REPLACEMENT OF REFRIGERATION SYSTEM

1. <u>General</u>

- (a) General Requirements
 - (i) Comply with Division 16.
- (b) Application
 - (i) This Section applies to and is an integral part of all succeeding Sections of this Division of the specification.
- (c) Definitions
 - (i) The following are definitions of words found in Sections of this Specification and on associated drawings:
 - (ii) "Concealed" hidden from normal sight in furred spaces, shafts, crawl spaces, ceiling spaces, walls and partitions;
 - (iii) "Exposed" all work normally visible to building occupants;
 - (iv) "Provide" (and tenses of "Provide") supply, install and connect complete.
 - (v) "Install" (and tenses of "install") install, and connect complete;
 - (vi) "Supply" Supply only.
 - (vii) "Work" all equipment, permits, materials and labour to provide a complete electrical installation as required and detailed in Drawings and Specification.
 - (viii) "Authorities" or "Authorities Having Jurisdiction" any and all current laws and/or by-laws of any federal, provincial or local authorized agencies having jurisdiction over the sum total or parts of the work including, but not restricted to the Municipal Planning and Building Department, Municipal Fire Department, Labour Canada, The Provincial Fire Marshall, The Local Hydro Supply Authority, The Ontario Building Code, The Construction Safety Act, Municipal Public Works Department, the Canadian Electrical Code with Ontario Supplement, hereinafter referred to as the "Code", the Electrical Safety Authority and all Inspection Bulletins.
 - (ix) "Drawings and Specifications" "the Contract Drawings and Specifications".
 - (x) "Consultant" shall mean the firm of Moon-Matz Ltd., or other person authorized to act on their behalf.
- (d) Work Included
 - (i) The work shall include all labour, materials, equipment, permits, inspections and tools required for a complete supply and installation of breakers, motor starts, disconnect switches, lighting fixtures and all conduit, wiring and accessories as detailed on drawings and as described but not necessarily limited to items, in the following sections:

- (ii) Removal and disposal of electrical wiring, conduits, starters associated with the old boilers and pumps.
- (iii) Section 16010 Electrical General Provisions
- (iv) Section 16100 Electrical Basic Materials and Methods
- (v) Section 16400 Distribution and Controls
- (e) Scheduling of Product Delivery
 - (i) Every effort must be made to ensure delivery of all materials and products in the Contract Documents on time. At commencement of contract, assist Contractor in preparation of schedule of order dates for items requiring long delivery periods.
- (f) Examination of Site
 - (i) Prior to submitting a tender carefully examine conditions at the site, which may or will affect the work. Refer to and examine all contract documents, including room finish schedules to determine finished, partially finished and unfinished areas of the building.
 - (ii) Ensure that materials and equipment are delivered to the site at the proper time and in such assemblies and sizes so as to enter into the building and to be moved into the spaces where they are to be located without difficulty. Be responsible for any cutting and patching involved in getting assemblies into place.
- (g) Quality Assurance
 - (i) General Codes and Standards:
 - (A) Comply with the Ontario Building Code and Canada Labour Code, Part 4.
 - (B) Where provisions of pertinent codes or local by-laws conflict with these Specifications and Drawings or each other, comply with the more stringent provisions.
 - (C) Operating voltages shall comply with CAN3-C235-83 (R2015).
 - (D) Ground system shall comply with CSA Standard C22.1.
 - (E) Abbreviations for electrical terms: to CSA Z85-1983
 - (ii) Provide new materials bearing certification marks or labels acceptable under Ontario Electrical Safety Code.
 - (A) Equipment must bear, on manufacturer's label, certification mark or label acceptable under Electrical Safety Authority.
 - (iii) Provide units of same manufacture where two or more units of same class or type of equipment are required.

- (iv) Manufacturer's names are stated in this Specification to establish a definite basis for tender submission and to clearly describe the quality of product that is desired for the work.
- (v) Standard Specifications
 - (A) Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with latest issue of applicable Standard Specifications issued by authorities having jurisdiction, but such Standard Specifications shall not be applied to decrease the quality of workmanship, products and services required by the Contract Documents.
- (vi) Electrical Codes and Permits:
 - (A) The work shall be tendered on and shall be carried out in accordance with these Drawings and Specifications and shall comply with the essential requirements of the latest editions of the Canadian Electrical Code C. 22.1 and the Electrical Safety Code (together with applicable bulletins issued by the Inspection Department of Electrical Safety Authority). In no instance, however, shall the standards established by the Drawings and Specifications be reduced by any of the codes referred to above. In the event of conflicting requirements, the codes shall take precedence over these Contract Documents and the Engineer's decision shall be final.
 - (B) Arrange for and obtain all necessary permits, inspection and approvals from authorities having jurisdiction, and also pay all applicable fees. The Contractor shall conform with all Municipal Codes and By-laws which affect the work.
 - (C) Applicable Codes
 - (I) Ontario Electrical Safety Code
 - (II) Canadian Electrical Code with applicable regional amendments
 - (III) Ontario Building Code
 - (IV) National Building Code
 - (V) Ontario Fire Code
 - (VI) National Fire Code and Fire Commissioner Canada requirements
 - (D) Before starting any work, submit the required number of copies of Drawings and Specifications to the Electrical Safety Authority and the local authority for approval and comments. Comply with any changes requested as part of the Contract, but notify the Engineer immediately of such changes for proper processing of these requirements. Prepare and furnish any additional Drawings, details or information as may be required by the Engineer.
 - (E) On or before the completion of this Contract, obtain at own expense, the necessary certificate of inspection from the Inspection Branch of the Electrical Safety Authority of Ontario and forward same to the Engineer.

- (F) Equipment and material must be acceptable to Electrical Safety Authority.
- (G) Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the cooperation of the material supplier.
- (H) Supply and install warning signs, nameplates and glass covered Single Line Diagrams as required by Electrical Safety Authority.
- (I) Submit required Documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose.
- (h) Requirements of Drawings:
 - (i) Contract:
 - (A) The Drawings for electrical work are essentially performance drawings, partly schematic, intended to convey the scope of work and extent of work. They only indicate general arrangement and approximate location of apparatus, fixtures and general typical sizes and locations of equipment and connections. The Drawings do not intend to show architectural, structural or mechanical details.
 - (B) Do not scale Drawings, but obtain information involving accurate dimensions to structure from those shown on Architectural and Structural Drawings, or by site measurements of existing areas. Follow the Electrical Drawings in laying out the work but consult general Construction Drawings as well as detail Drawings to become familiar with all conditions affecting the work, and verify spaces in which the work will be installed and structures to which it will be attached.
 - (C) Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.). Alter, at no additional cost, the location of materials and/or equipment up to 3m, or as directed, provided that the changes are made before installation and do not necessitate additional material or labour.
 - (D) Leave space clear and install work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or material supplied by other trades. Verify all equipment sizes in relation to space allowed and check all clearances.
 - (E) Confirm on the site, the exact location and mounting elevation of equipment and fixtures as related to Architectural or Structural details. Confirm location of outlets and/or connection points for equipment supplied by other trades.

