

1 ELECTRICAL GENERAL PROVISIONS

1.1 GENERAL REQUIREMENTS

- .1 Comply with the requirements set out in Division 1.

1.2 APPLICATION

- .1 This Section applies to and is part of all Sections of divisions 26, 27 and 28.

1.3 DEFINITIONS

- .1 Notwithstanding any definition elsewhere in the contract documents, wherever the term "Contractor" is used in divisions 26, 27 and 28 Specifications, it means the firm having a contract with the "Departmental Representative" 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, 27 and 28 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 INSPECTION AUTHORITY means agent of any authority having jurisdiction over construction standards associated with any part of electrical work on site.
- .4 ELECTRICAL CODE means Local Code in force at Project location.
- .5 INDICATED means as shown on contract drawings or noted in Contract Documents.
- .6 Notwithstanding any definition elsewhere in the contract documents, wherever the term "Provide" is used in relationship to equipment, conduit, etc., in this Division, it means "Supply, Install, connect, test, commission and put into working order".
- .7 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.

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.
- .2 The project is a renovation project that includes main floor space, partial basement and partial second floor space of an existing 4 story office building with basement.
- .3 The building electrical power is distributed through a ceiling grid/quadrant system. Devices indicated for demolition shall have the wiring removed up to the nearest grid junction box, allowing the circuit to be reused for the renovation.
- .4 Existing ceiling devices to be disconnected or removed from existing ACT ceiling. The existing lighting wiring uses a modular wiring system (MWS). The lighting is controlled with an existing Douglas control system which is being retained for reuse. This project intend to reuse the existing light fixtures. The contractor will be require the safely store these items to be installed in ACT ceiling.
- .5 Fire Alarm ceiling devices are to be removed for demolition of existing ACT and re-installed in New ACT.
- .6 All existing Voice/Data cabling to be removed from the ceiling space back to the communication room.
- .7 All unused cables in ceiling space to be removed back to source.
- .8 Install existing 2'x4'light fixture in new ACT ceiling and provide new light fixture as indicated. Provide switching and dimming as indicated.
- .9 Provide new power connections for powered furniture. Some coring will be required to power some furniture.
- .10 Relocate and provide new card access to doors as indicated on drawings. There is an existing card access system which will require some modifications. Contractor to add existing system.
- .11 Relocate existing CCTV camera as indicated. This system is part of the base building CCTV system.
- .12 Provide new CCTV system for department use and to be viewed at the department security desk.
- .13 Provide a sound masking system for open areas.
- .14 Provide an emergency generator as associated distribution. Emergency generator will located outdoor with distribution located in the basement.

- .15 Provide fire alarm devices as indicated and provide additional power boosters are required.
- .16 Provide voice/data cable tray for new voice/data wiring.

1.6 DETAILED SCOPE OF WORK

- .1 The detailed Scope of Work includes, but is not limited to:
 - .1 Provide all labour, new materials, tools, transportation, services and facilities for a complete electrical installation to the satisfaction of the Departmental Representative.
 - .2 All other work as described herein or as shown on the drawings.
 - .3 Provide 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.
 - .4 Provide all Emergency and Exit lighting system including conduit, wire remote heads, batteries and battery charging system. Systems shall be complete in every respect.
 - .5 Provide power supply to all mechanical equipment and controls. Provide motor control as indicated.
 - .6 Provide a complete receptacle system including conduits, wire, receptacle, boxes and termination.
 - .7 Provide a complete operating system including wire, conduit, boxes, and pull string for, access control, CCTV, sound masking and security system.
 - .8 Provide all required interlocks between Fire Alarm System and door holders, Mag locks in accordance with MBC.
 - .9 Provide complete voice data system including conduit, cables, cable trays. The contractor is responsible for all facets of the project, including but not limited to backboards, BIX blocks, patch panels
 - .10 Provide all required seismic restrains.
 - .11 Provide complete Security system including but not limited to CCTV, door access, intrusion detection and intercom systems.

1.7 SUPPLEMENTARY TENDER FORM

- .1 There will be no substitution of named Subtrades / Manufactures after tender close except as approved by the Departmental Representative.

1.8 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 Departmental Representative 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.

1.9 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 conduits, cables and systems are 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 Departmental Representative reserves the right to furnish any additional detail drawings, which, in the judgement of the Departmental Representative, 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 Departmental Representative.
- .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 Departmental Representative, 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 Departmental Representative.

1.10 CHANGES TO THE SCOPE OF WORK

- .1 From time to time during construction, changes to the scope of work may be proposed by the Departmental Representative. These Proposed Changes are to be priced by the contractors in a timely manner. Only after the Departmental Representative 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.

1.11 LIABILITY

- .1 Maintain all necessary insurance coverage to save and indemnify the Departmental Representative.
- .2 Protect and maintain the work until the project has been completed and turned over to the Departmental Representative. Protect the building and contents from damage during the construction period. Repair all damages without additional cost to the Departmental Representative.
- .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 Departmental Representative.

1.12 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 Departmental Representatives and occupants.
- .3 It shall be the responsibility of the Contractor to schedule the work to meet the Departmental Representative's completion date. The Contractor shall coordinate the sub-trades and adjust the workforce as required to meet the schedule.

1.13 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 Departmental Representative.

1.14 ENGINEERING SITE REVIEW

- .1 The Sub-Contractor's work will be reviewed periodically by the Departmental Representative, the Departmental Representative 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 Departmental Representative any responsibility to supervise or oversee the erection or installation of any work.
- .2 The Departmental Representative will issue inspection reports and deficiency lists from time to time. All deficiencies shall be cleared up to the satisfaction of the Departmental Representative within a reasonably short time.

1.15 PATENTS

- .1 Pay all royalties and license fees, and defend all suits or claims, for infringement of any patent rights, and save the Departmental Representative 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.

1.16 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.

1.17 CODES, PERMITS, FEES AND INSPECTIONS

- .1 Comply with the most stringent requirements of the latest editions of the applicable C.S.A. standards 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 Departmental Representative 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 Departmental Representative. Should the authorities require the information on specific forms, fill in these forms by transcribing the information provided by the Departmental Representative.
- .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 Departmental Representative 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.

1.18 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
 - .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 Departmental Representative 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 Departmental Representative is for the sole purpose of ascertaining conformance with the general design concept.
- .3 This review shall not mean that the Departmental Representative 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 Soft copy of shop drawings will be acceptable.
- .6 Bind one complete set of final shop drawings in each operating and maintenance instruction manual.
- .7 Refer to the Architectural General Specifications for requirements.

1.19 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.

1.20 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 Departmental Representative for review. Make changes as requested by the Departmental Representative and resubmit. This process will continue until the "Record" drawings are deemed complete by the Departmental Representative.
- .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 Departmental Representative review.
- .5 For Additional Information, refer to Division 01 specification.

1.21 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.

1.22 WORK IN EXISTING AREAS

- .1 Do the work in existing areas to best suit the available space and not interfere with or obstruct the use of the existing facilities.
- .2 Cut, cap-off, modify, or extend as necessary or as directed by the Departmental Representative, existing material or equipment to be removed, reused or relocated to suit the work under this contract.
- .3 Where disruptions of existing Electrical services are required, coordinate the shutdown with the Departmental Representative and do the work at a time and in a manner mutually acceptable. Carefully schedule disruptions to keep "Down Time" to a minimum. Submit a concise written schedule of each disruption at least 72 hours in advance and obtain the Departmental Representative's written consent prior to implementation.

1.23 TEMPORARY SERVICES

- .1 Do not use any of the permanent Electrical systems during construction unless specific written approval is obtained from the Departmental Representative.
- .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.

1.24 TEMPORARY AND TRIAL USAGE

- .1 The Departmental Representative 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 Departmental Representative, 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 Departmental Representative.
- .4 Provide and pay for all testing required on the system components where, in the opinion of the Departmental Representative, Manufacturer's ratings or specified performance is not being achieved.

1.25 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 Departmental Representative.
 - .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 Departmental Representative 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 Departmental Representative.

1.26 INSTRUCTIONS TO DEPARTMENTAL REPRESENTATIVES

- .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 Departmental Representative's Representative.
- .2 Instruct the Departmental Representative'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 Departmental Representative for review. The Departmental Representative 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 Departmental Representative. The Sub-contractor shall turn over the completed manuals to the Departmental Representative.
- .6 Present all copies of the Final Record Drawings to the Departmental Representative.

