2 Feeder breakers which control large motor loads (e.g. chillers).
- .6 Voltage Testing and Adjusting:
 - .1 Test voltage at service entry point, motor control centres and secondary of transformers above 45 kVA. Record voltages at Interim Acceptance for a period of ten hours (07:00 to 17:00) during a normal work day.
 - .2 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by the Owner.
- .7 Starting Motors:
 - .1 Prior to starting motors:
 - .1 Confirm motor nameplate data with motor starter heater overloads, setting of MCPs and sizing of fuses.
 - .2 Verify rotation.
 - .3 Ensure disconnects are installed.
 - .4 Confirm labelling of motors, disconnects and starters.
 - .2 Measure and record operating load amp readings for all three phase motors.

3.6 LIGHTING

- .1 Function test all light switches, luminaries, dimmers and lighting control equipment.
- .2 Record all photocell and time-clock settings.
- .3 Prior to energizing lighting dimming system, ensure Manufacturer has checked all equipment and wiring for proper installation and termination. Manufacturer to check that all pre-set levels are set and operate as specified.
- .4 Check operation of all emergency lighting units, exit lights and connection of exit lights to emergency power as specified.
- .5 Verify that correct lamps and ballasts have been used.
- .6 Record lighting levels for typical rooms and specialized areas.
- .7 Confirm operation of battery operated emergency lighting units including battery size and operating time.
- .8 Confirm operation of exit lights and connections of exit lights to emergency lighting panels.
- .9 Check all terminations and label all lighting circuits.

3.7 WIRING AND WIRING DEVICES

- .1 Test all receptacles for proper polarity.

- .2 Verify panelboard directories and branch circuit designations as indicated on record drawings, directories and lamicoïd labelling.

3.8 VOICE AND DATA CABLE TESTING

- .1 Test all runs upon completion of permanent terminations, using instrumentation acceptable to the Owner. Before commencing testing, submit sample test data sheet(s) and information with respect to test instrumentation to be used.
- .2 Copper Media:
 - .1 Test for the following:
 - .1 Continuity.
 - .2 Pair placement and polarity.
 - .3 DC resistance.
 - .4 Characteristics at highest contemplated frequency Hz:
 - .1 Attenuation - data cable.
 - .2 Mutual Capacitance - data cable.
 - .3 Near-end crosstalk (NEXT) - data cable.
 - .4 Run length.
 - .2 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of the predicted value. Retest runs with:
 - .1 Resistance and capacitance readings more than [10% above [or below] predicted values.
 - .2 NEXT values [5 dB] higher than predicted values.
 - .3 Attenuation values [2 dB] higher than predicted values.
- .3 Reconnect or re-install and retest as necessary to correct excessive variations.
- .4 Check installation of all equipment.
- .5 Ensure all cables are properly identified at each end and correctly terminated prior to testing.

3.9 FIRE SAFETY SYSTEMS

- .1 Prior to requesting verification of Fire Alarm system by Contractor, Verification Agent, and Fire Safety system Manufacturer's technical staff shall:
 - .1 Inspect system in conjunction with the Manufacturer to ensure that Fire Alarm system is correctly installed, connected and fully operational in accordance with requirements of the Contract Documents and Manufacturers recommendations. This includes all auxiliary equipment connected to fire alarm system such as elevators, central station tie-in, fan shut-down, sprinklers, door hold-open devices, etc.
 - .2 Ensure that any subsequent work remaining to be performed on the above noted items will not invalidate examinations and test performed during verification procedure.
 - .3 Ensure that operation and maintenance data has been submitted.
 - .4 Ensure that spare parts and maintenance materials have been delivered.

- .2 Certify to the Owner in writing that above prerequisites have been fulfilled and specifying known exceptions in the form of a list of items to be completed or corrected, prior to proceeding with verification.
- .3 The Owner will proceed with verification, or advise Contractor that prerequisites are not adequately fulfilled.
- .4 Fire Alarm Verification:
 - .1 Assist and co-operate with the Owner in verification procedure.
 - .1 Provide following equipment:
 - .1 Velometer.
 - .2 Artificial Smoke.
 - .3 Rate of Rise Heat Detector Tester.
 - .2 Do not proceed with verification unless the following parties are present at all times during verification procedure:
 - .1 Electrical Contractor.
 - .2 Fire Alarm System Manufacturer's Representative.
 - .3 Owner's verification representative.
 - .3 Disassemble and reassemble system components.
 - .4 Disconnect and reconnect wiring.
 - .5 Perform required field adjustments.
 - .6 Repair defective work and replace defective components.
 - .7 Perform all other work on system required by verification procedure.

3.10 SECURITY SYSTEM

- .1 Prior to function testing of system, perform following in conjunction with Manufacturer:
 - .1 Ensure all equipment is properly installed and all terminations completed.
 - .2 Verify wiring of all magnetic locks, door contacts and card readers.
 - .3 Ensure all programming is complete and software is performing correctly.
 - .4 Confirm operation of each door. Check door contacts, proper latching of magnetic locks, card operation and exit pushbuttons.
 - .5 Confirm correct labelling of doors on annunciators, CRT monitor and in programming.
 - .6 Confirm system programming and printer operation.
 - .7 Check remote alarming via automatic diallers.
- .2 Manufacturer shall function test system in presence of the Owner as follows:
 - .1 Door Supervision System:
 - .1 Check installation and operation of all door contacts and control panels, including automatic dialler, if specified.
 - .2 Confirm proper door labelling on all annunciators and main control.
 - .3 Confirm operation of each door. Check door contacts, proper latching of magnetic locks, card operation and exit pushbuttons.
 - .2 Card Access System:
 - .1 Check installation of all equipment.
 - .2 Confirm operation of each card reader.

- .3 Check all interconnections with other systems.
- .3 Confirm correct labelling of all door security and access control equipment on annunciators, CRT monitor and in programming.
- .4 Confirm system programming and printer operation.
- .5 Check remote alarming via automatic diallers.
- .6 Record results on approved test report forms.

3.11 ELECTRICAL EQUIPMENT AND SYSTEMS DEMONSTRATION AND INSTRUCTION

- .1 Provide operation and maintenance instruction and demonstrations in accordance with Section 019113.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Contactors Section 26 29 01

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

2 PRODUCTS

2.1 EQUIPMENT

- .1 Enclosure constructed with minimum 14 gauge cold rolled steel, pad-lockable, flush mounted, finished with ASA 61 Grey baked enamel inside and outside.
- .2 Inner panel, 12 gauge, baked enamel, white.
- .3 Terminal blocks:
 - .1 Design base: Wiedmueller, SAK series.
 - .2 Acceptable materials: Wiedmueller, Allen Bradley, Schneider Canada or GE.
- .4 Lighting Contactor:
 - .1 20 amp, 4 pole, 600 volt rated (multiple 4 pole as required).
 - .2 Control transformer coil: 120 volt and fuse.
 - .3 Mount on inner panel.
 - .4 Design base: Cutler Hammer CN35 Series.
 - .5 Acceptable materials: Cutler Hammer, Allen Bradley, or Schneider Canada or GE.
- .5 Selector switch mounted inside: HAND-OFF-AUTO:
 - .1 Heavy duty Cam type.
 - .2 Acceptable materials: Klockner Moeller, Allen Bradley, Schneider Canada or GE.

3 EXECUTION

3.1 INSTALLATION

- .1 Terminate all conductors to terminal blocks.
- .2 Mount as indicated near breaker panelboard for control of outdoor building lights.
- .3 Provision for additional supports as required.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Wire and Cable | Section 26 05 21 |
| .3 | Grounding | Section 26 05 28 |
| .4 | Conduit | Section 26 05 34 |
| .5 | Circuit Breakers | Section 26 28 21 |

1.2 DESCRIPTION OF EQUIPMENT

- .1 Main distribution board incorporates service entrance cable connection section, main breaker complete with built-in ground fault, utility metering transformer compartment, sub-feeder distribution section and customer metering section, factory assembled in one enclosure.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Submit Short Circuit Coordination and Arc Flash Analysis study prior or at the same time with shop drawing submission.
- .3 Indicate:
- | | |
|----|--|
| .1 | Floor anchoring method and foundation template. |
| .2 | Dimensioned cable entry and exit locations. |
| .3 | Dimensioned position and size of bus. |
| .4 | Overall length, height and depth. |
| .5 | Dimensioned layout of internal and front panel mounted components. |
| .6 | Shipping sections and weights. |
- .4 Switchboard manufacturer to provide a coordination and short circuit study and submit to Consultant with switchboard shop drawings:
- | | |
|----|--|
| .1 | Manufacturer to obtain available fault current (at the customer connection point) from Electric Utility Co. |
| .2 | Manufacturer to make all calculations, provide a complete report with separate statement confirming the following: |
| .1 | Upstream Utility fusing and Utility fault level; |
| .2 | Interrupting capacity of breakers being supplied; |

- .3 Provide device coordination curves for utility transformer and fusing, main breaker, main distribution, largest breaker, smallest breaker and 600:120/208 dry type transformers (75kVA and larger), largest motor.
- .4 Summarize the study with a statement confirming device ratings are compatible with available short circuit and distribution equipment being provided. Confirm equipment is protected by respective breakers and comment on overall coordination.
- .5 Provide Arc Flash Study/Analysis in accordance with section 26 05 02

1.4 MAINTENANCE DATA

- .1 Provide data for incorporation into Maintenance Manual specified in Section 26 05 01.

