

Appendix C - Consultant Rink Specifications

SECTION 26 00 00

ELECTRICAL

(FILED SUB-BID REQUIRED)

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. The CONDITIONS OF THE CONTRACT and DIVISION 1. General Requirements shall be part of this section.

1.02 RELATED DOCUMENTS

- A. All of the Contract Documents, including General Conditions, Modifications, and Division 1 General Requirements, apply to the work of this section.

103 SCOPE OF WORK

- A. The scope of work consists of the installation of all materials to be furnished under this Section, and without limiting the generality thereof, includes all equipment, labor, and services required for the furnishing, delivering, and installing the principal items of work hereinafter and all items incidental thereto as specified herein and as shown on the drawings.
- B. The itemization of work hereinafter specified does not in any way limit the responsibility to perform all work and furnish all the equipment, labor, and materials necessary for completion and satisfaction of operation of the installations described in the Specifications and shown on the Contract Drawings. In addition to the principal and miscellaneous items of work specifically mentioned and/or indicated, to be responsible for furnishing and installing all incidental and collateral materials such as supporting hardware for panelboards, conduit hangers, fastening devices, insulating tape and the like, which constitute essential components of the grade of Electrical Trade Practices and Workmanship acceptable to the Department.
 - 1. Grounding.
 - 2. Panelboards.
 - 3. Distribution feeders and distribution panelboard.
 - 4. Raceways.
 - 5. Branch circuit wiring.
 - 6. Motor wiring.
 - 7. Main electrical service equipment.
 - 8. Wiring and connection of electrical equipment supplied by Owner and other Subcontractors.
 - 9. Fireproof seals.
 - 10. Core drilling and cutting.
 - 11. Cutting and patching.
 - 12. Junction boxes and pull boxes.
 - 13. Nameplates and labels.
 - 14. Disconnect switches.
 - 15. Electrical connections refrigeration equipment, cooling tower and associated pumps.
 - 16. Removal of existing electrical equipment, panelboards, and associated feeders.
 - 17. Disconnect and remove existing disconnect switches, starters, and branch circuit wiring serving all existing refrigeration equipment, cooling tower, and associated pumps as

indicated on the drawings.

1.04 RELATED WORK

- A. The following work is not included in this Section and is to be performed under the designated Sections:
 - 1. All control wiring shall be furnished and installed by the Refrigeration Contractor.
 - 2. Charges for current consumed by the temporary light and power system for construction will be paid by the Ice Rink Management Corporation.
 - 3. Painting (except for factory finished items) specified under Section "Painting".
 - 4. Refrigeration system starters and pump starters furnished by others, installed, and wired by the Electrical Contractor. All starters or VFD required for the refrigeration system and associated pumps shall be furnished by the Refrigeration Contractor and installed and wired by the Electrical Contractor.

1.05 BREAKDOWN

- A. This Subcontractor must submit a breakdown of his contract price to aid the Department in determining the value of work installed as the job progresses.
- B. No requisition will be paid to this Subcontractor until the breakdown is delivered to the Department.

1.06 PRODUCT DATA SHEETS

- A. Prepare and submit five (5) copies of product data sheets of all equipment, labels, tags, and nameplates supplied under this Section of the Specifications to the General Contractor for approval, as specified under General Conditions and Supplementary Conditions. No work shall be done until product data sheets have been approved.
- B. Shop drawings shall show plans, details, layouts and job conditions and relationship to other work.

1.07 RECORD DRAWINGS

- A. This Contractor shall furnish and keep on the job at all times, two, (2) complete and separate sets of blackline prints of the electrical work on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all changes, revisions and additions to the work. Wherever work is installed otherwise than as shown on the Contract Drawings, such changes shall be noted.
- B. Indicate daily progress on these prints by coloring in the various conduits, fixtures, apparatus, and associated appurtenances as they are erected.
- C. No approval of requisition for payment for work installed will be given unless supported by record prints as required above.
- D. At the conclusion of work, prepare Record Drawings in accordance with the requirements of the GENERAL CONDITIONS.

1.08 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

- A. This Subcontractor shall instruct to the Owner's satisfaction, such persons as the Owner designates in the proper operation and maintenance of the systems and their parts.

- B. Furnish in accordance with provisions under "Special Conditions" operating and maintenance manuals and forward same to the Department. The Subcontractor shall provide three (3) sets of Maintenance Manuals.
- C. The operating instructions shall be specific for each system and shall include copies of posted specific instructions.
- D. For maintenance purposes, provide shop drawings, parts lists, specifications, and manufacturer's maintenance bulletins for each piece of equipment. Provide name, address, and telephone number of the manufacturer's representative and service company, for each piece of equipment so that service or spare parts can be readily obtained.