1.27 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 Departmental Representative'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 for new light fixtures provided.
 - .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.

1.28 WARRANTIES

- .1 No certificate issued, payment made, or partial or entire use of the system(s) by the Departmental Representative, 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 Departmental Representative, 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 Departmental Representative. 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 Departmental Representative'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 Departmental Representative.
- .8 The Departmental Representative 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 Departmental Representative 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 Departmental Representative, 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 Departmental Representative for any temporary replacement component or for any labour required to implement the work.

1.29 DOCUMENTATION AND SYSTEM(S) ACCEPTANCE

- .1 The Contractor shall prepare a suitable document to be signed by the Departmental Representative confirming:
 - .1 The Departmental Representative 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 Departmental Representative.
 - .3 The "Record" and "As-constructed" drawings have been received and reviewed by the Departmental Representative.
 - .4 Specified spare parts, components, keys, removable handles, tools and the like, have been accepted by the Departmental Representative.

1.30 COMPLETION

- .1 The Contractor shall be aware that it is the Departmental Representative'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 SUBSTANTIAL COMPLETION
 - .1 The project will be ready for a Substantial Completion inspection only when it is ready for the Departmental Representative to occupy and utilize the building for its intended purpose.
 - .2 At Substantial Completion, the Departmental Representative realises 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 Departmental Representative'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 Departmental Representative 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 Departmental Representative will retain a sum of money, sufficient in his estimation to cover the cost of completing the deficiencies.

.3 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 Departmental Representative 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 Departmental Representative 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.

END OF SECTION

1 GENERAL

1.1 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 requirements of these codes, rules and regulations, the electrical installation shall be as shown on the drawings and as specified.

1.2 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.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data for review by the Departmental Representative. All drawings must be in English with metric where indicated. Manufacture 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 Departmental Representative's office. Pay all transportation costs to ship samples to Departmental Representative'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.

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 Departmental Representative 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 Departmental Representative reserves the right to review costing using accepted Contractor's Pricing Standards.

1.9 OTHER TRADES

- .1 Include in cost all work by sub-trades, 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 Departmental Representative.
- .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. This includes but not limited to receptacles, junction boxes, light fixture, fire alarm devices, etc.
- .2 Provide lamacoid nameplates, 1/8" (3 mm) thick plastic engraving sheet, black face, white core, 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 |
| Size 1 | 3/8" x 4" (10 x 100 mm) | 1 line 1/8" (3 mm) high |
| Size 2 | 1/2" x 3" (13 x 75 mm) | 1 line 3/16" (5 mm) high |
| Size 3 | 1/2" x 3" (13 x 75 mm) | 2 lines 1/8" (3 mm) high |
| Size 4 | 3/4" x 3" (19 x 75 mm) | 1 line 3/8" (10 mm) high |
| Size 5 | 3/4" x 4" (19 x 100 mm) | 2 lines 3/16" (5 mm) high |
| Size 6 | 1" x 4" (25 x 100 mm) | 1 line 1/2" (13 mm) high |
| Size 7 | 1" x 4" (25 x 100 mm) | 2 lines 1/4" (6 mm) high |
- .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 on 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.
- .8 Use heat shrink type markers or CAB-3 cable marking system (Pass & Seymour) for all conductors and cables. Mark cables at both ends. 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 (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 Departmental Representative before proceeding with installation.
- .4 Install electrical equipment at the following heights unless indicated or directed otherwise (to bottom of outlet).
 - .1 The electrical device mounting height requirements shall conform to Universal Design Institute guidelines and City of Winnipeg Access Design Standards.
 - .2 Outlets above counters: 150 mm; splashbacks: 100 mm.
 - .3 General receptacles, telephone and television outlets: 450 mm or match existing building outlet heights.
 - .4 Receptacles in mechanical and shop areas: 1 m.
 - .5 Switches, dimmers, push buttons: 900mm above the finished floor level measured from the centre of the device box or match existing building height.
 - .6 Fire alarm pullstations, thermostats: 1.2m above the finished floor level measured from the centre of the device box.
 - .7 Fire alarm bells, horns, speakers: 2.3 m.

- .8 Panelboards, annunciators, etc.: 2.0 m to top.
- .9 Handicap thermostats: 1.0 m.
- .10 Power door operator for person using wheel chair to be located and operated with two heights: one with its centre located 900mm from the finished floor level; and the other with its centre located 225mm from the finished floor level.
- .11 As per Architectural elevations.
- .12 Heights as above or at bottom of nearest block or brick course.
- .13 Wall mounted telephone: 1.2m.
- .5 All transformers, motor control centres and floor-mounted distribution panels shall be mounted on 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, 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, card access system, 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 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 Departmental Representative before arranging for any cutting. Patching shall restore the affected area to the original condition; materials and methods used for patching shall match existing.

3.11 WORKMANSHIP

- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Departmental Representative. 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 Junction Boxes and pull boxes are to be installed facing downwards, fully accessible without impediment of other conduits, piping, duct work or equipment.

- .3 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearances and accessibility for same.
- .4 Include, in the work, all requirements shown on the shop drawings or manufacturer's installation instructions.
- .5 Replace work unsatisfactory to the Consultant without extra cost.

END OF SECTION

1 GENERAL

1.1 SYSTEM DESCRIPTION

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

1.2 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.

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 Departmental Representative or General Contractor.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Electrical Safety and Essential
Electrical System in Health Care Facilities Z32-09

PART 2 PRODUCTS

2.1 Building Wires

- .1 Copper conductors: minimum #10, with 300V or 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .2 All wiring in EMT conduit.
- .3 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 Z32 standard Canadian Electrical Code rule 8-102. The contractor is responsible to increase sizes to suit voltage drop requirements without any extra additional cost.
- .4 Voltage drop for any feeder and branch circuits shall not exceed 3% between the branch circuit panel and the receptacle. Note: that voltage drop shall be calculated using minimum of 12 amps.
- .5 Provide bonding/grounding as per Canadian Electrical Code, section 24, and rules 24-104, 24-112. Each branch circuit in Patient care area shall have its own separate insulated bonding conductor.

PART 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 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 Z32 section 5.4 and Canadian Electrical Code rule 8-102. The contractor is responsible to increase sizes to suit voltage drop requirements without any extra additional cost.

3.2 Receptacle and Associated Circuit Testing Requirements:

- .1 Install receptacles and associated wiring in patient care areas as follows:
 - .1 Receptacle installation shall meet all requirement of Z32 and Canadian Electrical Code, section 24.
 - .2 Receptacle identification shall meet Z32-09, clause 5.6.5.
 - .3 Receptacle circuit quantity in patient care shall meet Z32-09, clause 5.6.1.1 and table 6.
 - .4 All circuits in patient care areas shall comply and meet all requirements of Z32 and Canadian Electrical Code, section 24.
 - .5 Receptacles shall be Hospital grade type. Hubbell 8200 Series or approved equal.
 - .6 The following tests shall be performed and submitted on the branch circuits of patient care areas:
 - .1 Insulation Resistance Test as per Z32, clause 5.3.2.
 - .2 Voltage Drop Test as per Z32, section 5.4 (5.4.1, 5.4.2, 5.4.3).

- .3 Mechanical Operation Test of circuit breakers as per Z32, section 5.5.
 - .4 Mechanical Tension Test of all non-locking receptacles by means of retention tester as per Z32, clause 5.6.6.1 and clause 5.6.6.2.
 - .5 Polarity Test of all receptacles per Z32, clause 5.6.6.3.
 - .6 Voltage Difference Limits Test as per Z32, section 5.9.
 - .7 Ground Return Path Voltage Rise Test as per Z32, section 5.10.
- .7 Submit test results to the consultant. The contractor shall be responsible for all corrections and modifications on all feeder/wiring and devices without any extra costs to meet all requirements of Z32 standard and Canadian Electrical Code section 24 and rule 8-102.

1 GENERAL

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 #10 AWG, copper.

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.
- .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 diameter 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 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 groundling 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 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .9 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.
- .10 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 Refer to Division 27 for telecommunication room grounding requirements.

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

2 PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, galvanized, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended as indicated.
- .2 Galvanized threaded rods 9.5 mm minimum.

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 two 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 galvanized 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.
- .12 Suspended equipment to be secured to concrete structure.
- .13 Conduits shall not run horizontally mounted on wall. All horizontally conduits to be on ceiling rack.