- (i) Shop Drawings:
 - (i) Pay careful attention to all shop drawings and review comments and ensure that all requirements are fully complied with.
 - (ii) Submit prior to commencement of work for review, manufacturer's or vendor's drawings for all products being furnished except cable (up to 1000V), wire and conduit. Include rating, performance, specification sheets, descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assembly.
 - (iii) Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
 - (iv) Submit prior to commencement of work for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.
 - (v) Obtain and comply with the manufacturer's installation instructions.
 - (vi) Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with your company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.
 - (vii) The Consultant will stamp shop drawings as follows:

(A)	Drawing: Reviewed	()
(B)	Reviewed as Modified	()
(C)	Revise and Resubmit	()
(D)	Not Reviewed	()

- (viii) If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED' is checked-off, the shop drawing is in error of submission, not applicable for this project.
- (ix) This review by the Consultant/Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant/Engineer approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the contract

REPLACEMENT OF REFRIGERATION SYSTEM

documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co- ordination of the work as well as compliance with codes and inspection authorities such as C.S.A., etc.

- (x) Coordinate Work of this Division such that items will properly interface with Work of other Divisions.
- (xi) Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.
- (j) Substitutions
 - (i) When only one manufacturer's catalogued trade name is specified, provide only that catalogued trade name, material or product.
 - (ii) When more than one manufacturer's trade name is specified for a material or product, the choice is the bidders.
 - (iii) No substitution is allowed upon award of contract.
- (k) Dimensions and Quantities
 - (i) Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.
 - (ii) Quantities or lengths indicated in Contract Documents are approximate only and shall not be held to gauge or limit the Work.
 - (iii) Make necessary changes or additions to routing of conduit, cables, and the like to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.
- (l) Equipment Locations
 - (i) Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Contract Drawings, to a maximum distance of 3 m without adjustment to Contract price.
 - (ii) Switch, control device and outlet locations are shown diagrammatically.
- (m) Working Drawings and Documents
 - (i) Contractor may be required to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one (1) trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.

- (ii) Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the contract documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.
- (n) Installation Drawings
 - Prepare installation drawings for equipment, based upon approved Vendor drawings, to check required Code clearances, raceway, busway and cable entries, sizing of housekeeping pads and structure openings. Submit installation drawings to Consultant for review.
- (o) "As Built" Record Drawings
 - (i) Maintain a set of Contract Drawings on site and record all deviations from the Contract Documents. As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.
 - (ii) Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run underground either below the building or outside the building.
 - (iii) Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.
 - (iv) Record deviations from branch circuit numbers shown on Drawings.
 - (v) Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by Owner and under other Specification Sections.
- (p) Test Reports
 - (i) For each check and test performed prepare and submit a Test Report, signed by the Test engineer, and where witnessed, by the Consultant.
 - (ii) Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.
 - (iii) Include calibration record, percentage error and applicable correction factors.
 - (iv) Submit a Certified Test Report from each manufacturer, signed by the certifying inspector, confirming correct installation and operation of each product and part of Work. Include name of certifying inspector, date and times of inspection, ambient conditions.

- (q) Fire Barriers
 - (i) Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.
 - (ii) Prior to installation, submit for review, proposed fire barrier seal materials, method of installation and ULC system number.
 - (iii) Acceptable Manufacturers:
 - (A) A/D Fire Protection Systems
 - (B) Dow Corning
 - (C) Fire Stop Systems
 - (D) IPC Flamesafe Firestop
 - (E) Nelson Electric
 - (F) 3M
 - (G) Tremco
- (r) Miscellaneous Metal Fabrications
 - Provide miscellaneous structural supports, platforms, braces, brackets and preformed channel struts necessary for suspension, attachment or support of electrical. All supports, platforms, brackets and channel struts shall be made of stainless steel material.
- (s) Sleeve and Formed Opening Location Drawings
 - (i) Prepare and submit to the Consultant for review and forwarding to the appropriate Sub-trade, drawings indicating all required sleeves. Such drawings shall be completely and accurately dimensioned and shall relate sleeves, recesses, and formed openings to suitable grid lines and elevation datum. Begin to prepare such drawings immediately upon notification of acceptance of tender and award of contract. Make all modifications to locations as directed by Structural Engineer at no extra cost to contract.
- (t) Superintendence
 - (i) Maintain at the job site, at all times, qualified personnel and supporting staff, with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.
 - (ii) The supervising personnel and their qualifications are subject to the approval of the Consultant.

- (u) Patents
 - (i) Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent right, and save the Owner and Consultant harmless of loss or annoyance on account of suit, or claims of any kind for violation of infringement of any letters, patent or patent rights, by this Subcontractor 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 or such letters, patent or rights.
- (v) Rights Reserved
 - (i) Rights are reserved to furnish any additional detail drawings, which in the judgment of the Consultant may be necessary to clarify the work and such drawings shall form a part of this contract.
- (w) Metals
 - (i) Steel construction required solely for the work of electrical trades and not shown on architectural or structural drawings shall be provided by this trade in accordance with applicable code requirements.
- (x) Flashing
 - (i) Flash electrical parts passing through or built into a roof, an outside wall, or a waterproof floor.
 - (ii) Provide sleeves passing through outside walls with lead or copper flashing as directed.
- (y) Workmanship
 - (i) Install equipment, ductwork, conduit and cables in a workmanlike manner to best suit space, to present a neat appearance and to function properly to the satisfaction of the Consultant.
 - (ii) Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore.
 - (iii) Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers installation instruction.
 - (iv) Replace work unsatisfactory to the Consultant without extra cost.
 - (v) Make provision to accommodate future plant and equipment indicated on drawings.
 - (vi) Protect from damage all equipment delivered to the site and during installation. Any damage or marking of finished surfaces shall be made good to the satisfaction of the Consultant.