1.5 MAINTENANCE MATERIALS

- .1 One set spare parts as recommended by manufacturer.
- .2 Fuses:
 - .1 3 fuses for each type above 600A.
 - .2 6 fuses for each type up to and including 600A.

1.6 SOURCE QUALITY CONTROL

- .1 Refer to Section 26 05 01.

2 PRODUCTS

2.1 MATERIALS

- .1 Service entrance board: to CSA C22.2 No.31.
- .2 Molded case circuit breakers: to CSA C22.2 No.5.
- .3 Fuse holder assemblies: to CSA C22.2 No.39.
- .4 HRC Fuses: to CSA C22.2 No.106.
- .5 Meters: to CSA C17.
- .6 Meter mounting devices: to CSA C22.2 No.115.
- .7 Analogue instruments: to ANSI C39.1.
- .8 Instrument transformers: to CSA C13.
- .9 Equipment shall be as manufactured by Schneider Canada, Cutler Hammer or Siemens.

2.2 POWER SUPPLY

- .1 Power supply: 3 phase, 4 wire, grounded neutral, 60 Hz, short circuit current rated at 65 KA RMS symmetrical, voltage as indicated on the drawings.

2.3 SERVICE ENTRANCE SWITCHBOARD

- .1 Ampere rating: as indicated on the drawings.
- .2 Enclosure:
 - .1 Free-standing, totally enclosed sheet steel, 'sprinklerproof' enclosure with steel frame.
 - .2 Sheet steel barriers to separate adjoining sections.
 - .3 Provision for installation of supply authority metering transformers.
 - .4 Customer metering instruments, transformers and selector switches.
 - .5 Distribution section or sections - see single line include spaces and spares as indicated.
 - .6 Hinged access panels with captive knurled thumb screws. Utility metering section to have provision for utility seals.
 - .7 High conductivity aluminium bus.
 - .8 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
 - .9 Identify phases with color coding.

2.4 MAIN BREAKER SECTION

- .1 The main circuit breaker shall be a manually operable, fixed mounted molded case circuit breaker. Breaker shall be equipped with solid state o/c relay to provide the following time/current curve shaping adjustments: (1) long time pick-up setting; (2) long time delay; (3) short time pick-up; (4) short time delay; (5) ground fault pick-up; (6) ground fault time delay. All LSI(G) functions shall be fully adjustable. Frame size ampere rating to be as indicated on the drawings.
- .2 The relay shall be provided with three light emitting diodes (L.E.D.'s) to indicate tripping occurred from long time overload, instantaneous or ground fault current. The relay shall be provided with contacts for remote indication. The breaker shall be equipped with in-built current sensors on each phase and neutral. Current sensors ampere tap setting shall be rated to match the frame size of the main breaker. Shunt trip shall be direct acting solenoid-type powered by the sensor/relay energy.

2.5 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.

- .2 Lugs at each end sized for grounding cable.
- .3 Bond non-current carrying metal parts to ground bus.
- .4 Connect to station ground and building ground bus.

2.6 HYDRO UTILITY METERING SECTION

- .1 Separate compartment for exclusive use of utility company metering transformers.
- .2 Provide mounting and wiring for the following:
 - .1 potential transformers
 - .2 current transformers.
 - .3 Hydro utility metering transformers to be supplied by the Hydro utility and factory installed by the switchboard manufacturer.

2.7 CUSTOMER METERING SECTION

- .1 Digital metering
 - .1 Standards: ANSI-C6241, IEEE-587.
 - .2 Phase selectable current and voltage (L-L and L-N).
 - .3 Capable of displaying kW, kVA, MWHR, kilowatt demand, current demand, kVA demand, frequency, power factor.
 - .4 LCD or LED display.
 - .5 Resettable minimum and maximum for current, voltage and p.f.
- .2 Potential transformers: if required.
- .3 Potential transformers fused with separate fuse block, equipped with fuse holder and fuses. Fuses to Section 26 28 14.
- .4 Current transformers: as indicated dry type for indoor use with the following characteristics:
 - .1 nominal voltage class as indicated
 - .2 rated frequency: 60 Hz
 - .3 primary circuit rated to match ampere rating of main breaker trip. Secondary current rated at 5 amp.

2.8 SECONDARY DISTRIBUTION

- .1 The distribution section shall contain thermal/magnetic molded case circuit breakers.

Each breaker shall be manually operated, field adjustable trip for breakers 150A and larger. Fixed trip to 125A ratings as shown on the drawings.

- .2 Breakers shall have a minimum interrupting capacity of 65kA symmetrical.
- .3 Breaker with 250A rating or greater shall be fully adjustable LSI type.
- .4 The distribution section to be provided with sufficient spaces for breakers and spare spaces as indicated on drawings.

2.9 FINISHES

- .1 Apply finishes in accordance with Section 26 05 01:
 - .1 service entrance switchboard finish to be exterior gray
 - .2 supply 2 spray cans of touch-up enamel
 - .3 treated to inhibit rusting.

2.10 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplates:
 - .1 black plate, white letters, size 7, to indicate voltage, amp rating and designation
 - .2 complete switchboard: labelled as above main disconnect: labelled "Main Breaker"
 - .3 sub-breakers: labelled to indicate panel or equipment fed.

2.11 SHOP FABRICATION

- .1 Assemble and wire complete service entrance board.
- .2 Energize switchboard.
- .3 Check meters and phase selector switches.
- .4 Prepare switchboard for shipment to site.

2.12 MANUFACTURERS

- .1 Acceptable manufacturers: Cutler-Hammer, Westinghouse, , Square D, Seimens, GE.

2.13 FUTURE ENERGY MANAGEMENT

- .1 Provide terminal board and wiring from separate customer CT's and PT's to facilitate the future installation of thermal demand, watt hour energy management equipment, recorders, etc.

3 EXECUTION

3.1 INSTALLATION

- .1 Locate service entrance switchboard as indicated.
- .2 Connect main secondary service entrance cables to line terminals of switchboard.
- .3 Connect load terminals of distribution breakers to outgoing feeders, as indicated.
- .4 Check factory-made connections for mechanical security and electrical continuity.
- .5 Run one #3/0, bare copper, grounding conductor in 1" (25 mm) conduit from ground bus to the main building ground.
- .6 Adjust relay settings to those indicated in shop drawings to ensure proper working and protection of components.
- .7 Manufacturer to provide test equipment and field test overload, magnetic and ground fault tripping. Include test report in Maintenance Manuals.
- .8 Perform 3 phase load testing under normal building load after project is deemed substantially complete. Measure voltage, current and power factor for 4 hours, sampling every 5 minutes and recording peak load. Customer metering device may be used for sampling. Recording instrument to be supplied by distribution manufacturer or third party - cost to be included.
- .9 Arrange for main distribution switchboard to be mounted on 4" (100 mm) housekeeping pad.
- .10 Switchboard manufacturer to provide a coordination and short circuit study, Arc Flash Analysis and submit to Consultant with switchboard shop drawings.
- .11 Provide breaker setting as per Coordination study report.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Panelboards shall be provided as indicated and required for the systems served and supplied under electrical Divisions.
- .2 Circuit breakers, switches and accessories shall be provided as indicated and required for a complete installation.

1.2 SUBMITTALS

- .1 Shop drawings shall be submitted for approval for all panelboards.
- .2 Voltage and amperage test results shall be submitted to the engineer, prior to the final site observation.
- .3 Short Circuits, Coordination study and Arc Flash Hazard Analysis shall be submitted prior or at the same time with shop drawing submission.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Panelboards shall be as manufactured by Schneider Canada, Cutler Hammer or Siemens.
- .2 Panelboards and all of the related components shall be supplied by only one of the indicated manufacturers. Partial or split packages of equipment are not acceptable.