1.09 SAMPLES

- A. Submit samples as requested by the Department of all materials specified herein in accordance with General Condition and Supplementary Conditions, and before ordering materials obtain approval from the Department.

1.10 LAWS, ORDINANCES, CODES, AND PERMITS

- A. The Electrical Subcontractor shall give all necessary notices, obtain all permits, and pay all taxes, fees, and other costs in connection with his work; file all necessary plans, prepare all necessary documents and obtain all necessary approvals of state authorities, all local, town, city, or county departments having jurisdiction; obtain all required certificates of inspection for his work.
- B. The Electrical Subcontractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, drawings in addition to Contract Drawings and Documents, in order to comply with all applicable laws, ordinances, rules and regulations whether or not shown on the drawings and/or specified.
- C. All materials furnished and all work installed shall comply with the rules and recommendations of the National Electrical Code as amended by the state of Vermont, the National Board of Fire Underwriters', all requirements of the local utility company, recommendations from the fire insurance rating organizations having jurisdiction, and with the requirements of all state, local, town, city, or county departments having jurisdiction.

1.11 DEFINITIONS

- A. "This Contractor" or "This Subcontractor" means specifically the Electrical Subcontractor working under this Section of the Specifications.
- B. "Furnish and Install or "Provide" means to supply, erect, install and connect up, complete for regular operation, the particular work referred to unless otherwise specified. "Piping" includes in addition to pipe, all fittings, boxes, hangers and other accessories relating to such piping. "Concealed" means hidden from sight as in trenches, chases, furred spaces, shafts, hung ceilings, embedded into construction, ground or concealed as defined above.

1.12 INSPECTION AND TEST

- A. All work will be subject to the inspection of the Department and such other inspections as may have jurisdiction.
- B. As the various part of the works are installed and/or revised, insulation resistance test shall be made to insure that the new systems are free from short circuits and grounds and that all

connections, switches, controls and equipment are in proper operating condition.

- C. The installation resistance between conductors and between conductors and grounds, for the distribution systems shall be not less than the requirements of the National Electrical Code.
- D. All testing equipment necessary shall be provided. The tests shall incur no additional expense to the Owner.
- E. Failure or defects in workmanship or materials revealed by tests shall be corrected promptly and retested. Defective materials furnished under this contract shall be replaced at no additional expense to the Owner.

1.13 REFERENCES

- A. Installation shall comply in all details with the National Electrical Code with its latest revisions and all prevailing local, Federal, and State regulations.
- B. Material and equipment shall be Underwriters' laboratories, Inc., listed, where a standard has been established.
- C. Manufacturers' names and nomenclature facilitates descriptions of certain materials and equipment and are used to establish type, quality, and function.
- D. Unless otherwise specified, all work shall be manufactured, tested and installed in accordance with the latest editions of applicable publications and standards of the following organizations:
 - 1. American Society for Testing and Material (ASTM).
 - 2. Underwriters' Laboratories, Inc. (U.L.)
 - 3. Insulated Power Cable Engineers Association (IPCEA).
 - 4. National Electrical Manufacturers Association (NEMA).
 - 5. Institute of Electrical and Electronic Engineers (IEEE).
 - 6. American National Standards Institute (ANSI).
 - 7. National Fire Protection Association (NFPA).
 - 8. National Electrical Code (NEC).
- E. Should specifications, Departments' instructions, laws, ordinances, or public authority require any special tests or approvals, arrange for these and give the Department timely notice. If the inspection is by another authority other than the Department, notify the Department of the dates fixed for such inspection.
- F. Make all reasonable tests required by the Department to provide the integrity of the electrical installation and leave the entire installation properly adjusted and in operating condition. After connections are made test the insulation resistance of all parts of the electrical work except that which is not furnished under this Specification. All wiring shall be so installed that when completed the system will be free from short circuits and from unintentional grounds.
- G. Where reference is made to Codes and Standards these shall be interpreted as minimum requirements. Requirements in excess of these codes and Standards may be indicated on the Drawings or in the Specifications and shall be so included in the contract work. Compliance with such code requirements only shall not be construed as fulfillment of the contract work, where the plans and/or Specifications indicate additional work which may exceed such code standards.
- H. Copies of NEMA, NFPA, and NEC shall be made available by the Electrical Subcontractor at the job site.