END OF SECTION

1 GENERAL

2 PRODUCTS

2.1 LOCATION

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

2.2 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.
- .4 Extension rings not acceptable.

2.3 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 JUNCTION PULLBOXES AND CABINETS

- .1 Install pullboxes in inconspicuous but accessible locations and facing downwards.
- .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 and fully accessible.

3.2 IDENTIFICATION

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

END OF SECTION

1 GENERAL

1.1 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 LOCATION OF CONDUIT

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Electrical contractor to produce layout sketches of conduit runs through mechanical and electrical service areas in order to 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 19mm (3/4").
- .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 32 mm (1 1/4") and smaller. Two hole steel straps for conduits larger than 32 mm (1 1/4").
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 U-channel galvanized type supports for two or more conduits at 1.52 m (60") intervals (surface-mounted or suspended). Four 6 mm (1/4") diameter threaded rods to support suspended channels. One rod shall be non-ferrous.
- .4 No wall mounted conduits.

2.3 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduit specified.

- .2 Manufacturer elbows where 90E bends are required for 64 mm (2") and larger conduits.
- .3 Steel set screw connectors and couplings, Insulated throat liners on connectors.
- .4 Raintight connector steel fittings, complete with O-rings, for use on weatherproof or sprinklerproof enclosures and electrical rooms. 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 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.
- .5 All wiring under computer floors shall be in liquid-tight flexible metal conduit, or teck cable, where indicated.
- .6 Motor connections (use liquid-tight flexible metal conduit only) shall not exceed 6' (1.83m) except where expressly allowed by the Consultant.
- .7 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

- .8 Install polypropylene fish cord in empty conduits.
- .9 Where conduits become blocked, remove and replace blocked section.
- .10 The length of any conduit run shall not exceed 45 m (150') 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 300 mm (12") of entering any junction box, pullbox, cabinet, or panelboard.
- .11 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.
- .12 Provide and install separate ground wire in each conduit run.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not locate conduits within 2 m (78") 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 150 mm (6") to steam or hot water lines.
- .6 Do not mount conduits horizontally on walls.

3.3 CONCEALED CONDUITS

- .1 Do not install conduit home runs horizontally in 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 SYSTEM DESCRIPTION

- .1 Provide complete electrical power and control connections for mechanical and 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 and pool equipment, unless otherwise indicated.
- .2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical and pool equipment, except for 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 and 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.
- .5 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 FIRE PROTECTION (SPRINKLER AND STANDPIPE)

- .1 N/A

3.4 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

Part 1 General

1.1 SUMMARY

.1 Acronyms:

- .1 Cx - Commissioning.
- .2 CxA - Commissioning Agent
- .3 CSA - Canadian Standards Association
- .4 EEMAC - Electrical and Electronic Manufacturers' Association of Canada

1.2 INTENT

- .1 Provide commissioning of electrical equipment and systems in accordance with this, Section 01 91 13 and related sections.
- .2 All items noted in this document are the responsibility of the contractor supplying and installing the equipment, unless noted otherwise.

1.3 MANUFACTURER'S SERVICE ON SITE

- .1 Arrange and pay for qualified Manufacturer's representatives to supervise starting and testing of electrical equipment and systems.
- .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 Departmental Representative prior to shipping.

Part 2 Products

- .1 Not Used

Part 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 all equipment not listed in this section.
- .3 Document the commissioning process by completing the Product Information (PI) forms, Performance Verification (PV) Tests and System PV 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 per voltages as indicated in electrical specifications.
 - .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 and Unfused Disconnect Switches:
 - .1 Visually inspect and clean.
 - .2 Megger test.
 - .3 Mechanical function test.
- 3.3 TRANSFORMERS - UNDER 225 kVA
- .1 Visual inspection of enclosure and all accessories.
 - .2 Test the following:
 - .1 Torque test all bus connections and cable terminations.
 - .2 Megger test.
 - .3 Test operation of temperature gauge and operation of all associated alarm contacts.
 - .4 Test and calibrate ground fault relays and function test to trip associated breakers.

3.4 MOTOR CONTROL CENTRES

- .1 Visually inspect and clean.
- .2 Remove starter covers to expose all bussing and confirm phasing continuity and rotation and identification of bussing.
- .3 Torque test all bus connections and cable terminations to Manufacturer's recommended levels.
- .4 After bus connections have been torque tested, apply red lacquer to bolted connections.
- .5 Megger test - phase to phase and phase to ground.
- .6 Ductor test bus connections and starter/feeder assemblies as follows:
 - .1 Across starter assembly with disconnect and contactor contacts closed (from line side of disconnect to load side of contactor).
 - .2 From source connection at MCC to each starter disconnect line terminals to check MCC bussing and stab connections.
- .7 Ensure all motor starters are properly labelled prior to testing.

3.5 600 V 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.

3.6 208 V 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.

3.7 STANDBY POWER GENERATION SYSTEM

.1 Factory Testing:

- .1 Perform a one-hour load test using a portable test bank.
- .2 Perform test for four hours with load applied in 20% steps every 30 minutes until full load is applied and one hour at 110% full load. Record following to at least the specified accuracy at 15 minute intervals during the entire test:

- .1 Power (+/- 2 W)
- .2 Current (+/- 0.5 A)
- .3 Voltage (+/- 1 V)
- .4 Frequency (+/- 0.05 Hz)
- .5 Oil Pressure (+/- 0.5 kPa)
- .6 Coolant Temperature (+/- 0.5 °C)
- .3 Test response of governor (droop or isochronous) applying 20% load and 100% load in one step. Use a storage oscilloscope or strip chart recorder to determine response time, voltage and frequency fluctuations during test.
- .4 Test voltage regulator and compare for conformance to Manufacturer's product data.
- .5 Record noise level measurements in dB at various locations around unit and area surrounding exhaust port.
- .6 Submit certified test results for approval by Owner.
- .2 Site Testing:
 - .1 Prior to energizing power generation units on site:
 - .1 Ensure generating system is disconnected from normal power supply.
 - .2 Ensure all auxiliary support devices are operational, including ventilation and exhaust systems.
 - .3 Ensure that engine has proper lubricant levels, coolant levels and fuel supply.
 - .4 Ensure all testing on emergency distribution equipment and transfer switch as specified has been completed.
 - .2 Conduct Site Testing in conjunction with Manufacturer and in presence of the Owner.
 - .3 Simulate power failure including operation of:
 - .1 Transfer switch.
 - .2 Automatic starting cycle.
 - .3 Automatic shutdown and return to normal.
 - .4 Test all alarm and shutdown circuits by simulating conditions. Closing or opening of appropriate sensor contacts mechanically is not acceptable.
 - .5 Record noise level measurements in dB at various locations in generator room and area surrounding exhaust port.
 - .6 Perform four-hour full-load testing utilizing portable test bank and as many of building loads as possible.

Record following to at least the specified accuracy at 15 minute intervals during entire test:

- .1 Power (+/- 2 W)
- .2 Current (+/- 0.5 A)
- .3 Voltage (+/- 1 V)
- .4 Frequency (+/- 0.05 Hz)
- .5 Oil Pressure (+/- 0.5 kPa)
- .6 Coolant Temperature (+/- 0.5 °C)
- .7 Room Temperature (+/- 0.5 °C)
- .7 Fuel required for unit testing to be provided by Division 16.

3.8 EMERGENCY SWITCHGEAR

.1 Enclosure:

- .1 Visually Inspect.
- .2 Torque all bus connections to Manufacturer's 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 check as listed above.

.4 Breakers - Molded Case Breakers 150 Amp Frame and Larger:

- .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 solid state relay 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 instructions.
 - .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 the trip operation.
 - .5 Check C/T and P/T ratios and compare to coordination data.

3.9 TRANSFER SWITCHES

- .1 Torque test all bus joints and cable terminations and seal with red lacquer.
- .2 Ductor test.
- .3 Megger test.
- .4 Power up control circuits, simulate loss of normal power and function all devices including timers.
- .5 Apply device settings as specified.
- .6 Wiring Checks as listed:
 - .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.

3.10 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 documentation.

3.11 ELECTRICAL START-UP AND TESTING

- .1 Energizing Main Electrical System:
 - .1 Prior to energizing main electrical system after modification:
 - .1 Verify supply authority voltage and phase rotation.
 - .2 Ensure all testing as specified by Design Authority 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, Canadian Electrical Code, and electrical specifications.
- .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 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.
 - .6 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.
- 3.12 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 lamicoid labelling.
- 3.13 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 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 Confirm operation of battery operated emergency lighting units including battery size and operating time.
- .7 Confirm operation of exit lights and connections of exit lights to emergency lighting panels.
- .8 Check all terminations and label all lighting circuits.