- (z) Mounting Heights
 - (i) Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
 - (ii) If mounting height of equipment is not indicated verify before proceeding with installation.
- (aa) Operating and Maintenance Instruction Manuals
 - (i) Each copy of the manual shall include:
 - (A) A set of as-built prints;
 - (B) Letters of Owners Instructions;
 - (C) Final Electrical Safety Authority Certificate of Inspection;
 - (D) Verification Certificates for all systems as specified hereinafter;
 - (E) A copy of "reviewed" shop drawings;
 - (F) Complete explanation of operation principles and sequences;
 - (G) Complete part lists with numbers;
 - (H) Recommended maintenance practices and precautions;
 - (I) Parts manual and repair manuals
 - (J) Complete wiring and connections diagrams;
 - (K) Certificates of guarantee;
 - (L) Single Line Diagram
 - (ii) Ensure that operating and maintenance instructions are specific and apply to the models and types of equipment provided.
- (bb) Trial Usage
 - (i) The Consultant/Engineer reserves the right to use any system, piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.

- (ii) Perform and pay for all costs associated with any testing required on the system components where, in the opinion of the Consultant/ Engineer the equipment manufacturer's ratings or specified performance is not being achieved.
- (cc) Instruction To Owners
 - (i) Instruct the Owner's designated representatives in all aspects of the operation and maintenance of all systems and equipment.
 - (ii) Arrange for, and pay for services of service engineers and other manufacturer's representatives required for instruction in the operation of systems and equipment.
 - (iii) Submit to the Consultant at the time of final inspection a complete list of systems stating for each system:
 - (A) Date instruction were given to the Owner's staff.
 - (B) Duration of instruction.
 - (C) Name of persons instructed.
 - (D) Other parties present (manufacturer's representative, consultants, etc.)
 - (iv) Obtain the signature of the Owner's staff verifying that they properly understood the system installation, operation and maintenance requirements, and that they have received the specified manuals and "as-built" drawings.
- (dd) System Acceptance
 - (i) Submit original copies of letters from the manufacturers of all systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the method of installation, connection and operation.
 - (ii) These letters shall state the names of persons present at testing, the methods used, and a list of functions performed with location and room numbers where applicable.
- (ee) Cleaning
 - (i) Before energizing any systems, inspect and clean the inside of panel boards, switchgear, and cabinets to ensure that they are completely free from dust and debris.
 - (ii) Clean all polished, painted and plated work bright.
 - (iii) Remove all debris, surplus material and all tools
 - (iv) Carry out additional cleaning operating of systems as specified in other sections of this Division.

- (ff) Painting Work Supplied Under Division 16
 - (i) Touch up minor chips or damage to electrical equipment, installed in this Division, with standard, factory supplied, enamel finish.
 - (ii) Colour code, as specified herein, outlet boxes, pull boxes, junction boxes by applying a small dab of paint to inside of each item during installation.
 - (iii) Colour code, as specified herein, all exposed ducts, conduits, outlet boxes, and similar items by applying a 25 mm (1") wide band of paint around ducts and conduits adjacent to boxes described in above paragraph and on both sides of wall penetration.
- (gg) Removals
 - (i) Co-ordination Between New and Existing Installations
 - (A) Provide interfacing components between new and existing systems as necessary for proper performance and operation.
 - (ii) Existing Services
 - (A) Ensure existing services remain undisturbed and energized except where indicated.
 - (B) Disconnect and remove abandoned wiring materials and devices.
 - (iii) Modifications to Existing Structures
 - (A) Provide new electrical equipment to existing structures as detailed on drawings. Remove existing devices as shown and as required. Salvage existing circuits for reuse as noted.
 - (iv) Interruption of Services
 - (A) Maintain existing systems in existing school at all times during construction.
 - (B) Obtain Consultant's written approval before interrupting any service. Long outages are not acceptable.
 - (C) Provide temporary services to maintain continuity in the event that services must be interrupted.
 - (v) Premium Time
 - (A) Power shutdowns to the site will only be allowed on weekends between the hours of Friday 12.00 midnight to Sunday 12.00 midnight. Include all costs for this overtime work in the contractor's tender bid.
 - (B) Include cost of premium time in tender price for work during nights, weekends or other time outside normal working hours necessary to do the work and maintain electrical services in operation.

REPLACEMENT OF REFRIGERATION SYSTEM

- (C) Premium time is to include work by local hydro authority, ESA and any other authorities having jurisdiction as required.
- (vi) Use of Existing Material And Equipment
 - (A) Unless noted otherwise, do not use any existing panels, boxes and wiring materials unless shown on drawings.
- (vii) Demolition
 - (A) Demolish existing work, where indicated, and remove from site.
 - (B) Execute all demolition work so as to create minimum vibration or dust within and outside the building. Obtain Consultant's approval of methods before proceeding.

2. <u>Products</u>

Nil

3. <u>Execution</u>

Nil

END OF SECTION 16010

REPLACEMENT OF REFRIGERATION SYSTEM

1. General

- (a) General Requirements
 - (i) Comply with Division 16.
- (b) Scope of Work
 - (i) Supply all labour, tools, service and equipment and provide all the materials required to complete the electrical work specified in Division 16.
- (c) Shop Drawings
 - (i) Shop drawings need not be submitted for standard manufactured items and materials provided they are as specified.
- (d) Submittals
 - (i) Submit the following to the Consultant for review prior to commencement of work:
 - (A) A sample of lamicoid nameplates and list of proposed nameplate legends.
- (e) Quality Assurance
 - (i) All components shall be C.S.A. and/or U.L.C approved listed and labelled.

2. **Products**

- (a) Conduit and Raceways
 - (i) Conduits and Fittings
 - (A) Rigid Steel Conduit:
 - (I) To CAN/CSA C22.2 No. 45-M.
 - (II) Rigid thickwall steel threaded conduit
 - (B) EMT
 - (I) To CSA C22.2 No. 83-M
 - (II) EMT galvanized cold rolled steel tubing
 - (C) Liquid Tight Flexible Steel Conduit Fittings.
 - (I) To CSA 22.2 No. 56.
 - (II) Liquid-tight flexible steel conduit with PVC cover.
 - (III) Watertight connectors with nylon insulated throat.
 - (D) Rigid Steel Conduit Fittings
 - (I) To CAN/CSA C22.2 No. 18
 - (II) Steel cast fittings

REPLACEMENT OF REFRIGERATION SYSTEM

- (III) Expansion fittings, watertight with integral bonding jumper suitable for linear expansion and 19 mm³/4" deflection in all directions
- (E) Liquid Tight Flexible Steel Conduit Fittings
 - (I) Watertight connectors with nylon insulated throat