1.14 EXAMINATION OF SITE AND CONTRACT DOCUMENTS

- A. Before submitting prices or beginning work, thoroughly make an examination of the site and the Contract Documents.
- B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and Contract Documents prior to executing contract would have revealed.
- C. The drawings showing layout of the electrical systems indicate the approximate location of outlets, apparatus, and equipment. The runs of feeders and branch circuits as shown on the drawings are schematic only, and are not intended to show the exact routing of the wire; the final determination as to the routing of the wire shall be governed by structural conditions and other obstructions. This shall not be construed to mean that the design of the system may change; it merely refers to the exact run of a raceway between given points.
- D. The right to make any reasonable change in the location of outlets, apparatus, and equipment up to the time of roughing-in is reserved by the Owner without involving any additional expense to the Owner.
- E. The Drawings and these specifications are complementary with one another, any labor, or materials called for by either, whether or not by both, or necessary for the successful operation of any of the particular types of equipment furnished under this contract, shall be furnished and installed.
- F. Before installing any work, see that it does not interfere with the clearance required for finished columns, pilasters, partitions or walls, as shown on the contract Architectural drawings and details.
- G. Be responsible for all materials delivered to the site in connection with the work and pay all charges for cartage, scaffolds, planking, rigging, and erecting. Take every precaution necessary to protect equipment and installation in addition to plugging and protecting open ends of all pipes, outlet boxes, panelboxes, and junction boxes. All equipment must be stored in a clean dry place to preserve the quality of materials being used. Equipment and/or materials damaged during the construction period shall be replaced at no additional cost to the Owner.
- H. All materials and equipment required by this Electrical Specification shall be new, clean, and free of defects at the time of installation. The manufacturer's and Underwriter's label shall be on all materials and equipment unless otherwise approved, in writing, by the Department.

1.15 SUBSTITUTION OF MATERIALS OR EQUIPMENT

- A. If the Electrical Subcontractor wishes to use materials or equipment other than those specifically designated herein, as being equal to those so specifically designated; BEFORE PURCHASING AND/OR FABRICATION, he shall submit the proposed substitution in accordance with the requirements of the GENERAL CONDITIONS, supported by sufficient proof of equality, the successful subcontractor will be required to furnish the specifically named items designated under the base bid.
- B. If the apparatus or materials substituted for those specified necessitate changes or additional connections, piping supports, or construction: same shall be provided and the Electrical Subcontractor shall assume the cost and the entire responsibility thereto.
- C. The Department's permission to make such substitutions shall not relieve the Electrical Subcontractor from full responsibility for the work.

1.16 DAMAGE TO OTHER WORK

- A. This Contractor shall be held responsible for and shall pay for all damage to other work caused by his work or workmen.
- B. Repairing of such damage shall be done by the General Contractor or Subcontractor who installed the work, and so directed by the Department.

1.17 COORDINATION OF TRADES

- A. This Contractor shall give cooperation to other trades and shall furnish (in writing, with copies to the Department) any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay. Where the work of this Subcontractor will be installed in close proximity to work of other trade, or where there is evidence that the work of this Subcontractor will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Department, this Subcontractor shall prepare composite working drawings and sections, in conjunction with other trades at a suitable scale not less than 1/4" - 1"-0", clearly showing the installation of his work in relation to the work of other trades. If this Subcontractor installs his work before coordinating with other trades, or so as to cause interference with work of other trades, he shall make necessary changes in his work to correct the conditions without extra charge. All cutting, patching, excavation, and backfilling, except for primary electrical service, shall be done by the General Contractor. This Subcontractor shall inform the General Contractor well in advance as to his requirements, and if, in the Department's judgment, he is negligent in this respect, this Subcontractor shall bear all expenses flowing from his negligence with respect thereof.

1.18 PROCEDURE

- A. This Subcontractor shall provide all labor and materials necessary for the complete and substantial execution of the work, including all transportation, scaffolding, apparatus, utensils, tools, etc., requisite for the faithful performance of the work to the true intent and meaning of the Specifications, Drawings, and Instructions. All workmanship and materials shall be of the best of their respective kinds.
- B. This Subcontractor shall store his material and equipment prior to installation only where designated by the Owner. He shall be responsible for all his property stored on the premises and shall hold the Owner free from liability for loss by theft or carelessness of employees of the Owner, or of other Contractors. This Subcontractor must take particular care to protect any finished work from injury caused thereto by his operations. After completion of the work, this Subcontractor shall remove all waste, rubbish and other materials left as a result of his operations and leave the premises in clean condition.

1.19 FIELD MEASUREMENTS

- A. This Subcontractor shall verify in the field all measurements necessary for his work and shall assume responsibility for their accuracy.