3.14 LIGHTING CONTROL SYSTEM

- .1 Inspect system to ensure that the low voltage lighting system is correctly installed, connected and fully operational in accordance with requirements of the Contract Documents and Manufacturers recommendations.
- .2 Test each lighting sequence and document appropriately.
- .3 Demonstrate the operation of each timed, occupancy control or daylight control function to the Owner.
- .4 Ensure the program interface provides an easy means for the building operator to make changes to the sequences.

3.15 REPORTING

- .1 Provide CxA and the Design Authority with installation and test documentation consistent with the requirements in this section.

3.16 ELECTRICAL EQUIPMENT AND SYSTEMS DEMONSTRATION AND INSTRUCTION

- .1 Provide operation and maintenance instruction and demonstrations in accordance with Section 01 91 13.

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.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Panelboards shall be as manufactured by Schneider Canada to match existing panelboards within the existing space.
- .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 and panelboard's shall be sprinkler proof and CSA enclosure 3.
- .10 Provide 3 spare 15 amp 1 Pole breakers for each new panelboard and 1 spare 15 amp 3 Pole for each new CDP.
- .11 Provide GFCI and AFCI breakers as indicated.
- .12 Provide removable directory on clear plastic holders.

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.

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 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 Brown or white toggle as directed by Architect.
 - .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:

<u>Volt</u>	<u>Manufacturer</u>	<u>120 Volt</u>	<u>347</u>
18200 Series	Hubbell	1200 Series	
	Bryant	4800 Series	
	6800 Series		
54500 Series	Leviton	1200 Series	
	Pass & Seymour	15AC1 Series	3715
	Arrow Hart	1891 Series	
18201 Series	Woodhead	1890 Series	

2.2 RECEPTACLES

- .1 Duplex receptacles, NEMA No. 5-15R, 125V AC, 15A, U-ground, with the following features:
- .1 Nylon face, red for emergency 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.
- .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 of one manufacturer throughout project.

- .4 Receptacles to be premium specification grade.
- .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 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.
- .5 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.
- .6 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 COVERPLATES

- .1 Coverplates from one manufacturer throughout project.
- .2 Stainless steel coverplates for wiring devices mounted

in flush-mounted outlet boxes.

- .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.

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 vertically 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.

END OF SECTION

1 GENERAL

1.1 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 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.

2.5 MANUFACTURERS

- .1 Acceptable manufacturers: Cutler Hammer,

Schneider Canada, or General Electric.

3 EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

1 GENERAL

1.1 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 and 4X, size as indicated.
- .2 Process areas, Cooler, Cutting, and Packaging Areas: Fusible and non-fusible disconnect switches shall be EEMAC Type 4X, 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
- .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

2HP 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 2HP 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.
- .14All the equipment required disconnect with short circuit level greater than 10KA shall be equipped fusible disconnect switch c/w current limiting fuses type J, RK1 RK5 or L.

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 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 REFERENCES

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

1.3 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

1.4 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 1.4, and shall incorporate all changes made during the manufacturing process.
 - 2. Wiring diagrams

1.5 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.

1.6 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. The enclosure shall be NEMA 3 in Electrical and Mechanical rooms.

2.3 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 REFERENCES

- .1 The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards below:

- .1 CSA C22.2 No14
- .2 CSA 282
- .3 CSA 100
- .4 EN61000-6
- .5 EN55011
- .6 FCC Part 15 Subpart B
- .7 ISO8528
- .8 IEC61000
- .9 UL508
- .10 UL2200
- .11 UL142
- .12 Designed to allow for installed compliance to NFPA 70, NFPA99 and NFPA 110

1.4 SYSTEM DESCRIPTION

- .1 Supply and delivery to site of a standby power generator.
- .2 Standby generator shall meet the following specifications
- .3 Diesel generating set rated at 100KW 347/600V, 3 phase, 4 wire
 - .1 Diesel engine
 - .2 Generator
 - .3 Engine/generator control panel
 - .4 Automatic transfer equipment and control
 - .5 Remote annunciation panel (for installation in electrical room by others)
 - .6 Emergency stop button (Provide 2 pushbuttons, 1 installed within the enclosure and 1 shipped loose for installation by others)

- .7 Battery charger and batteries
- .8 Cooling system
- .9 Fuel supply system and sub base fuel tank
- .10 Exhaust system
- .11 Structural steel mounting base.
- .12 Lube system
- .13 Insulated weatherproof skin tight type enclosure
- .14 Critical grade muffler. Extend muffler to underside of second floor. Provide thimble where exhaust run under the underside of the second floor.
- .15 60Amp 120/240V 1 Phase 3 Wire Panel c/w breakers as required. Panel shall be integral to enclosure to service block heaters, space heaters, controls etc. All accessories shall be prewired.
- .4 Set designed to operate automatically as emergency standby source.

1.5 SUBMITTALS

- .1 Engine-generator submittals shall include the following information:
 - .1 Factory published specification sheet.
 - .2 Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, etc.
 - .3 Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
 - .4 Weights of all equipment.
 - .5 Concrete pad recommendation, layout and stub-up

locations of electrical and fuel systems.

- .6 Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, control panel, and remote alarm indications.
- .7 Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.
- .8 Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
- .9 Generator resistances, reactances and time constants.
- .10 Generator locked rotor motor starting curves.
- .11 Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.
- .12 Manufacturer's and dealer's written warranty.
- .13 Remote annunciator panel.
- .14 Remote Emergency Stop Station.

1.6 OPERATION AND MAINTENANCE DATA

- .1 Provide Operation and Parts Manuals, as listed below, for incorporation into Maintenance Manuals.
 - .1 Operation instructions - with description and illustration of all switchgear controls and indicators and engine and generator controls
 - .2 Parts book - that illustrate and list all assemblies,

sub- assemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.)

- .3 Preventative maintenance instructions - on the complete system that covers daily, weekly, monthly, bi-annual, and annual maintenance requirements and includes a complete lubrication chart.
- .4 Troubleshooting chart - covering the complete generator set showing description of trouble, probable cause, and suggested remedy.
- .5 Recommended spare parts list - showing all consumables anticipated to be required during routine maintenance and test.
- .6 Wiring diagrams and schematics - showing function of all electrical components.

1.7 MAINTENANCE MATERIALS

- .1 Provide maintenance materials and turn over to Owner.
- .2 Include:
 - .1 2 fuel filter replacement elements.
 - .2 6 lube oil filter replacement elements.
 - .3 2 air cleaner filter elements.
 - .4 2 set of fuses for control panel.
 - .5 One battery hydrometer.

1.8 PROTOTYPE TESTING

- .1 The power system consisting of prime mover, generator and all necessary controls must be tested as complete systems on representative engineering prototype models. The tests, being potentially damaging to the equipment tested, must not be performed on equipment sold, but on separate prototype models. A certificate certifying that this prototype testing as applicable to a 100KW unit has been

performed shall be submitted along with submittal data for approval. These tests shall have included, but not have been limited to:

- .1 Maximum power level (maximum kW).
- .2 Maximum motor starting capacity (maximum kVA).
- .3 Structural soundness.
- .4 Torsigraph analysis per MIL-STD 705B, Method 504.2. A torsional analysis shall be calculated using data from actual tests by the engine-generator set manufacturer to verify freedom from torsional stresses with $\pm 10\%$ of rated speed. Results shall be made available to Consultant upon request. Actual torsional fatigue test must be performed on the complete prototype generator-set. Calculations based on engine and generator data separately are not acceptable.
- .5 Engine-alternator cooling air flow.
- .6 Transient response and steady-state governing.
- .7 Alternator temperature rise by imbedded thermocouples and by resistance method per NEMA MG1-22.40.
- .8 Harmonic analysis and voltage wave form deviation per MIL-STD-05B, Method 601.4.
- .9 Three-phase short-circuit test for mechanical and electrical strength. With system operating at rated volts, amps, power factor, and speed, the generator terminals must be short circuited ten times on all three phases for duration of thirty seconds. Generator set must build up and perform normally without manual interventions of any kind such as re-setting of circuit breakers or other ripping devices when the short circuit is removed.
- .10 Failure mode test for voltage regulator. With generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The generator set must be fully operative after the test, and without evidence of any kind of damage.