2.2 GENERAL

- .1 Panel ratings, sizes, mounting, and components shall be as indicated on the drawings.
- .2 Multiple circuit breakers shall be common trip type.
- .3 All bussing shall be full height at the panelboard rated capacity.
- .4 Provide lockable covers for all CDP's, panels, including suite panelboards.
- .5 Covers shall be hinged, locking type with concealed trim clamps. Covers will not be required for distribution type panelboards.
- .6 Main circuit breakers and disconnect switches shall not be branch-mounted unless explicitly indicated.

- .7 Branch circuit breakers shall have a minimum interrupting capacity of 10,000 amps at 120/208 volts and 14,000 amps at 347/600 volts. Refer to single line drawing.
- .8 Provide CDP type panels where indicated.
- .9 All CDP's shall be sprinkler proof and CSA enclosure 3. Panels shall be sprinkler proof.
- .10 Provide 3 spare 15 amp 1 Pole breakers for each panelboard and 1 spare 15 amp 3 Pole for each CDP.
- .11 Provide GFCI and AFCI breakers as indicated.

3 EXECUTION

3.1 INSTALLATION

- .1 Wall mounted panels shall be mounted with tops at 6'-0" and mounted to 3/4" plywood equipment mounting panels which are painted with a gray fire-retardant.
- .2 Floor mounted panels shall be provided with a 4" concrete housekeeping pad.
- .3 Typed circuit directories shall be provided for all circuit breaker panelboards. Include supply disconnect location and size of feeder.
- .4 Laminated (black/white) plastic nameplates with 3/16" letters shall be provided for each panelboard and for each device in the distribution panelboard(s).
- .5 Loads shall be evenly balanced on all phases.
- .6 Every breaker feeding receptacles in suite bedrooms shall be AFCI type (arc fault circuit interrupter) with series and parallel protection, and meeting C.E.C. rule 26-722. Install in strict conformance with manufacturers instructions do not connect smoke alarms to AFCI protected circuits.

3.2 TESTING

- .1 Voltage and amperage readings shall be taken on the incoming line side of each panelboard with the maximum possible number of systems operating to simulate peak operating conditions.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Outlet Boxes and Fittings Section 26 05 32

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

2 PRODUCTS

2.1 SWITCHES

- .1 Toggle-operated general purpose AC switches 15A and 20A, 120V AC and 347V AC, single pole, double pole, three-way and four-way switches as indicated, with the following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea molding.
 - .4 Suitable for back and side wiring.
 - .5 Decora style, colour as directed by Departmental Representative.
 - .6 Fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .2 Switches of one manufacturer throughout project.
- .3 Switches to be premium specification grade.
- .4 Acceptable manufacturers:
 - .1 Hubbell, Bryant, Leviton, Pass & Seymour, Arrow Hart, Woodhead

2.2 RECEPTACLES

- .1 Duplex receptacles, NEMA No. 5-15R, 125V AC, 15A, U-ground, with the following features:
 - .1 Decora style, nylon face, red for emergency power or computer power. Other receptacles: color to be determined by Departmental Representative.
 - .2 Suitable for No. 10 AWG for back and side wiring.

- .3 Break-off links for use as split receptacles.
- .4 Double wipe contacts and riveted grounding contacts.
- .5 Child tamper proof receptacles in accordance with Canadian Electrical Code requirement.
- .6 GFCI receptacles in accordance with Canadian Electrical Code requirement.
- .2 Single receptacles NEMA No. 5-15R, 125V AC, 15A, U-ground, with the following features:
 - .1 Nylon face, color as indicated above.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Receptacles to be orange face isolated ground type where indicated. Provide a separate insulated ground wire for each isolated ground circuit.
 - .4 Receptacles to be of one manufacturer throughout project.
 - .5 Acceptable manufacturers: Hubbell, Arrow Hart, Bryant, Woodhead, Pass & Seymour. Catalogue No. 5252 (or equivalent) for all manufacturers.

2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices: as indicated on drawings.
- .2 Pushbutton stations to be flush or surface-mounted as required. Units to be complete with up/down or start/stop buttons, as required, and green pilot light.
- .3 Range outlets to be NEMA #14-50, 125/250V, 50A, black, complete with cord set.
- .4 Dryer outlets to be NEMA #14-30, 125/250V, 30A, black, complete with cord set.
- .5 Power poles to be Emergi-lite #STD/9'6"/W/LC/VP102/RD/AF, complete with telephone and power sections, two duplex receptacles, 10' (3 m) cord and adjustable foot. Color to be white. Provide a receptacle in the ceiling space for unit to plug into.
- .6 Floor mounted, pedestal-type receptacle to consist of a 5" (127 mm) square low profile, 2-piece fitting with steel frame with black plastic housing and 2 duplex receptacles. Bottom plate to be complete with knockout and AC-90 connector for centred installation.
- .7 Floor mounted, pedestal-type combination telephone/receptacle to consist of a 5" x 10" (127 mm x 250 mm), low profile, 2-piece fitting with steel barriered frame with black plastic housing with 2 duplex receptacles and space for two Amphenol jack connectors. Bottom plate to be complete with AC-90 connector in power section and slot for conduit entry in telephone section

- .8 Floor mounted, flush-type receptacle to consist of a Hubbell #B-2529 round formed steel shallow concrete pour box, #S-3925 round cover (brass) and duplex receptacle.

2.4 INCANDESCENT LIGHTING DIMMER CONTROLS

- .1 Dimmer control devices to have a calibrated linear slide control lever from 0% to 100%. A separate ON/OFF switch, the bottom position of slider to have a positive OFF switch, to turn off current flow to lamps.
- .2 Dimmers shall be Lutron Novs 'NT' Series or Prescolite 'HT' Series rated at 1500, 1000 or 600 watts, as indicated on drawings. Dimmers for low voltage lamp circuits to be rated for low voltage applications.
- .3 Color or dimmer snap-on cover to be as selected by the Departmental Representative, or as indicated on the drawings.
- .4 Provide a separate neutral wire for each dimmer circuit.

2.5 TRANSIENT VOLTAGE SURGE PROTECTION RECEPTACLES

- .1 Transient voltage surge protection (TVSS) receptacles, NEMA No. S-15R, 125V AC, 15A, U-ground with the following features:
 - .1 Thermo-plastic face, duplex, ivory, hospital grade construction.
 - .2 Back and side wiring.
 - .3 80 joules of energy absorption in each of the three modes: line-to-neutral; line-to-ground; neutral-to-ground.
 - .4 6000 volts protection in each of the three modes.
 - .5 Two filtering capacitors for 7:1 RFI and EMI noise reduction.
 - .6 Varistor clamping voltage 150V RMS.
 - .7 Response time of less than 1 nanosecond.
 - .8 Built-in LED for surge protection indication.
 - .9 Electronic components potted for electrical, mechanical and thermal stability.
- .2 TVSS receptacles to be orange face, isolated ground-type. Provide a separate insulated ground wire for each isolated ground circuit.
- .3 Acceptable manufacturers: Pass & Seymour 6262-SP Series, or equivalent product by Hubbel or Leviton.

2.6 COVERPLATES

- .1 Coverplates from one manufacturer throughout project.
- .2 Stainless steel coverplates for wiring devices mounted in flush-mounted outlet boxes. Where indicated by Departmental Representative, in-suite outlets may have nylon cover plates in white, off-white or brown. Confirm colour with architect.
- .3 Sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.
- .4 Cast gazetted coverplates for wiring devices mounted in surface mounted FS or FD.
- .5 Weatherproof double lift spring-loaded cast aluminum coverplates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof coverplates, complete with gaskets for single receptacles or switches as indicated.

3 EXECUTION

3.1 INSTALLATION - SWITCHES

- .1 Install single throw switches with handle in "UP" position when switch closed.
- .2 Install switches in gang-type outlet box when more than one switch is required in one location.
- .3 Mount toggle switches at height specified in Section 26 05 01 or as indicated.

3.2 INSTALLATION - RECEPTACLES

- .1 Install receptacles in gang-type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles horizontally at height specified in Section 26 05 01, or as indicated.
- .3 Install cord sets on ranges and dryers.