(F) EMT Fittings

- (I) Compression type, steel (cast fittings not acceptable).
 - (1) Gland compression connectors with insulated throats
 - (2) Compression couplings
- (G) Minimum size conduit will be 21mm diameter.
- (H) All conduit shall contain a separate dedicated ground conductor.
- (I) All conduit must have adequate support systems complete with approved fittings, outlet boxes, junction boxes, sealing fittings and drains as indicated or as required. Provide hot dipped galvanized steel beam clamps, hot dipped galvanized steel channel type supports where required. Provide six (6)mm threaded galvanized steel rods to support suspended channels and provide all necessary galvanized steel spring loaded bolts, nuts, washers and lock washers. Support systems shall be Thomas & Betts Superstrut or equal.
- (J) Provide all conduit, fittings and ducts necessary to complete the distribution of all power, lighting and control conductors to electrical equipment specified under the corresponding Section. Include that necessary for connecting to mechanical heating and ventilating equipment, also equipment specified under other Divisions.
- (K) Fasten conduit with malleable PVC coated galvanized steel twohole straps at intervals to suit code requirements and job conditions.
- (b) Fastenings, Supports and Sleeves
 - (i) Galvanized steel, size and load rating to suit application.
 - (ii) One hole steel straps to secure surface mounted conduits or surface mounted cables 50 mm dia. and smaller. Two hole steel straps for conduits and cables larger than 50 mm.
 - (iii) Beam clamps to secure conduits to exposed steel work.
 - (iv) Channel type supports for two or more conduits.
 - (v) 6 mm minimum dia. threaded rods to support suspended channels.

- (vi) 6 mm minimum dia. U-bolts.
- (vii) Sleeves schedule 40 steel pipe minimum I.D. 13 mm larger than O.D. of conduit or cable passing through.
- (viii) Strut
 - (A) Continuous slotted channel
 - (B) 12 gauge pre-galvanized steel
 - (C) 41.2 mm x 41.2 mm minimum
 - (D) Acceptable manufacturers:
 - (I) B-Line
 - (II) Pilgrim
 - (III) Pursley
 - (IV) Unistrut
 - (V) Or approved equal
- (ix) Acceptable Manufacturers: Burndy, Electrovert, Unistrut.
- (c) Junction Boxes
 - (i) Code gauge (galvanized) sheet steel EEMAC Type 1 size as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminals and mounting channels.
 - (ii) Screw-on sheet steel covers to match enclosure for surface mounting boxes.
 - (iii) Covers with 25 mm minimum extension around for flush-mounted junction boxes.
- (d) Conduit Boxes General
 - (i) Size boxes in accordance with latest edition of Electrical Safety Authority (ESA) Electrical Safety Code.
 - (ii) Code gauge, galvanized pressed steel for EMT.
 - (iii) Steel cast boxes for rigid thickwall threaded steel conduit.
 - (iv) Corrosive resistant coated: cast boxes for corrosive resistant coated rigid steel conduit with same finish as conduit.
 - (v) 200 mm square or larger outlet boxes as required for special devices.
 - (vi) Gang boxes where wiring devices are grouped except in classified hazardous areas.
 - (vii) Blank cover plates for boxes without wiring devices.

- (viii) 50 mm x 100 mm outlet boxes for devices, ganged for grouped devices, barriers where required by code.
- (e) Pull Boxes
 - (i) Code gauge galvanized sheet steel welded construction, EEMAC Type 1.
 - (ii) Screw-on galvanized sheet steel covers for surface mounting boxes.
 - (iii) Covers with 25 mm minimum extension around, for flush mounted pull boxes.
- (f) Rigid Conduit Boxes
 - (i) Zinc electroplate and polymer enamelled cast FS boxes with factorythreaded hubs and mounting feet for surface mounted switches and receptacles, with gasketed cover plate for exterior work and wet areas.
- (g) Outlet Boxes Fittings
 - (i) Bushings and connectors with nylon insulated throats.
 - (ii) Knock-out fillers to prevent entry of foreign materials.
 - (iii) Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
 - (iv) Double locknuts and insulated bushings for sheet steel metal boxes.
- (h) Branch Circuit Conductors
 - (i) Conductors
 - (A) ASTM Class B, soft drawn, electrolytic copper
 - (B) Stranded
 - (ii) Insulation
 - (A) CSA type RW90 XLPE $(-40^{\circ}C)$
 - (I) Heat and moisture resistant
 - (II) Low temperature, chemically cross-linked thermosetting polyethylene material
 - (III) 600V rated
 - (IV) For maximum 90°C conductor temperature
 - (V) For installation at minimum -40°C temperature
 - (VI) To CSA C22.2 No. 38
 - (iii) Branch circuit conductors up to and including #12 AWG shall be solid. Branch circuit conductors in sizes larger than #12 AWG shall be stranded. All branch circuit conductors shall be constructed of 90% conductive copper, unless otherwise noted, and shall be approved for 600 volts.

- (iv) Electric service, distribution and special conductors are specified in this Section and/or on the drawings.
- (i) Wire and Cable Connectors
 - (i) Copper compression type wire and cable terminations for #8 AWG and larger conductors, colour keyed, sized to suit. Long barrel NEMA 2 hole lugs for sizes #1/0 AWG and larger.
 - (A) Acceptable Manufacturers: Thomas & Betts series 54000, Ideal Powr-Connect, Burndy Hylug, or approved equal.
 - (ii) Twist type splicing connectors, copper, sized to suit, with black nylon or plastic shroud for tee connections in #10 AWG and smaller conductors.
 - (A) Acceptable Manufacturers: Thomas & Betts, Ideal Twister, Marr Marrette or approved equal.
 - (iii) Conductor compression splice for #10 AWG or smaller.
 - (A) Acceptable Manufacturers: Thomas & Betts STA-Kon series, Ideal Splices, Burndy or approved equal.
- (j) Heat Shrinkable Tubing Insulation, Heavy Wall
 - (i) Acceptable Manufacturers: Thomas & Betts, Shrink-Kon series, Ideal Thermo-Shrink, TS-46, Raychem tubing WCSM, 3M cable sleeve ITCSN or approved equal.
- (k) Sleeves
 - (i) In concrete slabs, except as noted below, sleeves shall be #24 gauge galvanized steel or factory fabricated plastic sleeves, each with an integral flange to secure the sleeve to form work construction.
 - (ii) In waterproof concrete slabs and in other slabs where waterproof sleeves are required sleeves shall be Schedule 40 mild steel galvanized.
- (l) Escutcheon Plates
 - (i) One-piece chrome plated steel sized to completely cover sleeves and complete with set screws to secure the plates to the conduit. Split plates will not be acceptable.
- (m) Inserts, Beam Clamps Fasteners, Equipment Hangers And Supports
 - (i) Inserts for concrete formwork shall be Crane Canada type, #4-M Unistrut, or approved equal cast iron inserts, multiple type where required.
 - (ii) Inserts for precast concrete and existing concrete shall be lead cinch anchors of "WEJ-IT" or self-drilling "STARR" or "PHILLIPS" anchors.