- .11 Endurance testing at rated load and speed is required without significant damage or failures of electrical or mechanical components.

1.9 FACTORY TESTING

- .1 Before shipment of equipment, factory test generator set including engine, alternator, control panels, transfer equipment and accessories for performance and proper functioning of control and interfacing circuits.
- .2 Test procedures shall include:
 - .1 Load test at rated load and power factor for a continuous 1 hour time period to observe engine blow by, slobber, combustion gas leaks, inlet air leaks, excessive vibration and unusual noise.
 - .2 Single step load pickup per NFPA 76A.
 - .3 Transient response and steady state governing.
 - .4 Functional compatibility between generator set controls and transfer switch controls (start, transfer, retransfer, stop, with all time delays).
 - .5 Fuel consumption.
 - .6 Time of reading
 - .7 Running time
 - .8 Ambient temperature in °C
 - .9 Lube oil pressure in kPa
 - .10 Lube oil temperature in °C)
 - .11 Engine coolant temperature in °C
 - .12 Exhaust stack temperature in °C
 - .13 Alternator voltage, Phase A, B, C, AN, BN, CN

- .14 Alternator current, Phase A, B and C
- .15 Power in kW
- .16 Frequency in Hz
- .17 Power factor
- .18 Battery charger current in A
- .19 Battery voltage
- .20 Alternator stator temperature in °C.

1.10 FIELD TESTING

- .1 Prior to the official field test, the following related items must be completed and operational:
 - .1 The ventilation system and related damper controls for the generator enclosure.
 - .2 The fuel tank, float sensors and related pumps.
 - .3 The insulation on the exhaust system.
 - .4 The complete standby power system shall be initially started and checked out for operational compliance by factory-trained representatives of the manufacturer of the generator set or the electrical contractor with assistance of factory representatives. The initial start-up must be performed at least two days in advance of the Field Test to allow the factory representative time to correct any part of the system, which may not be functioning properly.
- .2 Upon completion of the above items the standby power system shall be ready for a Field Test, which shall be performed by the generator set supplier and witnessed by the Consultant.
- .3 Notify the Consultant 6 working days in advance of the Field Test.
- .4 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 number
 - .3 Engine make, model, serial number
 - .4 Alternator make, model, serial number
 - .5 Voltage regulator make and model
 - .6 Rating of generator set kW, kVA, V, A, RPM, Hz.
- .2 Submit test results with the Maintenance Manuals.
- .5 Using the building as load on generator, operate set for 4 hours, taking readings at 30 min. intervals, and record following:
 - .1 Time of reading
 - .2 Running time
 - .3 Ambient temperature in °C
 - .4 Lube oil pressure in kPa
 - .5 Lube oil temperature in °C)
 - .6 Engine coolant temperature in °C
 - .7 Exhaust stack temperature in °C
 - .8 Alternator voltage, Phase A, B, C, AN, BN, CN
 - .9 Alternator current, Phase A, B and C
 - .10 Power in kW
 - .11 Frequency in Hz
 - .12 Power factor
 - .13 Battery charger current in A

- .14 Battery voltage
- .15 Alternator stator temperature in °C.
- .6 Demonstrate automatic starting of set and automatic transfer of load on failure of normal power and transfer on resumption of normal power.
- .7 Demonstrate operation of manual bypass switch (if provided) in both directions.
- .8 Demonstrate automatic shut down of engine on resumption of normal power.
- .9 Demonstrate that battery charger reverts to high rate charge after cranking. Demonstrate two-minute total cranking capacity and recharge cycle.
- .10 Demonstrate low oil pressure and high engine temperature shutdowns.
- .11 Simulate loss of normal power by de-energizing main distribution feeder breaker. Allow generator to operate with building loads. Re-energize main distribution feeder breaker. Note operation of transfer switch and controls during the simulated power failure test.

1.11 GUARANTEE

- .1 After the site testing is completed and all systems are operating satisfactorily, the system supplier shall submit a certification report and letter stating that the complete standby generator installation complies with the requirements of the manufacturer.
- .2 The standby generator equipment, as supplied and installed, shall be guaranteed for a period of two years from date of acceptance and turnover to the Owner.

1.12 ON-SITE INSTRUCTION

- .1 The generator set supplier shall provide 2 hours on-site instruction to familiarize personnel with the operational techniques and preventive maintenance procedures for the system.

PART 2 PRODUCTS

2.1 GENSET REQUIREMENTS

The generator set shall be Standby Duty rated at 100kw, 1800 RPM, 0.8 power factor, 600 V, 3-Phase, 60 hertz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 85F and altitude of 900.0 feet

2.2 MATERIAL AND PARTS

- .1 All materials and parts comprising the unit shall be new and unused.

2.3 ENGINE

- .1 The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 - D2 Emissions Cycle at specified ekW / bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder. Emissions requirements / certifications of this package: EPA Tier 3
- .2 **ENGINE GOVERNING**
 - .1 The engine governor shall be a electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing

which isolates and protects electronic components from moisture and dirt contamination. Speed droop shall be adjustable from 0 (isochronous) to 10%, from no load to full rated load. Steady state frequency regulation shall be +/- 6 RPM. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The ECM shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

2.4 GENERATOR

.1 GENERATOR SPECIFICATIONS

- .1 Generator shall be a synchronous, three phase, four pole, 2/3 pitch, random wound, single or double bearing, and IP23 drip proof. Bearing(s) shall be double shielded and maintenance free. The insulation system shall meet NEMA MG 1 and UL1446 standards for Class H insulation. Generator temperature rise shall be limited to NEMA MG1 temperature limit of 150C at a 40C ambient. The excitation system shall enable the generator to sustain 300% (250% for 50hz) of rated current for ten seconds at prime rating during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads

2.5 VOLTAGE REGULATOR

.1 Digital Voltage Regulator

- .1 The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.25% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to

optimize voltage and frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.

- .2 The voltage regulator shall communicate with the Generator Control Panel via a J1939 communication network with generator voltage adjustments made via the controller keypad. Additionally, the controller shall allow system parameter setup and monitoring, and provide fault alarm and shutdown information through the controller. A PC-based user interface shall be available to allow viewing and modifying operating parameters in a windows compatible environment.

2.6 CIRCUIT BREAKER SPECIFICATIONS

- .1 Provide a generator mounted 14 KAIC adjustable LSI electronic trip circuit breaker sized accordingly to the generator output. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

2.7 CONTROLS – GENERATOR SET MOUNTED

- .1 Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

2.8 ENVIRONMENTAL

- .1 The generator set control shall be tested and certified to the following environmental conditions:
 - .1 -40°C to +70°C Operating Range
 - .2 0-95% humidity non-condensing, 30°C to 60°C
 - .3 IP22 protection for rear of controller; IP55 when

- installed in control panel
- .4 5% salt spray, 48 hours, +38°C, 36.8V system voltage
- .5 Sinusoidal vibration 4.3G's RMS, 24-1000Hz
- .6 Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)
- .7 Shock: withstand 15G

2.9 FUNCTIONAL REQUIREMENTS

- .1 The following functionality shall be integral to the control panel.
 - .1 The control shall include a minimum 64 x 240 pixel, 28mm x 100mm, white backlight graphical display with text based alarm/event descriptions
 - .2 The control shall include a minimum of 3-line data display
 - .3 Audible horn for alarm and shutdown with horn silence switch
 - .4 Standard ISO labeling
 - .5 Multiple language capability
 - .6 Remote start/stop control
 - .7 Local run/off/auto control integral to system microprocessor
 - .8 Cooldown timer
 - .9 Speed adjust
 - .10 Lamp test
 - .11 Push button emergency stop button
 - .12 Voltage adjust
 - .13 Voltage regulator V/Hz slope - adjustable
 - .14 Password protected system programming

2.10 DIGITAL MONITORING CAPABILITY

- .1 The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units
 - .1 Engine
 - .1 Engine oil pressure
 - .2 Engine oil temperature
 - .3 Engine coolant temperature
 - .4 Engine RPM
 - .5 Battery volts
 - .6 Engine hours

- .7 Engine crank attempt counter
- .8 Engine successful start counter
- .9 Service maintenance interval
- .10 Real time clock