3.3 INSTALLATION - COVERPLATES

- .1 Install suitable common coverplates where wiring devices are ganged.
- .2 Do not use coverplates intended for flush outlet boxes on surface mounted boxes.
- .3 Provide a coverplate on each outlet. Stainless steel, unless otherwise directed.

3.4 IDENTIFICATION

- .1 Identify receptacles with size \varnothing nameplate indicating panel and circuit number. Nameplates to be pre-glued with peel-off paper backing.

- .2 Where directed by Departmental Representative, do not provide name plates on outlets in independent living suites (only).

END OF SECTION

1 GENERAL

1.1 Related Work

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Disconnect Switches Section 26 28 23

1.2 Submittals

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Submit fuse melting and clearing time-current characteristics for each fuse type and size above 400A.

1.3 Maintenance Manuals

- .1 Provide maintenance materials in accordance with Section 26 05 01.
- .2 Three spare fuses of each type and size.

1.4 Delivery and Storage

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboards or disconnects.
- .3 Store spare fuses in storage cabinet.

2 PRODUCTS

2.1 Fuses - General

- .1 Plug and cartridge fuses: to CSA C22.2 No.59.
- .2 HRC fuses: to CSA C22.2 No.106 (R1967) to have interrupting capability of 200,000 amps symmetrical.
- .3 Fuses: product of one manufacturer.

2.2 Fuse Types

- .1 Form I, HRC fuses, Class L:
 - .1 Type L1, time delay, capable of carrying 500% rated current for 4s minimum.
 - .2 Type L2, fast-acting.
- .2 Form I, HRC fuses, Class J:

- .1 Type J1, time delay, capable of carrying 500% rated current for 10s minimum.
- .2 Type J2, fast-acting.
- .3 Form I, HRC fuses, Class R:
 - .1 Type R1, time delay, capable of carrying 500% rated maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500% rated current for 10s minimum, to meet UL Class K5 maximum let-through limits.
 - .3 Type R3, fast-acting Class R, to meet UL Class K1 maximum let-through limits.
- .4 Form II, HRC fuses, Class C:
 - .1 Type C, current limiting.

2.3 Manufacturers

- .1 Acceptable manufacturer's products: FuseTek, Bussmann, English Electric, Gould.

3 EXECUTION

3.1 Installation

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

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Panelboards | Section 26 24 17 |

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 26 05 01.
- .2 Include with requests for equal time-current characteristic curves for breakers with ampacity of 800A and over, or with interrupting capacity of 25,000A symmetrical RMS and over at system voltage.

2 PRODUCTS

2.1 BREAKERS - GENERAL

- .1 Bolt-on molded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C (104°F) ambient.
- .2 Common-trip breakers with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.

2.2 STATIC TRIP (LSI) BREAKERS

- .1 All upstream breakers to protect transformers, or breaker with 250A rating or greater shall be equipped with LSI fully adjustable type breaker. Instantaneous setting of the breakers shall be greater than transformer inrush current (12x primary rated current).
- .2 All LSI breakers as indicated in the drawings shall be fully adjustable. Fixed setting is not accepted.

2.3 THERMAL MAGNETIC BREAKERS

- .1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

2.4 GROUND FAULT CIRCUIT INTERRUPTERS

- .1 Molded case circuit breakers as above with integral Class A Group 1 ground fault

interrupter.

2.5 ARC FAULT CIRCUIT INTERRUPTERS

- .1 Molded case circuit breakers as above with integral Arc Fault Circuit Interrupter to CSA-C22.2 No. 5.1.
- .2 Series, parallel and ground protection.

2.5 MANUFACTURERS

- .1 Acceptable manufacturers: Cutler Hammer, Schneider Canada, Siemens or General Electric.

3 EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

1 GENERAL

1.1 Related Work

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Fastenings and Supports | Section 26 05 29 |
| .3 | Mechanical Equipment Connections | Section 26 05 80 |

1.2 Submittals

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

2 PRODUCTS

2.1 Disconnect Switches

- .1 Fusible and non-fusible disconnect switches in EEMAC Type 3R, size as indicated.
- .2 All Areas: Fusible and non-fusible disconnect switches shall be EEMAC Type 3R, size as indicated.
- .3 Provision for padlocking in "ON-OFF" position with 3 padlocks. Mechanically interlocked door to prevent opening when handle in "ON" position.
- .4 Mechanically interlocked door to prevent opening when handle in "ON" position.
- .5 Fuse holders: suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 "ON-OFF" switch position indication on switch enclosure cover.
- .8 Fuses as indicated in accordance with Section 26 28 14.
- .9 Fuse holders in each switch suitable without adaptors, for type of fuse, as indicated.
- .10 Single-phase motor disconnect switches shall be one or two-pole toggle-type, 20 amp, 120/227V AC, brown handle with side and back wiring complete with pilot light.
- .11 Three-phase motor disconnect switches for motors up to 5HP at 208V and 10HP at 600V shall be 3-pole, toggle-operated with surface-mounting enclosure and pilot light, as indicated.
- .12 Three-phase motor disconnect switches for motors above 5HP at 208V or 10HP at 600V shall be 600V non-fusible safety switches, sized as required. Switch shall be non-teasing, quick-make, quick-break type with visible blades, line terminal shield and enclosure, as indicated, with cover interlock and lockable handle.

- .13 Fusible and non-fusible disconnect switches in sprinkler proof enclosure for interior applications, and EEMAC Type 3 enclosure for exterior applications, unless otherwise indicated.

3 EXECUTION

3.1 Installation

- .1 Install motor disconnect switches (complete with fuses) where indicated.
- .2 Install fused circuit disconnect switches where indicated or where required by the inspection authorities and/or for equipment supplied by other trades.

3.2 Identification

- .1 Indicate name of load controlled on Size 4 nameplate to Section 26 05 01.

3.3 Manufacturers

- .1 Acceptable manufacturers: Cutler Hammer, SquareD or approved equal.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Lighting Contactor Panel | Section 26 09 25 |

2 PRODUCTS

2.1 CONTACTORS

- .1 Contactors to EEMAC No. ICS-1970.
- .2 Mechanically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Fused switch combination contactor as indicated.
- .4 Complete with two normally open and two normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in CSA enclosure Type 3R, or specific control panel, unless indicated otherwise.
- .6 Include the following options in cover:
 - .1 Red indicating lamp.
 - .2 Hand-Off-Auto selector switch.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.
- .2 Size 4 nameplate indicating name of load controlled as indicated.

2.3 MANUFACTURER

- .1 Acceptable manufacturers: Schneider Canada, Allen Bradley, or Cutler Hammer

3 EXECUTION

3.1 INSTALLATION

- .1 Install contactors and connect auxiliary control devices.

END OF SECTION

1 GENERAL

1.1 SCOPE

- .1 The Contractor shall furnish and install the low voltage motor starters as specified herein and as shown on the contract drawings.

1.2 RELATED SECTIONS

- | | | |
|----|----------------------------------|------------------|
| .1 | Mechanical Equipment Connections | Section 26 05 80 |
| .2 | Circuit Breakers | Section 26 28 21 |

1.3 REFERENCES

- .1 The motor starters shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI, UL and CSA.

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

- .1 The following information shall be submitted to the Engineer:
 1. Master drawing index
 2. Dimensioned outline drawings
 3. Conduit entry/exit locations
 4. Cable terminal sizes
 5. Wiring diagrams
 6. Nameplate schedule
 7. Ratings including:
 - a. Voltage
 - b. Horsepower and/or continuous current
 8. Product data sheets

1.5 SUBMITTALS – FOR CONSTRUCTION

- .1 The following information shall be submitted for record purposes:
 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process.
 2. Wiring diagrams
 3. Seismic certification as specified

1.6 QUALIFICATIONS

- .1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

- .2 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- .3 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.7 REGULATORY REQUIREMENTS

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Eaton / Cutler-Hammer
- .2 Square D
- .3 Allen Bradley

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 MANUAL MOTOR CONTROL

- .1 Single-Phase Manual Starters
 - 1. Manual single-phase starters 1 hp or smaller shall be Cutler-Hammer type MS starters or approved equal. The starter shall have a quick-make/quick-break toggle mechanism. The overload shall have a field adjustment allowing up to +/- 10% variance in ratings of the nominal heater value
 - 2. Manual single-phase starters above 1 hp shall be Cutler-Hammer type B100 or approved equal. The starter shall have quick-make/quick-break mechanism. The closure of the contacts shall be blocked while the line terminals are exposed. The operating handle or button shall clearly indicate whether the unit is ON, OFF or TRIPPED
 - 3. The enclosure shall be general purpose NEMA 1 or general purpose NEMA 1B – flush mounted as indicated on the contact drawings]
- .2 Three-Phase Manual Starters
 - 1. The starter shall have quick-make/quick-break operating mechanism
 - 2. The operating handle or button shall clearly indicate whether the unit is ON, OFF or TRIPPED