REPLACEMENT OF REFRIGERATION SYSTEM

- (iii) Beam clamps for hanging and support to structural steel shall be Crane Canada Ltd., or equal.
- (n) Water Resistant Protection
 - (i) Where the area is sprinklered and electrical distribution equipment is located in sprinklered areas, enclosures shall be louvred and gasketed and provided with water-tight roof assemblies with overhanging drip shields. The equipment shall be fabricated by the manufacturer in such a way as to prevent sprinkler fluid from entering the equipment and/or interfering with its operation as per the requirements of C.S.A. C22.1 Rule 26-006.
 - (ii) Weatherproof equipment where noted in the specifications and or drawings shall have EEMAC 4X enclosures in accordance with the requirements of C.S.A. C22.2 No. 94 Standard.
- (o) Finish
 - (i) Equipment enclosure finish: baked grey enamel, ANSI 49 or ANSI 61.

3. **Execution**

- (a) General Conduit and Conductor Installation Requirements
 - (i) Install conduit and conductors concealed in all finished areas, and concealed to the degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished area such as Electrical Rooms and Mechanical Rooms, unless otherwise noted on the drawings or specified herein. Refer to and examine the architectural drawings and room finish schedules to determine finished, partially finished and unfinished areas of the building.
 - (ii) Where conduit and/or conductors are exposed, arrange same to avoid interference with other work and parallel to the building lines, where horizontal conduits and/or conductors are exposed, install as high as possible. Do not install conduit and/or conductors within 150mm of flue or heating pipes or equipment.
- (b) Conduit and EMT General
 - (i) Run parallel or perpendicular to building lines.
 - (ii) Group raceways wherever possible. Support on channels.
 - (iii) Install expansion joints as required.
 - (iv) Run raceways in web portion of structural steel columns and beams.
 - (v) Do not drill structural members to pass through.
 - (vi) Locate raceways not less than 125 mm clear where parallel to steam or hot water lines with a minimum of 75 mm at crossovers.

- (vii) Use metallic raceway where temperatures exceed 75°C or where enclosed in thermal insulation.
- (viii) All conduits to contain insulated green ground wire.
- (ix) Install 6 mm diameter nylon pull cord in empty raceways.
- (x) EMT and non-metallic conduits to contain insulated green ground wire.
- (xi) Install 6 mm¹/4" diameter nylon pull cord in empty raceways.
- (c) Conduit And Fittings
 - (i) Minimum conduit sizes:
 - (A) Surface installation 21mm trade size conduit
 - (ii) Conduit application and type:
 - (iii) Application Type
 - (A) Outdoor areas rigid steel
 - (iv) Exposed in unfinished areas up to 3m above finished floor, use rigid steel, above 3m use EMT.
 - (v) Connection to motors and equipment subject to vibration use liquid tight flexible steel conduit.
 - (vi) Use field threads on rigid conduit of sufficient length to draw conduits up tight.
 - (vii) Do not bend coated steel conduit. Use elbows for deflections.
 - (viii) Do not install conduit in or under slab.
 - (ix) Use factory "ells" where 90° bends are required for 27mm trade size and larger conduits.
 - (x) Bend conduit offsets cold. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Prevent the entrance of water and lodging of concrete, plaster, dirt, or trash in conduit, boxes, fittings, and equipment during course of construction.
 - (xi) Where conduit joints occur in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible.
 - (xii) Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc., with standard galvanized plumber's pipe caps.
 - (xiii) Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.

- (xiv) Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings, or floors, and fill void between sleeve and conduit with caulking. If fire-rated caulking is required by code, use same class as walls, ceilings or floors.
- (xv) Terminate conduit stubbed up through concrete floor for connection to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except where required, use flexible conduit from a point 150 mm above floor.
- (xvi) Install double locknuts and bushings on all rigid conduit terminations into thread less openings. Increase length of conduit threads at terminations sufficiently to permit bushing to be fully seated against end of conduit.
- (xvii) Mechanically bend steel conduit.
- (xviii) Install sealing conduilets in conduits at hazardous area boundaries.
- (d) EMT and Fittings
 - (i) Minimum EMT size: $\frac{3}{4}$ (21) trade size conduit.
 - (ii) EMT Application
 - (A) Exposed in unfinished areas, above truss level and for drops in column web to 3m above finished floor. Use rigid steel conduit below 3m.
 - (B) In block walls and stud partitions.
- (e) Fastenings and Supports
 - (i) Provide supports and fastenings for the Work of this Division. Do not use supports or equipment provided by other Trades.
 - (ii) Equipment fastenings and supports shall conform to manufacturers recommendations.
 - (iii) Do not attach to, or suspend any electrical product or service from the roof deck, mechanical ductwork or piping.
 - (iv) Do not use wire lashing or perforated strap to support or secure raceways or cable.
 - (v) Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
 - (vi) For surface mounting of two or more raceways or cables use channels.
 - (vii) Where there is no wall support for raceways and cables dropped vertically to equipment, provide channel properly secured to floor and structure.

- (viii) Hang supports from structural members. Where location does not permit direct support from structure provide necessary brackets, frames, channels secured to structural members.
- (ix) Fasten exposed conduit and cables to building construction or support systems using straps. Use beam clamps on exposed steelwork.
- (x) Masonry, tile and plaster surfaces: use lead anchors.
- (xi) Poured concrete: use expandable inserts. Low velocity powder activated fastenings may be used only in poured concrete.
- (xii) Steel structures: use clips, spring loaded bolts, cable clamps, designed as accessories to basic channel members.
- (xiii) Do not use powder activated fasteners in, tile, precast concrete or steel structure.
- (xiv) Do not install conduits or cables on the bottom chord of joists or trusses.
- (xv) Use beam clamps of the 2-bolt design and of such type that the rod load is transmitted only concentrically to the beam web centreline. The use of "C" and "I" beam side clamps will not be allowed.
- (f) Junction Boxes
 - (i) Install junction boxes in inconspicuous but accessible locations. Secure to structure.
 - (ii) Install terminal blocks on mounting rails, for termination of each wire and cable regardless of size.
 - (iii) Only one voltage source is permitted in a junction box.
 - (iv) Install barriers to separate different auxiliary systems
- (g) Pull Boxes
 - (i) Install pull boxes in inconspicuous but accessible locations. Secure to structure.
 - (ii) Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
 - (iii) Only one voltage source is permitted in a pull box.
 - (iv) Install barriers to separate different auxiliary systems.
- (h) Outlet and Conduit Boxes
 - (i) Install conduit outlet boxes for conduit up to 32 mm and pull boxes for larger conduits.