.2 Generator

- .1 Generator AC volts (Line to Line, Line to Neutral and Average)
- .2 Generator AC current (Avg and Per Phase)
- .3 Generator AC Frequency
- .4 Generator kW (Total and Per Phase)
- .5 Generator kVA (Total and Per Phase)
- .6 Generator kVAR (Total and Per Phase)
- .7 Power Factor (Avg and Per Phase)
- .8 Total kW-hr
- .9 Total kVAR-hr
- .10 % kW
- .11 % kVA
- .12 % kVAR

.3 Voltage Regulation

- .1 Excitation voltage
- .2 Excitation current

2.11 ALARMS AND SHUTDOWNS

- .1 The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:
 - .1 Engine Alarm/Shutdown
 - .2 Low oil pressure alarm/shutdown High coolant temperature alarm/shutdown
 - .3 Loss of coolant shutdown
 - .4 Overspeed shutdown
 - .5 Overcrank shutdown
 - .6 Emergency stop depressed shutdown
 - .7 Low coolant temperature alarm
 - .8 Low battery voltage alarm
 - .9 High battery voltage alarm
 - .10 Control switch not in auto position alarm
 - .11 Battery charger failure alarm Generator

Alarm/Shutdown

- .12 Generator over voltage
- .13 Generator under voltage
- .14 Generator over frequency
- .15 Generator under frequency
- .16 Generator reverse power
- .17 Generator overcurrent
- .18 Voltage Regulator Alarm/Shutdown
- .19 Loss of excitation alarm/shutdown
- .20 Instantaneous over excitation alarm/shutdown
- .21 Time over excitation alarm/shutdown
- .22 Rotating diode failure
- .23 Loss of sensing
- .24 Loss of PMG

.2 INPUTS AND OUTPUTS

.1 Programmable Digital Inputs

- .1 The Controller shall include the ability to accept eight (8) total with six (6) programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

.2 Programmable Relay Outputs

- .1 The control shall include the ability to operate eight (8) total with six (6) programmable relay output signals, integral to the controller. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.

.3 Programmable Discrete Outputs

- .1 The control shall include the ability to operate two (2) discrete outputs, integral to the controller, which are capable of sinking up to 300mA.

2.12 MAINTENANCE

- .1 All engine, voltage regulator, control panel and accessory

units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control

- .1 Engine running hours display
- .2 Service maintenance interval (running hours or calendar days)
- .3 Engine crank attempt counter
- .4 Engine successful starts counter
- .5 20 events are stored in control panel memory
- .6 Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
 - .1 Day of week
 - .2 Time of day to start
 - .3 Duration of cycle

2.13 REMOTE COMMUNICATIONS

- .1 Remote Communications
 - .1 The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.
- .2 Remote Monitoring Software
 - .1 The control shall provide Monitoring Software with the following functionality
 - .1 Provide access to all data and events on generator set communications network
 - .2 Provide remote control capability for the generator set
 - .3 Ability to communicate via Modbus RTU or remote modem

2.14 LOCAL AND REMOTE ANNUNCIATION

- .1 Provide both a local and remote annunciator panel. Remote panel shall be shipped loose for installation by others
 - .1 Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1. Provide

extra set of alarm contacts as required for fire alarm connection and monitoring.

- .2 Annunciators shall be networked directly to the generator set control
- .3 Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
- .4 Provide the following individual light indications for protection and diagnostics
 - .1 Overcrank
 - .2 Low coolant temperature
 - .3 High coolant temperature warning
 - .4 High coolant temperature shutdown
 - .5 Low oil pressure warning
 - .6 Low oil pressure shutdown
 - .7 Overspeed
 - .8 Low coolant level
 - .9 EPS supplying load
 - .10 Control switch not in auto
 - .11 High battery voltage
 - .12 Low battery voltage
 - .13 Battery charger AC failure
 - .14 Emergency stop
 - .15 Spare
 - .16 Spare

2.15 COOLING SYSTEM

- .1 The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories.

The cooling system shall be sized to operate at full load conditions and 110 F* ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.16 FUEL SYSTEM

.1 Fuel System

- .1 The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi.

.2 Fuel Sub Base Tank

- .1 Provide a double wall sub-base tank constructed to meet all local codes and requirements. A fuel tank base of minimum 12 hour capacity shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall meet UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.

2.17 EXHAUST SYSTEM

- .1 The exhaust silencer shall be mounted outside the enclosure to the ceiling (floor mounted structures are not acceptable). It shall be in a shroud to protect against routing near combustible material. Exhaust tip will be mounted minimum 2.4m or meet Authority having Jurisdiction requirements for exhausting in a back lane. It shall include horizontal discharge exhaust piping with bird screen or an elbow with a flapper. It shall also incorporate stainless steel flexible piping between the silencer inlet and the generator outlet that is a minimum of 12 inches long. The flexible piping shall utilize at least one floating flange and shall not support the weight

of the silencer. Gaskets shall be required for all flanged connection points in the exhaust system. All roof or wall penetrations must be water tight. Internal silencers shall ship to site installed.

- .2 The silencer shall be critical grade providing sound attenuation of 25-35 dB(A). The silencer and exhaust piping shall be coated to resist rust and high temperatures. The silencer and exhaust piping shall not exceed the recommended backpressure allowance of the generator manufacturer.

2.18 STARTING MOTOR

A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

2.19 JACKET WATER HEATER

- .1 Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

2.20 BATTERIES

- .1 Batteries - A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system.

2.21 BATTERY CHARGER

- .1 Battery Charger - A minimum 10Amp current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

2.22 AUTOMATIC BYPASS TRANSFER SWITCH

- .1 Provide supply only of a 100Amp 347/600V 3 Phase 4 Wire 35KA rated open transition transfer switch complete with normal bypass Refer to section 26 36 23
- .2 Provide supply only of a 60Amp 347/600V 3 Phase 4 Wire 35KA rated open transition transfer switch complete with normal

bypass Refer to section 26 36 23

2.23 FABRICATION

.1 Shop assemble generating unit including:

- .1 Base
- .2 Sub-base fuel tank
- .3 Engine
- .4 Generator
- .5 Control panel
- .6 Enclosure

2.24 FLUIDS

- .1 Provide lube oil and antifreeze.
- .2 Provide Number 2 or cold weather blend diesel fuel, as recommended by the manufacturer.

2.25 WEATHER PROOF SOUND ATTENATED ENCLOSURE

- .1 The enclosure design shall be a sound attenuated style
- .2 Enclosure shall be designed to meet wind and snow loading as per the National Building Code (NBC)
- .3 Enclosure is to be manufactured of aluminum or galvanized steel
- .4 Enclosure must be assembled on an aluminum or galvanized steel frame.
- .5 Enclosure base shall have an opening of minimum 24"x16" below the generator breaker
- .6 External fasteners shall be stainless steel. Internal fasteners shall be rust resistant (zinc/nickel coated or stainless steel).

.7 Automotive grade paint or powder coat shall be used to cover all exposed surfaces.

.8 The enclosure shall include the following accessories:

a. 60A 120/240V 1 phase distribution panel for wire and connection of all engine and space heaters, battery chargers, controls, damper interior lighting, receptacles etc. Electrical feeds to equipment shall be in EMT except where flexible connections are required, liquid tight flex shall be used

b. 1 GFCI convenience receptacles.

c. Space Heater

d. Motorized Intake & Discharge Louvers c/w modulating actuators

e. All equipment/accessories shall be CSA approved

.9 The enclosure, generator, & tank shall ship completely assembled to site. The enclosure manufacturer shall assemble silencer, electrical components, plenums, etc.

.1

2.26 ACCEPTABLE MANUFACTURERS

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

PART 3 EXECUTION

3.1 START-UP AND TESTING

.1 Coordinate all start-up and testing activities with the Engineer and Owner. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

- .1 Perform 100% of generator set rating for a 4 hour

- test using resistive load bank.
- .2 Test must meet CSA C282 requirements. Provide all documentation and reports to the Departmental Representative.

3.2 INSTALLATION

- .1 Deliver complete genset/enclosure to site and place as per site plan.

END OF SECTION

1 GENERAL

1.1 SCOPE

- .1 The Contractor shall furnish the low voltage automatic transfer switches and bypass isolation switch having the ratings, features/accessories as specified herein and as shown on the contract drawings.