3. The closure of the contacts shall be blocked while the line terminals are exposed
4. The enclosure shall be general purpose NEMA 1, as indicated on the contract drawings]
5. Manual three-phase motor starters shall be Cutler-Hammer type B100 or equal

2.3 ELECTROMECHANICAL MOTOR CONTROL

.1 Non-Reversing Starters

1. Magnetic starters through NEMA Size 9 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter shall have one (1) NO auxiliary contact
2. Coils shall be permanently marked with voltage, frequency and part number
3. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have (+/-) 24% adjustability, single-phase sensitivity, and isolated alarm contact, and manual or automatic reset
4. NEMA Size 1 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any arrangement normally open or normally closed. Size 3 through 8 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any arrangement normally open or normally closed
5. Motor starters shall be Cutler-Hammer Freedom Series or approved equal

.2 Reversing Starters

1. Reversing starters shall consist of two (2) contactors and a single overload relay assembled together. The contactors shall be mechanically and electrically interlocked to prevent line shorts and the energizing of both contactors simultaneously
2. Magnetic starters through NEMA Size 8 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring
3. Coils shall be permanently marked with voltage, frequency and part number
4. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have +/- 24% adjustability, single-phase sensitivity, and isolated alarm contact and manual or automatic reset

.3 Two-Speed Starters

1. Magnetic starters through NEMA Size 6 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring

2. Coils shall be permanently marked with voltage, frequency and part number
3. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have +/- 24% adjustability, single-phase sensitivity, and isolated alarm contact and manual or automatic reset
4. NEMA Size 1 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any combination of normally open or normally closed contacts. Sizes 3 through 6 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any combination of normally open or normally closed contacts
5. Two-speed magnetic starters for motors up to 400 hp, 600 volts shall be Cutler-Hammer Freedom Series type AN700 or approved equal

2.4 SOLID-STATE REDUCED-VOLTAGE MOTOR CONTROL

.1 Reduced Voltage Motor Starter Type S801

1. Controller shall be Cutler-Hammer type S801
2. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing
3. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV
4. Units using triacs or SCR/diode combinations shall not be acceptable
5. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects
6. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits
7. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns
8. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current
9. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions
10. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIP switch setting on the device keypad
11. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter

12. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad
13. Starter shall be capable of either an electronic or mechanical reset after a fault
14. Units using bimetal overload relays are not acceptable
15. Over temperature protection (on heat sink) shall be standard
16. Starters shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via a DIP switch on the device keypad
17. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50% current differential between any two phases is encountered. This feature can be disabled via a DIP switch on the device keypad
18. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via a DIP switch on the device keypad
19. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via a DIP switch on the device keypad
20. Starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload)
21. The following control function adjustments on the device keypad are required:
 1. Selectable Torque Ramp Start or Current Limit Start
 2. Adjustable Kick Start Time: 0–2 seconds
 3. Adjustable Kick Start Torque: 0–85%
 4. Adjustable Ramp Start Time: 0.5–180 seconds
 5. Adjustable Initial Starting Ramp Torque: 0–85%
 6. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
22. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues
23. Maximum continuous operation shall be at 115% of continuous ampere rating

2.5 ENCLOSURES

- .1 The enclosure shall be as indicated on the contract drawings.
- .2 Starters shall have an adjustable instantaneous motor circuit protector (HMCP) type disconnect device.

2.6 OPTIONS

- .1 Each starter shall be equipped with a fused control power transformer (100 va minimum)] HOA selector switch, red “run” pilot light, green “stop” pilot light, 2 no/2 NC auxiliary contacts and or as indicated on the contract drawings.

- .2 Pilot Lights shall be LED type

3 EXECUTION

3.1 FACTORY TESTING

- .1 Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA, UL and NEMA standards.
- .2 The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 FIELD QUALITY CONTROL

- 1. Provide a detailed motor list indicating the size and type of overloads installed for each motor.
- 2. Include motor overload list in operation and maintenance manuals.

3.3 SPARE PARTS

- .1 Provide three spare overloads of each size installed.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Natural gas generator shall be rated for a minimum 75KW and 120/240V, 1 phase, 3 wire.

1.2 RELATED SECTIONS

- .1 Basic Electrical Materials and Methods Section 26 05 01

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Petroleum Institute (API)
 - .1 ANSI/API 650-[1988(A2000)], Welded Steel Tanks for Oil Storage Tenth Edition; Addendum 1.
- .2 American National Standards Institute (ANSI)/National Electrical Manufacturers' Association (NEMA)
 - .1 ANSI/NEMA MG1-[1998], Motors and Generators.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-3.6-[2000].
- .4 International Organization for Standardization (ISO)
 - .1 ISO 3046-1-[2002], Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations Of Power, Fuel And Lubricating Oil Consumptions, And Test Methods.
- .5 National Electrical Manufacturers Association (NEMA)
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 ULC-S601-[00], Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
 - .2 CAN/ULC-S603-[92], Standard for Steel Underground Tanks for Flammable and Combustible Liquids.

1.4 SYSTEM DESCRIPTION

- .1 Generating system consists of:
 - .1 Natural gas engine.
 - .2 Alternator.
 - .3 Alternator control panel.
 - .4 Automatic transfer equipment.
 - .5 Battery charger and battery.
 - .6 Automatic engine room ventilation system.

- .7 Exhaust system.
- .8 Steel mounting base.
- .9 Synchronizing panel.
- .10 Manual by-pass switch.
- .2 System designed to operate as a standby generator.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 01.
- .2 Include:
 - .1 Engine: make and model, with performance curves.
 - .2 Alternator: make and model.
 - .3 Voltage regulator: make, model and type.
 - .4 Automatic transfer switch: make, model and type.
 - .5 Manual bypass switch: make and model.
 - .6 Battery: make, type and capacity.
 - .7 Battery charger: make, type and model.
 - .8 Alternator control panel: make and type of meters and controls.
 - .9 Governor type and model.
 - .10 Automatic engine room ventilation system.
 - .11 Cooling air requirements in m³/s.
 - .12 British standard or DIN rating of engine.
 - .13 Flow diagrams for:
 - .1 Natural gas.
 - .2 Cooling air.
 - .14 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
 - .15 Continuous full load output of set at 0.8PF lagging.
 - .16 Description of set operation including:
 - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.

- .2 Manual starting.
- .3 Automatic shut down and alarm on:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temp.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator overvoltage.
 - .7 Lube oil high temperature.
 - .8 Over temperature on alternator.
- .4 Manual remote emergency stop.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 26 05 01.
- .2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:
 - .1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.
 - .2 Technical data:
 - .1 Illustrated parts lists with parts catalogue numbers.
 - .2 Schematic diagram of electrical controls.
 - .3 Flow diagrams for:
 - .1 Fuel system.
 - .2 Lubricating oil.
 - .3 Cooling system.
 - .4 Certified copy of factory test results.
 - .5 Maintenance and overhaul instructions and schedules.
 - .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Divert unused metal and wiring materials from landfill to metal recycling facility.
- .6 Divert unused batteries from landfill to battery recycling facility.
- .7 Divert unused lubricating oil materials from landfill to oil recycling facility.
- .8 Divert unused antifreeze from landfill to antifreeze recycling facility.
- .9 Fold up metal banding, flatten and place in designated area for recycling.

1.8 WARRANTY

- .1 For Work of this Section 12 month warranty period prescribed in subsection GC32.1 of General Conditions "C" is extended to 60 months or 1500 operating hours, whichever occurs first.

1.9 EXTRA MATERIALS

- .1 Provide maintenance materials.
- .2
- .3 Include:
 - .1 [2] fuel filter replacement elements.
 - .2 [2] lube oil filter replacement elements.
 - .3 [2] air cleaner filter elements.
 - .4 [2] sets of fuses for control panel.
 - .5 Special tools for unit servicing.

PART 2 PRODUCTS

2.1 NATURAL GAS ENGINE

- .1 Engine: standard product of current manufacture, from company regularly engaged in production of such equipment.
- .2 Capacity:
 - .1 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = 75 kW divided by Generator efficiency at full load.