1.20 CLEANING AND PROTECTION

- A. All materials and equipment shall be carefully protected during shipment and protected during installation and properly handled and stored at the job site so as to prevent damage. This

Subcontractor shall assume full responsibility for protection of work until its completion and final acceptance.

- B. Upon completion of this work, this Subcontractor shall clean all fixtures and equipment and replace damaged parts. Upon failure of this Subcontractor to fulfill his obligation, this work will be taken care of at his expense.

1.21 GUARANTEE

- A. All materials, items of equipment and workmanship furnished under this Section shall carry the standard warranty against all defects in materials and workmanship for a period of not less than one (1) year from the date of final acceptance of the work.

1.22 CLEANING UP

- A. The Electrical Contractor shall, at the completion of the work, clean, polish and/or wash all exposed items of material, equipment, and fixtures in his contract so as to leave such items bright and clean. Special attention being given to interiors and exteriors of all panels, electrical equipment, and enclosures.
- B. All painted metal surfaces which have been scratched, dented or marred shall be re-painted by the Electrical Contractor.
- C. At the end of each work day, the Electrical Contractor shall remove all waste, rubbish and other materials left as a result of his operation and leave the premises in clean condition.

1.23 CONFLICT BETWEEN PLANS AND SPECIFICATIONS

- A. In case of a conflict between contract plans and the specification the Department will decide which takes precedence.

1.24 SUPERINTENDENCE OF WORK

- A. This Subcontractor shall give his personal superintendence to the work and shall retain at the job site during the period of construction, a competent foreman, satisfactory to the Department, who shall be in full charge of the work under this Section.

1.25 SITE VISITATION

- A. The Electrical Contractor shall be required to visit the site and to have examined the existing conditions which may affect his work under this Contract. Failure to do so shall be his responsibility and no claims for extra compensation or extension of time shall be allowed because of lack of compliance herewith.

1.26 COOPERATION AND WORK PROGRESS

- A. The electrical wiring shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The Electrical Contractor shall cooperate with the Department and all contractors and equipment suppliers working on the site, coordinate the work, and proceed in a manner so as not to delay the progress the project.
- B. The Electrical Contractor shall coordinate his work with the progress of the building and other trades so that he shall complete his work as soon as conditions permit. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other trades of the Owner by the Electrical Contractor shall be assumed by the Electrical Contractor without

any additional cost to the Owner.

- C. The Electrical Contractor has a responsibility to coordinate the exact mounting arrangement and location of equipment indicated on the Drawings to allow for proper space requirements for equipment access, operation and maintenance. Particular attention shall be given in the field to such group installations. If it is questionable that insufficient space or conflict with the work of other contractors, or Architectural or structural obstructions will result in an arrangement which will prevent proper access, operation or maintenance of the indicated equipment, the Electrical Contractor shall immediately notify the Department and not proceed with this part of the contract work until definite instructions have been given to him by the Department.
- D. It shall be the responsibility of the Electrical Contractor to coordinate the delivery of electrical equipment to the project prior to the time installation of equipment will be required; but he also shall make sure such equipment is not delivered too far in advance of such required installation, to assure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of the Department) on the project site prior to installation may be subject to rejection by the Department.

PART 2 - PRODUCTS

2.01 RIGID STEEL CONDUIT

- A. All rigid steel conduits shall be standard IPS, galvanized or sheradized, threaded conduit equal to Pittsburgh Standard, J & L, Youngstown, or equal. Conduit installed in slabs on grade shall be wrought iron.
- B. Changes in direction of conduit, where concealed, shall be made by means of standard radius bends, and where exposed, or by means of galvanized, or sheradized threaded condulets as manufactured by Crouse-Hinds or equal.
- C. Conduits shall be continuous from junction or pull boxes and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from service to all outlets. Terminals of all conduits shall be furnished with double lock nuts and grounding bushings.

2.02 ELECTRICAL METALLIC TUBING

- A. Electrical metallic tubing may be used for sprinkler system flow and tamper switch wiring to a junction box on wall and liquid tight flexible metallic conduit between junction box and respective switches.
- B. Tubing shall be continuous between outlets, making a continuous electrical system for bonding.
- C. Connector and couplings shall be set screw type.

2.03 FLEXIBLE METALLIC CONDUIT

- A. Flexible metallic conduit may be used for short connections to recessed fixtures and motors, except in wet areas. In wet areas liquid tight flexible metallic conduit shall be used.