1.3 REFERENCES

- .1 The automatic transfer switch and bypass isolation switches and all components shall be designed, manufactured and tested in accordance with the latest applicable CSA standards as follows:
 - .1 CSA 22.2 No. 178 - Automatic Transfer Switches
 - .2 CSA C282 - Emergency Electrical power Supply for Buildings
 - .3 CSA Z32 - Electrical Systems in Health Care Facilities
 - .4 CSA 22.2 No. 5.1 - Moulded Case Circuit Breakers
 - .5 CSA 22.2 No. 5.2 - Moulded Case Switches.
 - .6 NFPA 110: Standard for Emergency and Standby Power Systems
 - .7 Canadian Electrical Code 2012 (CEC), Section 46.

1.4 SUBMITTALS - FOR REVIEW/APPROVAL

- .1 The following information shall be submitted to the Engineer:
 - .1 Master drawing index
 - .2 Front view and plan view of the assembly
 - .3 Schematic diagram
 - .4 Nameplate schedule
 - .5 Component list
 - .6 Conduit space locations within the assembly
 - .7 Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current rating
 - .8 Major component ratings including:
 - a. Voltage
 - b. Continuous current rating
 - c. Interrupting ratings
 - .9 Cable terminal sizes

- .10 Product Data Sheets.
- .2 Where applicable, the following additional information shall be submitted to the Engineer:
 - .1 Busway connection
 - .2 Connection details between close-coupled assemblies
 - .3 Composite front view and plan view of close-coupled assemblies
 - .4 Interlock schematic drawing, Kirk-key or as indicated otherwise, and sequence of operations
 - .5 Mimic bus.
 - .6 Submit electronic copies of the above information.

1.5 SUBMITTALS - FOR INFORMATION

- .1 When requested by the Departmental Representative, the following product information shall be submitted:
 - .1 Descriptive bulletins.
 - .2 Product guides/sheets

1.6 SUBMITTALS - FOR CONSTRUCTION

- .1 The following information shall be submitted for record purposes:
 - .1 Final as-built drawings and information for items listed in section 1.4
 - .2 Wiring diagrams
 - .3 Certified production test reports
 - .4 Installation information
- .2 The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.
- .3 Submit electronic copies of the above information.

1.7 QUALIFICATIONS

- .1 The manufacturer of the assembly shall be the manufacturer of major components and control modules installed within the assembly.
- .2 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Departmental Representative, an acceptable list of installations with similar equipment shall

be provided demonstrating compliance with this requirement.

- .3 For the equipment specified herein, the manufacturer shall be certified as a minimum to ISO 9002.
- .4 Provide a certificate of compliance with CSA 22.2 No. 178 for the transfer switches furnished under this section. The certificate of compliance is not required if the manufacturer's published data submitted and approved reflect CSA C22.2 No. 178.

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.

1.9 OPERATION AND MAINTENANCE MANUALS

- .1 Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

2 PRODUCTS

2.1 MATERIALS

- .1 Instrument transformers: to CAN3-C13.
- .2 Contactors: to ANSI/NEMA ICS2.
- .3 Manufacturers: Products branded the same as the generator shall be acceptable, Eaton and ASCO

2.2 SYSTEM DESCRIPTION

- .1 Automatic load transfer equipment to:
 - .1 Monitor voltage on phases of normal power supply.
 - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
 - .3 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period

- .4 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

2.3 CONSTRUCTION

- .1 Transfer Equipment: to CSA C22.2 No.178.
- .2 For switches 1200A and below, the switching panel shall consist of completely enclosed contact assemblies and a separate control or transformer panel. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
- .4 The transfer switch shall be mechanically interlocked to prevent cross connection of sources when operated either automatically, or manually.
- .5 Transfer switches shall be capable of being operated manually under full rated load conditions. Manual operation shall be accomplished by a permanently attached manual operator, or by integrally mounted pushbuttons. Removable manual operating handles, and handles that may move in the event of an electrical operation during the manual operation, are not acceptable. Manual operators requiring source or load disconnection prior to manual operation are not acceptable.
- .6 On transfer switches requiring a fourth pole for switching the neutral, the neutral shall be fully rated with equal withstand, closing and interrupting ratings to the power poles. Switched neutral poles which are add-on or overlap, or that are not capable of breaking full rated load current are not acceptable.
- .7 The transfer switch shall have a multi-tap voltage selection plug for ease of voltage adjustment in the field.

2.4 BYPASS ISOLATION SWITCH

- .1 The ATS shall be provided with a manual bypass of the load to normal source and permit isolation of the ATS from all source and load power conductors. Bypass arrangement must possess a second transfer mechanism which can operate as a fully functioning ATS when the bypass is enabled, allowing automatic switching between sources when bypass is enabled.

- .2 Positive mechanical key interlocks shall be provided for bypass and isolation switches to prevent cross connection of services.
- .3 Bypass to the load carrying source shall be accomplished with no interruption to the load, via make-before-break contacts.
- .4 Where indicated on the drawings, the bypass/isolation transfer switches shall be provided with a draw-out mechanism to allow easy access for preventive maintenance, testing or inspection. The draw-out mechanism shall provide visual indicators as to the position of the switch/breaker during the draw-out operation.
- .5 The automatic transfer switch and the bypass isolation switch sections shall be interconnected with copper bus or cable.

2.5 CONTROLS

- .1 The automatic transfer switch controllers shall meet or exceed the following standards in addition to the basic switch standards:
 - .1 IEC 61000-4-2 - EMC Testing and Measurement Techniques - Electrostatic Discharge Immunity Test
 - .2 IEC 61000-4-3 - EMC Testing and Measurement Techniques - Radio-frequency, Electromagnetic Field Immunity Test
 - .3 IEC 61000-4-4 - EMC Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test
 - .4 IEC 61000-4-5 - EMC Testing and Measurement Techniques - Surge Immunity Test
 - .5 IEC 61000-4-6 - EMC Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio-frequency Fields
 - .6 IEC 61000-4-11 - EMC Testing and Measurement Techniques - Voltage Dips, Short Interrupts and Voltage Variations Immunity Tests
 - .7 CISPR11, Class B - Industrial, Scientific and Medical Radio-frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement
 - .8 FCC Part 15, Subpart B, Class B
- .2 The transfer switch shall be controlled by a microprocessor-based controller. The controller shall be hardened against potential problems from transients and surges. Operation of the transfer

switch and monitoring of both sources shall be managed by the controller.

- .3 The logic control panel shall control the operation of the transfer switch. All sensing and logic shall be controlled by an onboard microprocessor for maximum reliability and minimum maintenance. The logic controller shall be connected to the transfer switch by and interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control panel to be disconnect from the transfer switch for routine maintenance.

- .4 Microprocessor-based controller (CLOSED transition)

- .1 The microprocessor-based logic controller shall be door mounted and shall provide the operator with an overview of the transfer switch status, parameters, and diagnostic data. The controller shall have a voltage range of 0-700 volts (50/60 Hz) and an accuracy of +/-1% of nominal input voltage. The controller shall have a frequency range of 40-80 Hz and an accuracy of +/- 0.1 Hz. Control power input range shall be from 65 Vac - 160 Vac RMS 50/60 Hz. The controller's programmable set points shall be modifiable by placing the toggle switch located on the back panel of the controller in Program mode. The controller shall be listed under CSA.

- .2 The microprocessor-based controller shall include an LCD display, and shall be capable of displaying the following:

- .1 Connected Source and Load voltages on all phases

- .2 Connected Source and Load frequency

- .3 Condition status - Under-voltage, under-frequency.