- (ii) Support boxes independently of connecting conduits.
- (iii) Seal boxes during construction to prevent entry of debris, dust and dirt.
- (iv) For flush installations mount plaster rings to box, flush with wall surface to permit wall finish to come within 6 mm of opening.
- (v) Provide correct size of openings in boxes for conduit, armoured cable connections. Reducing washers will not be acceptable.
- (i) Installation of Branch Circuit Conductors
 - (i) Install wiring in raceways unless noted otherwise.
 - (ii) Minimum wire sizes:
 - (A) Power and lighting No. 12 AWG
 - (B) Control No. 14 AWG
 - (iii) Wire and cable application and type:
 - (A) Branch circuits other than those covered above use RW90
 - (B) Equipment feeders and circuits use RW90
 - (iv) Use lubricant when pulling wires into conduit. Ensure that wires are kept straight and are not twisted or abraded.
 - (v) Neatly secure exposed wire in apparatus enclosures with approved supports or ties.
 - (vi) Junctions of all conductors shall be done with Ideal Wing nut #450 Series (Black) for conductors from #14 AWG to #8 AWG.
 - (vii) For all conductors larger that #8 AWG junctions shall be done with Burndy Servit connectors wrapped with 3 M #33 Scotch tape.
- (j) Connectors
 - (i) Install compression terminations and splices in accordance with manufacturer's written instructions.
 - (ii) Make splices in junction boxes.
 - (iii) Make connections in lighting circuits with twist type splicing connectors.
 - (iv) Terminate and splice conductors No. 8 and larger at terminal blocks in junction boxes.
 - (v) Seal terminations and splices exposed to moisture, corrosive conditions or mechanical abrasions with heavy wall heat shrinkable insulation.

- (k) Installation of Escutcheon Plates
 - (i) Provide escutcheon plates over all exposed conduit passing through walls, floors, ceilings, partitions, furring etc., in finished areas.
- (1) Installation of Inserts, Beam Clamps, Fasteners, Hangers And Supports
 - (i) Install all inserts, beam clamps, fasteners, and similar hardware required for conduit, duct, raceway, conductor, etc., and equipment hanger and/or support materials to best suit structural details.
 - (ii) Accurately and properly set concrete inserts in the concrete framework.
 - (iii) For runs of three (3) or more conduits, raceways, or conductors in concrete formwork, use multiple type inserts used for the smallest conduit in the group.
 - (iv) Where inserts are required in precast concrete and in concrete work where concrete inserts have not been installed, drill a neat hole of the proper diameter and depth in the concrete and insert an anchor to accept the hanger rod, bolt, etc., or where concrete mass permits, use self-drilling concrete anchors.
 - (v) Fasten hangers and support provisions to brick or masonry with expansion shields and machine bolts, or for light loads, use plugs, and screws.
 - (vi) In cavity walls and/or ceilings use two (2) wing toggles and for heavy loads, provide steel anchor plates with two (2) or more toggles to spread the load.
 - (vii) Provide beam clamps for attaching, hanging and/or support provisions to the Consultant, weld the hanging and support provisions to the structural steel.
 - (viii) Explosive power actuated fasteners will not be permitted unless specific approval for their use has been obtained from the Consultant.
- (m) Painting And Finishes
 - (i) Provide all painting and patching to match existing services as required.
 - (ii) All exposed electrical fittings, supports, hangers, frames conduit, racks, boxes, raceways and similar material and apparatus shall be galvanized or finished with corrosion resistant primer ready to accept paint. Take special care when priming work exposed to the elements or in wet areas to prevent rust or corrosion from damaging adjacent surfaces.
 - (iii) Touch up and/or repaint any factory finished equipment that has been scratched or otherwise damaged during installations.

- (iv) Provide for all patching and painting for all removals and as required.
 Painting shall be completed to the approval of the Consultant and Owner.
 Paint shall match adjacent surfaces. Include all costs.
- (v) Where cutting, patching, fire stopping and construction involves painted surfaces these must be painted to match the surrounding surfaces or as directed by Consultant.
- (n) Standard Identification
 - (i) Identify electrical work as specified below.
 - (ii) For each piece of electrical equipment and for any other piece of equipment where specified in this Section, provide engraved lamacoid identification nameplates. Nameplates shall generally be lamacoid black with white letters and with bevelled edges, secured to apparatus with stainless steel screws. Warning signs, if and when required, shall be red with white lettering.
 - (iii) Exact nameplate wording and sizes must be approved by and confirmed by the Consultant prior to manufacture.
 - (iv) Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting the outside of the covers. Paint colours shall be in accordance with the following schedule:
 - (v) Colour code conductors, throughout to identify phases, neutrals and grounds by means of self-laminating coloured tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours shall be as follows:
 - (A) Phase A Red
 - (B) Phase B Black
 - (C) Phase C Blue
 - (D) Ground Green
 - (E) Neutral White
- (o) Cutting and Patching
 - (i) Inform other trades in time concerning required openings. In work already finished, cutting and patching shall be done by the trades installing the affected work at the expense of Division 16. Obtain the approval of the Consultant, before doing any cutting.
- (p) Field Fabricated Metal Work
 - (i) Clean and prime paint field fabricated metal work.

REPLACEMENT OF REFRIGERATION SYSTEM

- (ii) After fabrication deburr, scrape, grind smooth, wire brush with power brush and degrease metal work.
- (iii) Prime paint steel with 1 coat of CISC/CPMA 2.75 oil alkyd primer.
- Prime paint aluminum as follows: wash with detergent solution and wipe down with SSPC-SP1 solvent. Apply Glidden #Y-5229 primer to 1.5 mils DFT.
- (v) For brass and bronze alloy materials, prepare as for aluminum but apply 1 coat of CAN/CGSB-1.40-M zinc chromate primer.
- (q) Tests
 - (i) Branch circuit balancing.
 - (ii) Connect all new branch power circuits to existing panelboards so as to balance the actual loads (wattage) within 5%.

END OF SECTION 16100

TERRY MILLER RECREATION CENTRE

REPLACEMENT OF REFRIGERATION SYSTEM

1. General

- (a) General Requirements
 - (i) Comply with Division 16.