2.04 WIRES AND CABLES

- A. All conductor wire and cable shall consist of thoroughly tinned 98% conductivity copper, with 600 volt insulation, manufactured in strict accordance with the requirements of the Board of Underwriters' and AIEE.
- B. No wires smaller than No. 12 shall be used for any branch circuit unless noted on plans for special system circuits. Larger sizes shall be used where so indicated on the Drawings.
- C. All 600 volt wire and cables shall be single conductor suitable for use in wet areas and dry locations; shall have an insulation that is moisture and heat resistant cross linked thermosetting polyethylene without an outer jacket, shall be type "THHN" as manufactured by General Electric, Okonite, Rome Cable, or equal. Wire sized No. 12 and No. 10 AWG shall be solid. Sizes 8 and larger shall be stranded.

2.05 OUTLET BOXES

- A. Furnish and install all required outlet boxes as manufactured by Appleton, National, or Steel City or equal.
- B. All outlet boxes for concealed work shall be galvanized, stamped steel; those for fixtures, furnished with a fixture stud.
- C. Outlet boxes shall be of size and type to accommodate (1) structural conditions, (2) size and number of raceways, conductors, or cables entering, and (3) devices or fixtures for which required.
- D. Wall outlets shall be 4" sq. x 1-1/2" deep with plaster covers to suit, or Standard "new work" wall case boxes. Wall boxes shall be designed for rigid metallic conduit and shall be the best type for the wall construction involved.
- E. Install blank plates on all outlet boxes, in which no apparatus is installed, which do not integrally provide a cover for the box.
- F. Special care shall be taken to set all boxes correctly square and true with the building finish. As far as possible, all wall and switch outlets shall be erected in advance of furring and fireproofing, and shall be secured to the building structure or steel by adjustable strap iron supports, which shall be buried in.
- G. The exact location of all outlets and switches in finished rooms shall be obtained from the Department and from the Scale Drawings of interior details and finish. Final correct readjustment shall be made to the outlets if necessary to give proper centering.
- H. In centering of outlets and location of outlet boxes, allow for overhead pipes, and thickness of fireproofing and plastering; also for window trim, paneling, hung ceilings, and the like. Any inaccuracy resulting from failure to do so must be corrected under this Section of the Specifications without expense to the Owner. Confer with the Department and other Subcontractors and find out where hung ceilings occur and piping and ductwork run before signing the Contract and include in proposal whatever costs of the electrical work these conditions necessitate.

- I. The locations given or designated on the Drawings for the outlets are subject to modification. In the case of local wall switches established by the swing of the door. In all cases, the switch shall be on the side of the door opposite the hinges.

2.06 JUNCTION AND PULL BOXES

- A. Junction or pull boxes shall be furnished and installed under this Section of the Specifications where indicated on the Drawings and wherever else such a box may be deemed necessary to facilitate the pulling or splicing of wires or cables.
- B. All such boxes must be made accessible and shall be built only from approved detail Working Drawings. Conduits shall enter these boxes through tight fitting clearance holes.
- C. The covers of the boxes shall be designed for quick removal. Where junction boxes are required for a splicing box for special recessed fixtures, consult the Architect before installing boxes for these fixtures and determine the exact location of the boxes.
- D. Each feeder passing through a pull box shall be tagged or designated in some other approved manner. If tags are used, they shall be of fireproof material.
- E. Locations of junction boxes and pull boxes shall meet the approval of the Architect. Generally, junction boxes and pull boxes shall not be exposed in finished spaces; where necessary re-route conduits or make other arrangements to meet the approval of the Architect.

2.07 PANELBOARDS (120/208 Volt)

- A. Panels shall be type ANQOD≅ bolted as manufactured by Siemens, Square AD≅, Cutler Hammer, or equal.
- B. The panelboard schedule indicates the details as to size, voltage, capacity, and number of circuits necessary, including spares.
- C. The panelboard shall conform to the requirements of the Underwriters= label.
- D. The panelboard shall be designed for operation at 120/208 volts 3 phase 5 wire.
- E. Circuit breakers 1, 2, and 3-pole for 120/208 volts application shall be type AQOB≅ switch rated with interrupting capacity as indicated on drawings. Circuit breakers shall be bolt-on type.
- F. Furnish 10 circuit breaker locks for branch circuit locking control.
- G. All locks of all panels shall be operated by a common master key.
- H. Furnish and install on the inside cover of all light and power panels, a neatly typed index, giving the circuit number; and opposite each number the area of equipment which that particular circuit serves or controls.
- I. In connecting branch circuits to panels, care shall be taken to insure balance; and circuit numbering shown on plans shall be changed to prevent same circuits on same phase being connected to a common neutral.
- J. Panelboards shall be furnished with hinged trim with door and door covers to provide easy access to the panelboard interior, without removing the panelboard cover.
- K. Panelboard bussing shall be copper and shall meet the requirements of the Owner.