- .4 Real time clock for Time / Date stamp

- .5 Historical data

- .6 Programming and set point information

- .7 Timer countdown for each timer while functioning

- .8 Help function for detailed description of displayed messages

- .3 The microprocessor-based controller shall include individual LED's for indicating the following:

- .1 Mimic Bus Diagram showing Availability status of NORMAL source

- .2 Mimic Bus Diagram showing Availability status of EMERGENCY source
- .3 Mimic Bus Diagram showing Connection status of NORMAL source
- .4 Mimic Bus Diagram showing Connection status of EMERGENCY source
- .5 Mimic Bus Diagram showing Preferred status of NORMAL source
- .6 Mimic Bus Diagram showing Preferred status of EMERGENCY source
- .7 Mimic Bus Diagram showing Energized status of LOAD
- .8 Automatic mode
- .9 Test mode
- .10 Program mode
- .11 Display Navigational indicators for Status, Source 1, Source 2, History, Time/Date and Set Points
- .12 The microprocessor-based controller shall contain the following features:
 - .1 Programming protection
 - .2 Set points shall be stored in Non-Volatile memory, and use of an external battery source to maintain operation during "dead" periods shall not be required.
- .4 Shall be capable of communicating to monitor all set points and operational characteristics over the following network protocol:
 - .1 RS-232 INCOM
 - .2 10 Base T Ethernet
 - .3 RS485 Modbus RTU
- .5 Historical Data Storage to include:
 - .1 Engine Run Time
 - .2 NORMAL source Available time
 - .3 EMERGENCY source Available time
 - .4 NORMAL source Connected time
 - .5 EMERGENCY source Connected time
 - .6 LOAD Energized Time
 - .7 Number of Transfers
 - .8 Date, Time and Reason for Last Sixteen (16) transfers
- .6 The microprocessor-based controller shall contain the following voltage and frequency features:
 - .1 The voltage of each phase of the NORMAL source and the EMERGENCY source shall be monitored, with under-voltage dropout adjustable from 78% to 97% of nominal

- and pickup adjustable from dropout setting +2% to 99% of nominal.
- .2 The voltage of each phase of the NORMAL source and the EMERGENCY source shall be monitored, with over-voltage dropout adjustable from 105% to 110% of nominal and pickup adjustable from dropout setting - 2% to 103% of nominal.
- .3 The frequency of the NORMAL source and the EMERGENCY source shall be monitored with under-frequency dropout adjustable from 90% to 97% of nominal and pickup adjustable from dropout setting +1 Hz to 99% of nominal.
- .4 The frequency of the NORMAL source and the EMERGENCY source shall be monitored, with over-frequency dropout adjustable from 103% to 110% of nominal and pickup adjustable from dropout setting -1 Hz to 101% of nominal.
- .7 The microprocessor-based controller shall contain the following time delay features:
 - .1 A time delay shall be provided on transfer to EMERGENCY source, adjustable from 0 to 1800 seconds. TDNE - Time Delay Normal to Emergency
 - .2 A time delay shall be provided to override a momentary power outage or voltage fluctuation, adjustable from 0 to 120 seconds. TDES - Time Delay engine Start
 - .3 A time delay shall be provided on retransfer from EMERGENCY source to NORMAL source, adjustable from 0 to 1800 seconds. TDEN - Time Delay Emergency to Normal
 - .4 A time delay shall be provided after retransfer that allows the generator to run unloaded prior to shutdown, adjustable from 0 to 1800 seconds. TDEC - Time Delay Engine Cool down
 - .5 A time delay shall be provided for engine failure to start, fixed setting of 6 seconds. TDEF - Time Delay Engine Fail
 - .6 All delays shall be field adjustable from the microprocessor-based controller without the use of special tools.
- .8 The microprocessor-based controller shall contain the following features:

- .1 "HELP", "INCREASE", "DECREASE", "STEP" and "DISPLAY SELECT" pushbuttons
- .2 Plant exerciser, selectable - 7-day interval, adjustable 0-600 minutes, load or no-load with Failsafe
- .3 System Test Pushbutton
- .4 A programmable Preferred Source Selector with LED light indication for "Utility to Utility" or "Utility to Generator" systems
- .5 A programmable Preferred Source Selector with LED light indication for "Generator to Generator" systems. Provides dual engine starting circuits Alternative Transfer Mode of Operation Switch. Selectable via programming and LED display marked: "AUTOMATIC" and "NONAUTOMATIC" for full automatic operation or non-automatic retransfer operation with failsafe.
- .6 The microprocessor-based controller shall contain the following input/output contacts:
 - .1 One (1) Form C contact for closure of the Generator start circuit. The contacts shall be of silver alloy with gold flashing. The contacts shall be rated for 5 Amp at 250 Vac and 5 Amp at 30 Vdc.
 - .2 One (1) Form C contact for PRE-TRANSFER SIGNAL. The contacts shall be rated for 10-Amp at 250-Vac and 10-Amp at 30-Vdc.
 - .3 One (1) Form C contact for ALARM SIGNAL. The contacts shall be rated for 10-Amp at 250-Vac and 10-Amp at 30-Vdc

2.6 WIRING/TERMINATIONS

- .1 Terminal blocks shall conform to NEMA ICS 4. Terminal blocks for remote connections shall be arranged to facilitate the entrance of external conductors from the top or bottom of the enclosure. The main transfer switch terminals shall be suitable for the termination of conductors shown on the plans.

2.7 ENCLOSURE

- .1 Each transfer switch shall have an NEMA 1 drip proof enclosure unless otherwise noted.
- .2 The enclosure shall be painted with the manufacturer's standard painting procedures to ensure suitability for environmental conditions as referenced in the plans. EEMAC 1 enclosures shall be painted with the manufacturer's standard ASA 61 gray paint.

3 EXECUTION

3.1 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.
- .2 Tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.
 - .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
 - .3 Check voltage sensing and time delay relay settings.
- .3 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.

3.3 FIELD QUALITY CONTROL

- .1 Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of 5 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
 - .1 A manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

- .2 Submit Manufacturer's Field Report to the Engineer or Consultant within 3 days of review.
- .2 Perform the following tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.
 - .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
 - .1 Energize transfer equipment from normal power supply.
 - .2 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
 - .3 Set selector switch in "Manual" position and check to ensure proper performance.
 - .4 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
 - .5 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .3 Check voltage sensing and time delay relay settings.
- .4 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Submit list of replacement lamp data for each luminaire. Include lamp type, voltage, wattage, base type and order code. Include list in maintenance manual.

1.2 GUARANTEE

- .1 Replace:
 - .1 Incandescent and tungsten halogen lamps burnt out within 3 months of takeover.

1.3 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 Fixtures to come complete with COOPER Modular Wiring System (MWS). This is a base building standard and the existing fixtures being reinstalled already have the connectors for this system. Contractor is to reuse the existing wiring whips and provide new where required.
- .3 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.
- .4 Provide lenses or diffusers of 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.

- .5 Include finishes to Section 26 05 01 and as indicated.

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 rapid 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 MODULAR WIRING SYSTEM

- .1 The existing building's general lighting is connected using the Cooper Modular wiring system (MWS).
- .2 The existing MWS system is to be reconfigured as required to meet the new lighting layout.
- .3 Post demolition the shall provide a count of existing

MWS wiring whip and provide that count to the Departmental Representative.

2.5 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, meeting CSA-C860-01.
- .3 Arrange exit lights as required, to allow exits to be visible from access to egress locations.
- .4 Exits sign to be Bilingual EXIT SORTIE.

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 Architect.
- .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 using the MWS.
- .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 Prior to demolition, the electrical contractor is to notify the Departmental representative of quantity of burnt out lamps and/or ballast.
- .3 Check luminaires and advise Departmental Representative of 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 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.

1.2 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.

1.3 MAINTENANCE MANUALS

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

1.4 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.

1.5 SYSTEM DESCRIPTION

- .1 There is an existing Inverter system which supplies the life-safety lighting using the selected general lighting fixtures. The electrical contractor is to connect to existing zone circuits system for inverter power to the selected fixtures.
- .2 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 Emergency lighting system.
- .3 Provide Voltage sensing relay system for battery unit to serve all areas required emergency lighting but do not have night light circuits.
- .4 Unit equipment certified to CSA Standard C22.2 No. 141.

2 PRODUCTS

2.1 BATTERY BANK

- .1 347vAC/12vDC battery bank system.
- .2 Existing inverter system provide emergency power (for life safety lighting) within the building.

2.2 REMOTE HEADS

- .1 Double adjustable heads, as indicated.
 - .1 12Vdc, 5 watt LED MR16 lamps.

2.3 MANUFACTURERS

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

3 EXECUTION

3.1 INSTALLATION

- .1 Provide inverter circuits from existing zone junction boxes on floor to be renovated. Circuit lighting

fixtures from inverter circuits as indicated on drawings.

- .2 Install unit equipment for emergency lighting in accordance with CSA C22.1.
- .3 Install conduit and wiring as indicated.
- .4 Install unit equipment and remote mounted fixtures as indicated.
- .5 Cut and re-cap cord to remove surplus.
- .6 Direct heads as indicated.
- .7 Mount double remote heads on outlet box such that two heads will be horizontal with the building lines.
- .8 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.
- .9 Charge the batteries and test the system for proper operation (minimum of 35 minutes discharge time).

END OF SECTION

EMERGENCY LIGHTING VERIFICATION

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.