- .2 Engine overload capability 110% of continuous output for 1 hour within 12 hours period of continuous operation.
- .3 Cooling System:
 - .1 Liquid cooled: heavy duty industrial radiator mounted [on generating set base with engine driven pusher type fan to direct air through radiator from engine side, remotely with electrically driven fan, with ethylene glycol anti-freeze non-sludging above minus 46]degrees C.
 - .2 Air cooled: air cooling duct enveloping cylinder walls with pressure cooling by engine driven blower.
 - .3 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40 degrees C.
 - .4 Block heater: thermostatically controlled lube oil or liquid coolant heater connected to line side of automatic transfer switch to allow engine to start in room ambient [0] degrees C.
 - .1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.
- .4 Fuel:
 - .1 Natural gas.
- .5 Fuel system: mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
- .6 Governor:
 - .1 Mechanical hydraulic with:
 - .1 Steady state speed band of plus or minus 0.5%.
 - .2 Speed regulation no load to full load 5% maximum.
 - .3 Electronic [load sharing] type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
- .7 Lubrication system:
 - .1 Pressure lubricated by engine driven pump.
 - .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
 - .3 Lube oil cooler.
 - .4 Engine sump drain valve.
 - .5 Oil level dip-stick.
- .8 Starting system:
 - .1 Positive shift, gear engaging starter 12 or 24V dc.

- .2 Cranking limiter to provide [3] cranking periods of 10s duration, each separated by [5] s rest.
- .3 [Lead acid], 12 or 24V storage battery with sufficient capacity to crank engine for 1min at 0 degrees C without using more than 25% of ampere hour capacity.
- .4 Battery charger : constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: plus or minus 1% output for plus or minus 10% input variation. [Automatic boost for 6h every 30 days]. Equipped with dc voltmeter, dc ammeter and on-off switch. Minimum charger capacity: [7] A.
- .9 Vibration isolated engine instrument panel with:
 - .1 Lube oil pressure gauge.
 - .2 Lube oil temperature gauge.
 - .3 Lube oil level gauge.
 - .4 Coolant temperature gauge.
 - .5 Coolant level gauge.
 - .6 Running time meter: non-tamper type.
- .10 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .11 Drip tray.

2.2 ALTERNATOR

- .1 Alternator: to ANSI/NEMA MG1.
- .2 Rating: 1phase, 240 V, 3 wire, 75 kW, 60Hz, at 0.8PF.
- .3 Output at 40 degrees C ambient:
 - .1 100% full load continuously.
 - .2 110% full load for 1h.
 - .3 150% full load for 1 min.
- .4 Revolving field, brushless, single bearing.
- .5 Drip proof.
- .6 Amortisseur windings.
- .7 Synchronous type.
- .8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.
- .9 [Thermistors] [Platinum resistance temperature transducers] embedded in stator winding and connected to alternator control circuitry.

- .10 Alternator: capable of sustaining 300% rated current for period not less than 10s permitting selective tripping of down line protective devices when short circuit occurs.

2.3 CONTROL PANEL

- .1 Totally enclosed, [free standing] [wall mounted] [mounting base isolated from diesel generator].
- .2 Instruments:
 - .1 Digital, 100% solid state circuitry indicating type 2 % accuracy, rectangular face, flush panel mounting:
 - .2 Voltmeter selector switch, rotary, panel mounting, [round notched handle], [four position, labelled "Off-Phase A-Phase B-Phase C"].
 - .3 Ammeter selector switch, rotary, maintained contacts, panel mounting, designed to prevent opening of current circuits, [round notched handle], [four position labelled "OFF- Phase A-Phase B-Phase C"].
- .3 Controls:
 - .1 Engine start button.
 - .2 Selector switch: Off-Auto-Manual - [Test full load test no load].
 - .3 Engine emergency stop button and provision for remote emergency stop button.
 - .1 Alternator output breaker:
 - .1 Circuit breaker: bolt-on, moulded case, temperature compensated for 40 degrees C ambient, dual thermal-magnetic trip.
 - .2 Circuit breaker, solid state sensing with:
 - .1 Frame containing breaker contacts, arc quenchers, [manual] [motor operated] mechanism, quick- make, quick-break, spring-loaded overcenter switching mechanism, mechanically trip free from handle, [fixed] [drawout] type.
 - .2 Static sensor: current monitors detect overload, short-circuit and ground-fault currents, and send these signals through solid-state circuits to static sensor which acts to trip breaker. Adjustable for current values and time of tripping.
 - .3 Flux-transfer shunt trip- magnetic tripping device actuated by signal from static sensor to open breaker contacts. Requires no external source of power.
 - .2 Voltage control rheostat: mounted on inside of control panel.
 - .3 Operating lights, panel mounted:
 - .1 "Normal power" pilot light.
 - .2 "Emergency power" pilot light.

- .3 Green pilot lights for breaker on and red pilot lights for breaker off.
- .4 Solid state indicator lights for alarm with [1set] manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 - .1 Low fuel level.
 - .2 Low battery voltage.
 - .3 Ventilation failure.
 - .4 Low coolant temperature.
- .5 Solid state controller for automatic shutdown and alarms with [1set] manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 - .1 Engine overcrank.
 - .2 Engine overspeed.
 - .3 Engine high temperature.
 - .4 Engine low lube oil pressure.
 - .5 Short circuit.
 - .6 AC over voltage.
- .6 Lamp test button.
- .7 Synchronization and load sharing.
- .8 Provision for remote monitoring.

2.4 AUTOMATIC TRANSFER SWITCH

- .1 Provide as shown on electrical drawings.

2.5 MANUAL BYPASS SWITCH

- .1 Load break bypass and isolation switch: manually operated, double throw, to provide bypass around transfer switch to facilitate maintenance on diesel generator control panel and transfer switch. Switch lockable in bypass position.

2.6 STEEL MOUNTING BASE

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

2.7 EXHAUST SYSTEM

- .1 Heavy duty [residential type] [industrial] [critical] [horizontally] mounted exhaust silencer with condensate drain, plug and [flanged] [welded] couplings.
- .2 Heavy duty flexible exhaust pipe with flanged couplings as required.
- .3 Fittings and accessories as required.
- .4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

2.8 FUEL SYSTEM

- .1 Fuel storage tanks: to ANSI/API 650, ULC labelled.
- .2 Aboveground fuel storage tank: mounted indoors on elevated stand with fill and vent lines to exterior of building, fitted with weatherheads.
- .3 Underground fuel storage tank: [] L, as indicated.
 - .1 Electrically operated fuel transfer pump with float switch.
- .4 Fuel level gauge and vent alarm.
- .5 Drain and end plug.
- .6 [Copper] [Black iron] feed and return lines, with flexible terminations at engine.
- .7 Shut-off cock.
- .8 Renewable cartridge filter.
- .9 Fire valve.
- .10 Isolating valves on lines serving auxiliaries.
- .11 Low fuel level alarm for remote indication.

2.9 COOLING AIR SYSTEM

- .1 Engine ventilating system:
 - .1 Recirculating damper assembly with modulating motor.
 - .2 Cold air inlet damper assembly with modulating motor.
 - .3 Air discharge and intake gooseneck weatherhoods.
 - .4 Modulating thermostat.
 - .5 Replaceable air intake filters.

2.10 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01.

- .2 Control panel:
 - .1 Size [4] [5] nameplates for controls including alternator breakers and program selector switch.
 - .2 Size [2] [3] nameplates for meters, alarms, indicating lights and minor controls.

2.11 FABRICATION

- .1 Shop assemble generating unit including:
 - .1 Base.
 - .2 Engine [and radiator].
 - .3 Alternator.
 - .4 Control panel.
 - .5 Battery and charger.
 - .6 Automatic transfer equipment.

2.12 FINISHES

- .1 Apply finishes in accordance with Section 26 05 01.
- .2 Alternator control cubicle: paint inside, exterior to match engine and alternator.
- .3 Exhaust and inlet air hoods [international orange].
- .4 Other ducts and racks grey.
- .5 Supply 0.25L of grey touch-up enamel.

2.13 SOURCE QUALITY CONTROL

- .1 Factory test generator set including engine, alternator, control panels, transfer switch and accessories in presence of [Engineer] [Consultant].
- .2 Notify [Engineer] [Consultant] [[____]] days in advance of date of factory test.
- .3 Test procedure:
 - .1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:
 - .1 Date.
 - .2 Generator set serial no.
 - .3 Engine, make, model, serial no.
 - .4 Alternator, make, model, serial no.
 - .5 Voltage regulator, make and model.