2.08 PANELBOARDS (277/480v)

- A. Panels shall be type ANEHB≅, bolted as manufactured by Siemens, Square AD≅, Cutler Hammer or General Electric.
- B. The panelboard schedule indicates the details as to size, voltage, capacity and number of circuits necessary, including spares.
- C. The panelboard shall conform to the requirements of the Underwriters= label.
- D. The panelboard shall be designed for operation at 277/480 volts 3 phase 5 wire.
- E. Circuit breakers 1, 2 and 3-pole for 277/480 volt application shall be type AEHB≅ switch rated, 14,000 amps interrupting capacity minimum.
- F. Furnish 10 circuit breaker locks for branch circuit locking control.
- G. All locks of all panels shall be operated by a common master key.
- H. Furnish and install on the inside cover of all light and power panels, a neatly typed index, giving the circuit number; and opposite each number, the area of equipment which that particular circuit serves or controls.
- I. In connecting branch circuits to panels, care shall be taken to insure balance; and circuit numbering shown on plans shall be changed to prevent same circuits on same phase being connected to a common neutral.
- J. Panelboards shall be furnished with hinged trim with door and door covers to provide easy access to the panelboard interior, without removing the panelboard cover.
- K. Panelboard bussing shall be aluminum and shall meet the requirements of the Owner.

2.09 DISTRIBUTION PANELBOARDS

- A. Power Distribution Panelboard – Furnish and install distribution panelboard as specified herein and where shown on the associated schedule and drawing.
- B. References - The panelboard and circuit breaker referenced herein are designed and manufactured according to the latest revision of the following specifications.
 - 1. NEMA PB 1 – Panelboards
 - 2. NEMA PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
 - 3. NEMA AB 1 – Molded Case Circuit Breakers
 - 4. UL 50 – Enclosures for Electrical Equipment
 - 5. UL 67 – Panelboards
 - 6. UL 489 – Molded-Case Circuit Breakers and Circuit Breaker Enclosures
 - 7. Federal Specification W-P-115C – Type 1 Class 1
 - 8. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service
 - 9. Federal Specification W-C-865C – Fusible Switches
 - 10. NFPA 70 – National Electrical Code (NEC)
 - 11. ASTM – American Society of Testing Materials
 - 12. IBC – International Building Code – Seismic compliance requirements
 - 13. NFPA 5000 – NFPA Building Code – Seismic compliance requirements
 - 14. ASCE 7 – American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures – Seismic compliance requirements

C. Submittal and Record Documentation

1. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

D. Operations and Maintenance Manuals

1. Manufacturer shall provide installation instructions and NEMA Standards Publication PB1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

E. Related Work

1. Section 16280-1.2 – Surge Protective Devices (formally Transient Voltage Surge Suppression)

F. Manufacturers

1. Shall be Square D Company I-LINE – Class 2110 or equal as manufactured by General Electric or Cutter Hammer.

G. Power Distribution Panelboards

1. I-LINE Circuit Breaker Distribution Panelboard
 - a. Interior
 1. Shall be Square D I-LINE type rated 600 VAC or 250 Vdc maximum. Continuous main current ratings as indicated on associated schedule and drawing not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
 2. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated [schedule] [drawing] not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230.VI and VII.
 3. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
 4. The bussing shall fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated copper. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.
 5. Interior trim shall be of dead-front construction to shield user from all energized parts. Main lug interiors shall be field convertible for top or

- bottom incoming feed.
6. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided.
 7. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter-mounted neutral will not be acceptable.
 8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.
- b. Group mounted circuit breakers through 1200A
1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
 2. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of the bus.
 3. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.
 4. Line-side circuit breaker connections are to be jaw type.
 5. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- c. Molded Case Circuit Breaker Characteristics – General
1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
 2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
 3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing International I/O markings.
 4. The maximum ampere rating and UL certification standard with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
 5. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
 6. Circuit breakers shall be factory sealed with a hologram quality mark and shall have date code on face of circuit breaker.
 7. Circuit breakers shall not be Series Rated.
 8. Circuit breakers shall be equipped with UL Listed electrical accessories as noted on the associated schedule drawing or they may be field-installable.
 9. Circuit breaker handle accessories shall provide provisions for locking handle in ON and OFF position.