(b) References

- (i) Section 16010 Electrical General Provisions also applies to and is a part of this Section of the Specification.
- (ii) Conform to latest issues, amendments and supplements of following standards:

(A)	CSA C22.2 No. 4-M-	Enclosed Switches
(B)	CSA C22.2 No. 5.1M	Moulded Case Circuit Breakers

- (c) Scope of Work
 - (i) Supply all labour, tools, services and equipment and provide all materials and equipment required to complete service and distribution work in accordance with this section of the specification and the drawings.
- (d) Quality Assurance
 - (i) All low voltage distribution work shall be executed by skilled tradesmen fully experienced in the installation of electrical power systems.
 - (ii) All equipment shall be constructed to EEMAC standard and shall carry the CSA label or the contractor shall obtain Electrical Safety Authority approval.
 - (iii) All equipment shall be suitably noted for the system available fault and HRC fuses shall comply with CSA C22.2 No. 106.
- (e) Submittals
 - (i) Refer to specification Section 16010 Electrical General Provisions and submit shop drawings for the following:
 - (A) Breakers
 - (B) Combination Motor Starters
 - (C) Disconnect Switches
 - (D) Transformer

TERRY MILLER RECREATION CENTRE

- 2. **Products**
 - (a) References
 - (i) Refer to Section 16100 Basic Materials and Methods. This Section also applies to and is part of this section of the specifications.
 - (b) Fusible and Non-Fusible Safety Switches (Disconnects)
 - (i) Safety switches shall be heavy duty series safety switches.
 - (ii) Each safety switch shall be front operated with red handle suitable for padlocking in the "OFF" position and arranged so that the enclosure cover cannot be opened with the handle in the "ON" position. Operating mechanisms shall be quick-make, quick- break, positive acting with visible blades, and a line terminal shield. Fusible units shall be complete with fuse clips suitable for H.R.C., Class "J" fuses unless otherwise noted. Each unit shall also be equipped with solderless lugs and a front cover nameplate identifying the catalogue number and electrical characteristics.
 - (iii) Enclosures for safety switches shall be, unless otherwise noted, EEMAC
 3R raintight (sprinkler-proof) enclosures or EEMAC 4X for outdoor weatherproof installations.
 - (iv) The ampere rating, number of poles, and fuse requirements for safety switches shall be as specified on the drawings.
 - (v) The discount switches shall be selected so that they will fit into the space available in the electrical room and meet the requirements of the Ontario Electrical Safety Code.
 - (vi) Electrical Interlock: Mechanically operated from switch mechanism, rated 120 VAC, 15A, 1 NO and 1 NC contact.
 - (vii) Acceptable manufacturers, are FPE, Eaton, Square D or Siemens.
 - (c) Combination Motor Starters with Disconnects and Accessories
 - (i) Provide starters for motorized mechanical equipment, in accordance with the following specification and the motor control requirements indicated on the drawings.
 - (ii) Unless otherwise indicated, starters for 3-phase and single phase motors shall be combination, type adjustable instantaneous trip circuit breaker with full voltage non-reversing magnetic type for across-the-line starting. Full protection of each phase shall be provided in the starters by means of one (1) overload relay in each phase. Under voltage protection shall be provided by the starter coil (drop-out on 65% of rated voltage) unless otherwise noted.

TERRY MILLER RECREATION CENTRE

- (iii) All starters shall be provided with
 - (A) Selector switch hand/off/automatic or push button control to start/stop, as indicated.
 - (B) "ON" pilot light (red or green) as indicated.
 - (C) Elapsed time meter.
 - (D) 2 NO and 2 NC electrical interlocks. These requirements are a minimum for all starters. Extra accessories shall be provided as shown on the drawings.
- (iv) Supply and install timing relays in starters equipped with hand-off-automatic or on-off switches, and which serve motors larger than 30 HP. Set timers as instructed to provide sequenced starting of motors after power outage.
- (v) Disconnects shall be heavy duty, front operated with a handle suitable for padlocking in the "OFF" position and arranged so that the enclosure cover cannot be opened while the handle is in the "ON" position. Operating mechanisms shall be quick-break" positive acting with visible blades and a line terminal shield. Fusible units shall be complete with fuse clips and suitable for H.R.C. fuses unless otherwise noted. Each unit shall be equipped with solderless lugs and front cover nameplate identifying the catalogue number and electrical characteristics.
 - (A) Enclosures for disconnects mounted indoors and not exposed to the weather shall be EEMAC 3 sprinkler proof enclosures unless otherwise noted.
 - (B) Enclosures for disconnects mounted outdoors or in locations exposed to the weather shall be EEMAC 4X weatherproof, number of poles and fuse requirements as indicated on the drawings. Where indicated on drawings provide moulded case motor rated breakers.
- (vi) Unless otherwise indicated, fuses shall be Gould Shawmut Class "J" series CJ, H.R.C. fuses for constant running equipment and Class "J" series AJT time delay type for equipment that cycles "ON" and "OFF".
- (d) Panelboards
 - (i) Panelboards: Product of one manufacturer.
 - (ii) Install circuit breakers in panelboards before shipment.
 - (iii) 225V panelboards: bus and breakers rated for 22KA (symmetrical) interrupting capacity or as indicated.

TERRY MILLER RECREATION CENTRE

- (iv) 600V panelboards: bus and breakers rated for 35KA (symmetrical) interrupting capacity or as indicated.
- (v) Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- (vi) Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- (vii) Two keys for each panelboard and key panelboards alike.
- (viii) Solid copper bus for panelboard with neutral of same ampere rating as mains.
- (ix) Mains: copper bus, suitable for bolt-on breakers.
- (x) Trim with concealed front bolts and hinges.
- (xi) Trim and door finish: baked grey enamel.
- (xii) Acceptable manufactures are Eaton, Siemens, Schneider Group or approved equivalent.
- (e) Breakers
 - (i) Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
 - (ii) Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
 - (iii) Lock-on devices for security alarm, emergency lighting, lighting control and exit light circuits.
- (f) Relays
 - (i) Totally enclosed plug-in type relay with 4 form-C contacts, operating coil to suit required voltage. Complete with mounting socket.
 - (ii) Acceptable Manufacturers
 - (A) Allen-Bradley
 - (B) Schneider Square D
 - (C) Cutler-Hammer or approved equal.
- (g) Switches
 - (i) Specification grade.