- .6 Rating of generator set, kW, kV.A, V, A, r/min, Hz.
- .2 Mark check sheet and record data on forms in duplicate as test proceeds.
- .3 [Engineer's] [Consultant's] signature on completed forms to indicate concurrence in results of test.
- .4 Tests:
 - .1 With 100% rated load, operate set for [23] h, taking readings at [30] min intervals, and record following:
 - .1 Time of reading.
 - .2 Running time.
 - .3 Ambient temp in degrees C.
 - .4 Lube oil pressure in kPa.
 - .5 Lube oil temp in degrees C.
 - .6 Engine coolant temp in degrees C.
 - .7 Exhaust stack temp in degrees C.
 - .8 Alternator voltage: phase 1, 2, 3.
 - .9 Alternator current: phase 1, 2, 3.
 - .10 Power in kW.
 - .11 Frequency in Hz.
 - .12 Power Factor.
 - .13 Battery charger current in A.
 - .14 Battery voltage.
 - .15 Alternator cooling air outlet temp.
 - .2 At end of [23] hours run increase load to 110% rated value, and take readings every 15 min for 1 hour.
 - .3 After completion of [24] hours run, demonstrate following shut down devices and alarms:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temp.
 - .4 Low lube oil pressure.
 - .5 Short circuit.

- .6 Alternator overvoltage.
- .7 Low battery voltage, or no battery charge.
- .8 Manual remote emergency stop.
- .9 High alternator temperature.
- .4 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
 - .1 No load to full load to no load.
 - .2 No load to 70% load to no load.
 - .3 No load to 20% load to no load.
 - .4 20% load to 40% load to no load.
 - .5 40% load to 60% load to no load.
 - .6 60% load to 80% load to no load.
- .5 Demonstrate:
 - .1 Automatic starting of set and automatic transfer of load on failure of normal power.
 - .2 Operation of manual bypass switch.
 - .3 Automatic shut down of engine on resumption of normal power.
 - .4 That battery charger reverts to high rate charge after cranking.
- .6 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

2.14 ACCEPTABLE MANUFACTURERS

- .1 Caterpillar.
- .2 Onan.
- .3 Wajax.
- .4 Generac.
- .5 Cummins.
- .6 Kohler.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate generating unit and install as indicated.

- .2 Install fuel supply system as indicated.
- .3 Install ventilating air duct system as indicated.
- .4 Pipe muffler drains to nearest floor drain.
- .5 Complete wiring and interconnections as indicated.
- .6 Start generating set and test to ensure correct performance of components.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Notify Engineer 10 working days in advance of test date.
- .3 Provide fuel for testing and leave full tanks on acceptance.
- .4 Demonstrate:
 - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
 - .2 Unit start and shut down on "Manual" control
 - .3 Unit start and transfer on "Test" control.
 - .4 Unit start on "Engine start" control.
 - .5 Operation of manual bypass switch.
 - .6 Operation of automatic alarms and shut down devices.
- .5 Run unit on load for minimum period of 24 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.
- .6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

END OF SECTION 26 32 14

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Fastenings and Supports | Section 26 05 29 |
| .3 | Outlet boxes | Section 26 05 32 |

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified for approval by Consultant.
- .3 Submit list of replacement lamp data for each luminaire. Include lamp type, voltage, wattage, base type and order code. Include list in maintenance manual.

1.3 GUARANTEE

- .1 Replace:
 - .1 Incandescent and tungsten halogen lamps burnt out within 3 months of takeover.
 - .2 Fluorescent and HID lamps burning out within 12 months of takeover.
 - .3 Ballasts that fail or exceed their labelled noise level rating or THD within 12 months of takeover.
 - .4 LED boards/strips that fail within 12 months of takeover.

1.4 COORDINATION

- .1 Coordinate luminaire locations with work of other trades.
- .2 Coordinate luminaire types with ceiling finishes to ensure compatibility.

2 PRODUCTS

2.1 GENERAL

- .1 Luminaires shall carry the CSA label.
- .2 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.

- .3 Provide lenses or diffusers of glass or acrylic material as indicated. Acrylic lenses used with fluorescent luminaires shall be a minimum of .125" (3 mm) thick, and shall be mounted in a hinged frame.
- .4 Include finishes to Section 26 05 01 and as indicated.
- .5 Where soffits or ceilings have thermal insulation, and if recessed luminaire fixtures are used, they shall be fixtures type IC (intended for insulation contact) ,which are CSA approved for such use.

2.2 LAMPS

- .1 Provide lamps as indicated.
- .2 Incandescent lamps to be extended service type rated 5000 hours, 130 volts, inside frosted, unless indicated otherwise.
- .3 Fluorescent lamps shall be T-5,T-8 rapid start, 3100 lumens, rated 20,000 hours, 3500K, CRI 85 (or greater).
- .4 Fluorescent "PL" lamps shall be 13W (or as indicated on drawings) and match T5 or T8 lamps for color temperature.

2.3 BALLASTS AND ACCESSORIES

- .1 Provide ballasts and accessories as indicated.
- .2 Provide ballasts with non-PCB type capacitors with pressure sensitive devices to prevent rupturing.
- .3 Provide discreet electronic instant start fluorescent ballasts of 120 and 347V design, automatic reset thermal protected, 90% power factor, group A noise rating. Ballasts to have 4 watt/lamp or less loss. Only Manitoba Hydro Power Smart approved ballasts will be accepted.

2.4 EXIT LIGHTS

- .1 Provide exit lights as indicated, complete with directional arrows, as shown on the drawings.
- .2 Units to be provided with full panel LED's, English, meeting CSA-C860-01.
- .3 Arrange exit lights as required, to allow exits to be visible from access to egress locations.

3 EXECUTION

3.1 INSTALLATION (LUMINAIRES)

- .1 Install luminaires at locations indicated, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories, as required.
- .2 Install luminaires and lens materials in architectural details, as indicated.
- .3 Install luminaires parallel with building lines. Wall-mounted luminaires to be installed plumb.
- .4 Review all ceiling types, construction details and mounting arrangements before placing luminaire orders and ensure that all mounting assemblies, frames, rings and similar features are included for and match the required installation.
- .5 All luminaires and assemblies shall be properly secured and supported. Support luminaires independent of the ceiling construction, complete with all fasteners, framing and hangers, as may be required. Do not secure luminaires to mechanical ductwork or other vibration producing apparatus.
- .6 Where a luminaire is suspended from the ceiling using a self-aligning box cover, an additional ground wire from the outlet box to the luminaire shall be provided.
- .7 Coordinate the installation of luminaires with the work of other trades, ensuring that the necessary depths and mounting spaces are provided. Luminaires which cannot be installed due to a conflict with structural members, pipes or ductwork shall be relocated to a more suitable location, as directed by the Consultant and/or Departmental Representative.
- .8 Do not handle specular lenses with bare hands. Use plastic gloves as recommended by supplier.

3.2 WIRING

- .1 Connect luminaires to lighting circuits as indicated.
- .2 Circuit breakers for exit light circuits shall be provided with lock-on devices.
- .3 Wiring for exit and night light circuits shall be installed in a separate conduit system.
- .4 Connect luminaires to contactor controlled circuits where indicated. In general corridor, alternating fixtures on separate contactors.

3.3 TESTS

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Check luminaires and replace defective lamps, ballasts, lenses and accessories.

3.4 CLEANING

- .1 Prior to take-over of the project, clean the lenses and reflectors of all luminaires with a damp cloth to remove dust, smudges and fingerprints.
- .2 Do not handle specular lenses with bare hands. Use plastic gloves as recommended by supplier.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Wire and Cable | Section 26 05 21 |
| .3 | Outlet Boxes and Fittings | Section 26 05 32 |
| .4 | Conduit | Section 26 05 34 |

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 26 05 01.
- .2 Data to indicate system components, mounting method, source of power and special attachments.
- .3 Battery bank sizing criteria.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into Maintenance Manual specified in Section 26 05 01.
- .2 Operation and Maintenance Manual to include:
 - .1 Operation and maintenance instructions for complete battery system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings.

1.4 MAINTENANCE MANUALS

- .1 Provide maintenance manuals in accordance with Section 26 05 01.

1.5 WARRANTY

- .1 Provide a written guarantee, stating that the battery for emergency lighting is guaranteed against defects in material and workmanship for a period of ten years, with a no-charge replacement during the first five years and a pro-rate charge on the second five years from the date of the Final Acceptance from the Owner.