10. All circuit breakers with permanent trip units shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
 11. Circuit breakers shall be I-LINE – up to 1200 Amp maximum construction with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable [mechanical type] lugs (except type QB/QD/QG/QJ. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper conductors only. Lugs shall be suitable for [60° C rated wire – on 125A circuit breakers and below], [75° C rated wire] or [90° C rated wire, sized according to the 75° C temperature rating in the National Electrical Code].
- d. Thermal-Magnetic Circuit Breakers
1. Shall be Square D type: PowerPact Q-, H- and J-frame (15-250A) [or approved equal].
 2. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
 3. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor in a 40° C ambient temperature.
 4. Circuit breaker frame sizes above 150 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker (except type QB/QD/QG/QJ).
 5. Standard two- and three-pole circuit breakers up to 250 amperes at 600 VAC shall be UL Listed as HACR type.
- e. Electronic Trip Circuit Breakers with STR Trip System
1. Shall be Square D type: PowerPact D-frame (60-600A) [or approved equal].
 2. The circuit breaker trip system shall be a microprocessor based true rms sensing design. Sensor ampere ratings shall be as indicated on the associated [schedule] [drawing].
 3. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
 4. All trip units shall be removable to allow for field upgrades.
 5. The STR trip unit functions shall consist of adjustable long-time pickup and [adjustable or non-adjustable] delay, short-time pickup and [adjustable or non-adjustable]delay, [optional instantaneous pickup], [optional ground-fault pickup and delay].
 6. Adjustable rating plug shall allow for six long-time (Io) pickup settings from 0.5 to 1 times the sensor plug (In) and fine adjustment (Ir) with eight settings ranging from 0.8 to 1 times Io. [Adjustable long-time delay shall be available in bands from 0.5 to 8 seconds at six times Ir]
 7. Short-time pickup shall allow for seven settings.
 8. From 2 to 9 times Ir. Short time delay shall be fixed in trip units STR23SP and SR23SP.
 9. From 1.5 to 7 times Ir. Short-time delay shall be in eight bands from 0 to 0.3 12t ON and 0 to 0.3 12t OFF in trip units STR53UP.
 10. [Instantaneous settings on the trip units with LSI protection shall be available in seven bands from 1.5 to 9 times In]
 11. [Optional ground-fault settings shall be available to provide residual type ground fault protection. Ground fault pickup shall be in 8 settings from 0.2 to 1 times In. The adjustable delays shall be in 4 settings 0.1 to 0.4 12t ON

- and 0.1 to 04 12t OFF.
12. All trip units shall have the capability for the adjustments to be set and read locally by a rotating switch.
 13. Trip unit shall provide local trip indications.
 14. An ammeter (a digital display) shall be provided to indicate the current of the phase with the greatest load. By pressing a scroll button, it shall also be possible to display successively the readings of the 11, 12, 13, and I Neutral. LEDs shall indicate the phase for which the current is displayed.
- f. Surge Protective Device
See: SECTION 16280-1.2 (26 43 00.12) Integrated Surge Protective Device (SPDs) for Panelboards.
- g. Enclosures
1. Type 1 Boxes
 - a) Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
 - b) Boxes shall have removable blank end walls and interior installation.
 2. Type 1 Trim Fronts
 - a) Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
 3. Trim front shall be hinged 1-piece with door available in [surface] mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.
 4. Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.
- h. Type 3R
1. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 2. All doors shall be gasketed and be equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners. A clear plastic directory cardholder shall be mounted on the inside of the door. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

2.10 NAMEPLATES

- A. Nameplates consisting of black mica with white center, lettering to be 1/4" high engraved through to white layer and properly fastened with brass screws shall be provided for the following equipment:
1. Switchgear.
 2. Disconnect switches.
 3. VFD's.
 4. Panelboards.
- B. Junction boxes.
- C. Electrical Contractor shall note branch circuit number terminated at each disconnect switch

servicing mechanical system terminal box.

2.11 DISCONNECT SWITCH

- A. Furnish and install safety switches as required by plans and specifications. All safety switches shall be NEMA Heavy Duty Type HD and Underwriters' Laboratories listed. Square D Class 3110 or approved equal as manufactured by Siemens or General Electric.
- B. All switches shall have switch blades which are fully visible in the OFF position with the door open. All current-carrying parts shall be plated through electrolytic processes to resist corrosion and promote cool operation.
- C. Switches shall be quick-make and quick-break such that, during normal operation of the switch, the operation of the contacts shall be not capable of being restrained by the operating handle after the closing or opening action of the contacts has started. The handle and mechanism shall be an integral part of the box, not the cover, with positive padlocking provisions in the OFF position.
- D. Switches shall be furnished in NEMA 1 general purpose enclosures unless NEMA 3R (raintight) is indicated on the plans. Enclosures shall be of code gauge (UL 98) sheet steel (NEMA 1) or code gauge (UL 98) galvanized steel (NEMA 3R) with a rust-inhibiting phosphate treatment and gray baked enamel finish.
- E. Switches shall be horsepower rated for 600 volts ac.