TERRY MILLER RECREATION CENTRE

- (ii) 15 A, 120V as required, single pole or 3 pole where shown.
- (iii) Manually-operated general purpose AC switches with following features:
 - (A) Terminal holes approved for No. 10 AWG wire.
 - (B) Silver alloy contacts.
 - (C) Urea or melamine molding for parts subject to carbon tracking.
 - (D) Suitable for back and side wiring.
 - (E) Ivory (brown for utility rooms) toggle.
- (iv) Toggle operated, fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- (v) Switches of one manufacturer throughout Project.
- (h) Receptacles
 - (i) Specification grade.
 - (ii) Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
 - (A) Ivory (brown in utility rooms) urea molded housing.
 - (B) Suitable for No. 10 AWG for back and side wiring.
 - (C) Eight back wired entrances, four side wiring screws.
 - (D) Triple wipe contacts and rivetted grounding contacts.
 - (iii) Ground fault circuit interceptor receptacles:
 - (A) Ivory high strength nylon.
 - (B) Suitable for No. 10 AWG for back and side wiring.
 - (C) 15 amp feed through rating.
 - (D) Shallow body type.
 - (iv) Receptacles of one manufacturer throughout Project.
- (i) Cover Plates
 - (i) Cover plates for wiring devices.
 - (ii) Cover plates from one manufacturer throughout Project.
 - (iii) Sheet steel utility box cover for wiring devices installed in

TERRY MILLER RECREATION CENTRE

REPLACEMENT OF REFRIGERATION SYSTEM

surface-mounted utility boxes.

- (iv) Stainless steel, vertically brushed, 1 mm thick cover plates cover plates, for wiring devices mounted in flush-mounted outlet box.
- (v) Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- (vi) Weatherproof double lift spring-loaded cast aluminium cover plates, complete with gaskets for duplex receptacles as indicated.
- (vii) Weatherproof spring-loaded cover plates complete with gaskets for single receptacles or switches.
- (j) Grounding Equipment
 - (i) Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
 - (ii) Grounding conductors: bare stranded copper, soft annealed, size as indicated.
 - (iii) Insulated grounding conductors: green, type RWU.
 - (iv) Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
 - (v) Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - (vi) Grounding and bonding bushings.
 - (vii) Protective type clamps.
 - (viii) Bolted type conductor connectors.

3. **Execution**

- (a) General
 - (i) Protect equipment from dust, debris, moisture, and physical damage, with sealed envelope of plastic or other impervious material until building is enclosed and cleaned and equipment is energized.
 - (ii) Protect from condensation by maintaining at suitable temperature above 0° C.
 - (iii) Finish equipment enclosures to ANSI 49 or ANSI 61, baked grey enamel.

TERRY MILLER RECREATION CENTRE

- (b) Motor Control Equipment
 - (i) Secure equipment plumb true and square to structure.
 - (ii) Check nameplate rating of motor to select overload relay heater elements; install heater elements.
 - (iii) Check operation of starters and correct motor rotation. Coordinate with Mechanical Division.
 - (iv) Provide plastic covers to exclude dirt and dust until starters are energized.
- (c) Disconnect Switches
 - (i) Install local to equipment on adjacent wall, column, or other suitable mounting surface. Where necessary provide free standing rigid continuous slotted channel strut frame.
 - (ii) Where mounted on masonry walls, allow minimum of 6 mm clear space between enclosure and masonry wall.
- (d) Electrical Connections For Mechanical Equipment
 - (i) Provide all required electrical connections to apparatus provided and/or supplied by Division 15, or by the Owner.
 - (ii) Motor Starters and Motors
 - (A) All motor starters for mechanical equipment shall be supplied, installed and connected under this Division except where starters are included as part of a mechanical "package" and which will be provided under Division 15 but wired and connected under this Division.
 - (B) Provide line voltage disconnect switches at each piece of electrically operated mechanical equipment to meet Code Requirements.
 - (C) All motors shall be wired and connected under this Division. The drawings do not necessarily show the exact location of wiring to motors and it shall be the responsibility of this Division to fully coordinate this work with Division 15.
 - (iii) Mechanical Controls
 - (A) Be responsible for the provision of 120 volt line side power connections to all control apparatus where detailed or required to make the system operational.
 - (iv) Owners Electrical Apparatus Connections

TERRY MILLER RECREATION CENTRE

- (A) Provide all required electrical services for electrically operated apparatus supplied and/or provided by the Owner.
- (B) Generally, unless otherwise noted, starting equipment, controls and accessories will be supplied by the supplier/installer of the apparatus. Obtain accurate "roughing-in" information to make the necessary "line" and "local" connections required.
- (C) Be familiar with the apparatus being supplied and carefully co-ordinate and cooperate with the supplier/ installer to ensure a proper and complete installation.
- (e) Switches:
 - (i) Install single throw switches with handle in "UP" position when switch closed.
 - (ii) Install switches in gang type outlet box when more than one switch is required in one location.
 - (iii) Mount toggle switches at 1200mm or as indicated.
- (f) Receptacles:
 - (i) Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - (ii) Mount receptacles at 300mm or as indicated.
- (g) Cover Plates:
 - (i) Protect stainless steel cover plate finish with paper or plastic film until painting and other Work is finished.
 - (ii) Install suitable common cover plates where wiring devices are grouped.
- (h) Grounding Installation General
 - (i) Install complete permanent, continuous grounding system including, conductors, connectors, accessories and connect to the existing building ground system. Where EMT is used, run ground wire in conduit.
 - (ii) Install connectors in accordance with manufacturer's instructions.
 - (iii) Protect exposed grounding conductors from mechanical injury.
 - (iv) Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
 - (v) Use mechanical connectors for grounding connections to equipment provided with lugs.

TERRY MILLER RECREATION CENTRE

- (vi) Soldered joints not permitted.
- (vii) Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- (viii) Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- (ix) Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- (i) System and Circuit Grounding
 - (i) Install system and circuit grounding connections to neutral of secondary 120/208V system.
- (j) Grounding Field Quality Control
 - (i) Perform tests in accordance with Section 16010 Electrical General Requirements.
 - (ii) Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction over installation.
 - (iii) Perform tests before energizing electrical system.
- (k) Testing and Inspection of Power Distribution System
 - (i) Include in the base bid the cost of on-site inspection and testing of the following main distribution equipment.
 - (A) 600V Distribution Equipment
 - (B) 120/208V Distribution Equipment
 - (C) Grounding System
 - (D) Short circuit and coordination study
 - (E) Arc Flash Study
 - (ii) This engineering inspection and testing shall be done prior to the system being energized and shall include the following items where applicable:
 - (A) Testing, cleaning and where necessary, calibrating all relays and circuit breaker trip devices.
 - (B) Function test of protection and control devices.

TERRY MILLER RECREATION CENTRE

REPLACEMENT OF REFRIGERATION SYSTEM

- (C) Megger test interconnecting cables.
- (D) Replacement of fuses destroyed or damaged during the start- up or testing;
- (iii) Acceptance tests shall be conducted in the presence of and to the satisfaction of the Consultant.
- (iv) Make good any defects indicated in the equipment and in the installation by the tests.

END OF SECTION 16400