1.6 SYSTEM DESCRIPTION

- .1 The system to include battery unit(s) remote heads, wire and conduit, etc., to provide backup emergency lighting in the event of a loss of AC power to the normal lighting

system.

- .2 Unit equipment certified to CSA Standard C22.2 No. 141.

2 PRODUCTS

2.1 BATTERY BANK

- .1 Supply voltage: 120 or 347 volt.
- .2 Output voltage: 12 VDC.
- .3 Battery: long life sealed lead, maintenance-free.
- .4 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected, modular constructed.
- .5 Solid state transfer.
- .6 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .7 Signal lights: solid state, life expectancy 100,000 h minimum, for "AC Power ON" and "High Charge".
- .8 Lamp heads: integral on unit and remote as indicated. Adjustable mounting, swivel type, complete with LED lamp. Minimum twin heads required per location.
- .9 Cabinet: suitable for shelf mounting to wall and complete with knockouts for conduit.
- .10 Auxiliary equipment:
 - .1 test switch
 - .2 battery disconnect device
 - .3 AC input and DC output terminal blocks inside cabinet
 - .4 shelf
 - .5 cord and plug connection for AC
 - .6 RFI suppressors

2.2 REMOTE HEADS

- .1 Double adjustable heads, as indicated.

2.3 MANUFACTURERS

- .1 Acceptable Manufacturers: Lumacell, Beghelli, Emergi-Lite and ReadyLite.

3 EXECUTION

3.1 INSTALLATION

- .1 Install unit equipment for emergency lighting in accordance with CSA C22.1.
- .2 Install conduit and wiring as indicated.
- .3 Install unit equipment and remote mounted fixtures as indicated.
- .4 Cut and re-cap cord to remove surplus.
- .5 Direct heads as indicated.
- .6 Mount double remote heads on outlet box such that two heads will be horizontal with the building lines.
- .7 Provide “dark test” at the end of the project to direct heads as indicated and required to provide adequate egress lighting. Confirm test complete before requesting substantial performance and/or final on-site review by consultant.
- .8 Charge the batteries and test the system for proper operation (minimum of 35 minutes discharge time).

END OF SECTION

EMERGENCY LIGHTING VERIFICATION

1 GENERAL

The following document shall be dated and signed by E.C. and G.C. upon final completion, witnessing and verification of installed, fully operational emergency lighting systems (including installation and testing of all exit lights and emergency lights) as outlined in drawings and electrical specifications.

This **Emergency Lighting Verification** document must be submitted to Tower Engineering **PRIOR** to submitting request for 'Substantial Completion'.

Company Name: _____ Date: _____
(Electrical Contractor)

Printed Name: _____ Signature: _____

I hereby verify that all emergency lighting systems as noted above are complete and have been commissioned on above noted date.

Company Name: _____ Date: _____
(General Contractor)

Printed Name: _____ Signature: _____

I hereby verify that all emergency lighting systems as noted above are complete and have been commissioned on above noted date.

Witness (circle one):

Engineer - Tower representative Date: _____

Printed Name: _____ Signature: _____

I hereby verify that all emergency lighting systems as noted above are complete and have been commissioned on above noted date.

The above does not constitute a waiver of any of the contract document requirements.

2 **PRODUCTS**
Not Used

3 **EXECUTION**
Not Used

1 GENERAL

1.1 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Conduit | Section 26 05 34 |
| .3 | Wire and Cable | Section 26 05 21 |
| .4 | Underground Conduit and Cables | Section 26 05 43 |

1.2 COORDINATION WITH HYDRO SUPPLY AUTHORITY

- .1 Make all arrangements and coordinate with Electrical supply authority to ensure availability of service when required.
- .2 Contact: MB Hydro – 1-204-480-5900 or toll-free 1-888-MBHYDRO (1-888-624-9376)
- .3 Submit all required drawings to supply authority for their approval.
- .4 Refer to Section 26 05 01 for cash allowance requirements associated with electrical service by the supply authority.

1.3 COORDINATION WITH TELEPHONE AUTHORITY

- .1 Make all arrangements and coordinate with telephone utility to ensure availability of service when required.
- .2 Contact: MTS neteng.control@mtsallstream.com
- .3 Refer to Section 26 05 01 for cash allowance requirements associated with telephone service by the telephone utility.

1.4 COORDINATION WITH CABLE TV PROVIDER

- .1 Make all arrangements and coordinate with Cable TV utility to ensure availability of service when required.
- .2 Contact: Shaw Cable – Ph. (204) 480 - 3653.
- .3 Refer to Section 26 05 01 for cash allowance requirements associated with cable TV by the cable utility.

1 PRODUCTS

1.1 EQUIPMENT

- .1 Underground conduit in accordance with Section 26 05 43.

- .2 Conduit and fittings to Section 26 05 34.

2 EXECUTION

2.1 PAD MOUNTED TRANSFORMER

- .1 Pad mounted/pole mounted transformer/transformer bank to be supplied and installed by supply authority, unless otherwise indicated.
- .2 Coordinate with the General Contractor the provision of a concrete pad or fibreglass pad for the pad mounted transformer. Pad to be placed in accordance with Hydro utility requirements.
- .3 Coordinate with General Contractor the provision of vehicle protection bollards, if required, for the pad mounted transformer. Bollards to be concrete filled, 8" (200 mm) diameter steel posts and placed around the pad mounted transformer in accordance with the Hydro utility requirements.
- .4 Install transformer ground grid in accordance with supply authority regulations.
- .5 Arrange for and coordinate removal of existing pad mounted transformer as instructed by the Hydro utility.

2.2 PRIMARY CABLES

- .1 Primary cables to the utility supplied pad mounted transformer to be provided by the Hydro utility.
- .2 Coordinate shut down and re-servicing with utility.

2.3 SECONDARY CABLES

- .1 Install secondary cables from transformer/CSTE to main distribution, via a trench as indicated. Allow adequate conductor length for termination. Backfill trench and restore surface to original condition.
- .2 Arrange for inspection of cables in trench by Consultant BEFORE backfill, or provide and pay for Certificate of Inspection by Utility.

2.4 TELEPHONE ENTRANCE CONDUIT

- .1 New telephone Utility service entrance to be coordinated by contractor.

2.5 CABLE TV ENTRANCE CONDUIT

- .1 New cable tv utility service entrance to be coordinated by contractor.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Plywood backboard as drawings indicated.
- .2 Conduit systems to Section 26 05 34.

1.2 DESCRIPTION OF SYSTEM

- .1 Incoming telephone service to be underground. Coordination with Contractor to coordinate with telephone authority, to ensure telephone authority availability of service.

1.3 PAYMENT

- .1 Arrange and pay for all Utility services charges.

2 PRODUCTS

2.1 MATERIALS

- .1 Grounding: To Section 26 05 28, Grounding - Secondary.
- .2 Telephone Raceway System: To Section 26 05 14.
- .3 Conduits, conduit fastenings, and conduit fittings to Section 26 05 34.

3 EXECUTION

3.1 INSTALLATION

- .1 Install telephone conduit and service entrance. Support as per Canadian Electrical Code and utility requirements.
- .2 Install plywood backboard for main telephone distribution. Paint backboard with two coats of fire retardant paint.
- .3 Install grounding facilities, and make connections.
- .4 Provide a circuit(s) as required for connection of telephone service equipment provided by telephone utility provider.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

- .1 Plywood backboard as drawings indicate.
- .2 Conduit systems to Section 26 05 34.

1.2 DESCRIPTION OF SYSTEM

- .1 Incoming CATV service underground.

1.3 COORDINATION WITH CATV AUTHORITY

- .1 Contractor to coordinate with CATV authority to ensure availability of service.

1.4 PAYMENT

- .1 Arrange and pay for all Utility service charges from local CATV utility.

2 PRODUCTS

2.1 MATERIALS

- .1 Grounding: To Section 26 05 28, Grounding.
- .2 Underground Service Conduit: To Section 26 05 34, Conduits, Conduit Fastenings and Conduit Fittings.
- .3 CATV utility to install utility grade amplifier(s).

3 EXECUTION

3.1 INSTALLATION

- .1 Install underground CATV service conduit. Support as per Canadian Electrical Code, and utility requirements.
- .2 Install plywood backboard for main telephone distribution. Paint backboard with two coats of fire retardant paint.
- .3 Install grounding facilities, and make connections.
- .4 Provide a circuit(s) as required for connection of all amplifiers as provided by CATV installer.

END OF SECTION