2.12 SLEEVES, INSERTS, AND SUPPORTS

- A. The Electrical Subcontractor shall lay-out and install his work in advance of the pouring of concrete floors.
- B. Furnish and install all inserts, conduit hangers, anchors, and steel supports necessary for the support and installation of all electrical equipment.
- C. Where openings are required in walls and floors for the passing of raceways the Electrical Subcontractor shall furnish the General Contractor with the necessary information regarding dimensions and locations so that he may install suitable concrete stops to provide these openings. Such openings shall be by the General Contractor in such a manner so as not to interfere with the fireproof integrity of the building.
- D. This Subcontractor will be held responsible for the location of and maintaining in proper position, sleeves, inserts, and anchor bolts supplied and/or set in place by him. In the event that failure to do such required cutting and patching of finished work, such work shall be done at this Subcontractor's expense by the General Contractor.

PART 3 - EXECUTION

3.01 DRAWINGS

- A. The drawings are generally diagrammatic and are intended to convey the scope of work and indicate general arrangements of equipment, ducts, conduits and fixtures. The locations of all items shown on the drawings or called for in the Specifications that are not definitely fixed by dimensions are approximate only. The exact location necessary to secure the best conditions and results must be determined at the project and shall have the approval of the Architect before being installed. This Subcontractor shall follow drawings in laying out work and checking drawings of other trades to verify spaces in laying out work to be installed.

- B. Maintain maximum headroom and space conditions are all points. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with the installation. If directed by the Architect, this Subcontractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work. The Architect shall be the sole judge of what a "reasonable modification" in the layout is.

3.02 WORKMANSHIP

- A. The entire work provided in this Specification shall be constructed and finished in every respect in a workmanlike and substantial manner. It is not intended that the drawings shall show every pipe, fitting and appliance, but Subcontractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trade practice and satisfaction of the Architect.

3.03 INSTALLATION OF WIRING AND CONDUIT

- A. In general, all conduits shall be run concealed unless otherwise indicated to be run exposed.
- B. Exposed conduits shall be run parallel to, or at right angles to, the walls of the building, and all bends shall be made with standard conduit ells or conduits bent to, not less than, the same radius. Horizontal runs of exposed conduits shall be close to ceiling beams, passing over water or other piping where possible and shall be supported by pipe straps or by other approved means, not more than 5' apart. Installation of exposed conduits in finished areas of the building shall be checked with the Architect for layout before installation to conform to the pattern of the structural members, and when completed, is to present the most unobtrusive appearance possible. No exposed conduits will be permitted on walls or partitions in public areas.
- C. In no place shall a conduit be run within 3" of hot water pipes, or appliances, except where crossing is unavoidable and, in that case, the conduit shall be kept at least 1" from covering or pipe crossed.
- D. Conduits shall be supported on approved type if galvanized wall brackets, ceiling trapeze, strap hangers or pipe straps, secured by means of toggle bolts on hollow masonry units or expansion bolts in concrete or brick, matching screws on metal surfaces and wood screws on wood construction. No nails shall be used as a means of fastening boxes or conduits.
- E. In general, no splices or joints will be permitted in either feeder or branches except at outlets or accessible junction boxes.
- F. All splices in wire #8 AWG and smaller shall be standard pigtail, made mechanically tight, soldered and insulated with proper thickness of insulating tape. Wire splicing nuts as manufactured by Minnesota Mining Company (Scotch Lock) or Ideal wire nuts may be used, subject to the local wire inspector.
- G. Wire #6 and larger shall be connected to panels and apparatus by means of approved lugs or connectors. Connectors shall be solderless type, sufficiently large to enclosure all strands of the conductors and securely fastened.

3.04 CUTTING, PATCHING AND DRILLING

- A. It shall be the duty of the General Contractor to provide all cutting, patching, and drilling necessary for the electrical installation.

3.05 GROUNDING

- A. This Subcontractor shall furnish all fittings, clamps, conduits and wire of proper size to make ground connections between all apparatus and conduit and the water piping as required by the latest edition of the National Electrical Code and as indicated on the Drawings. Any ground wires shall be run in conduit of size required by the National Electrical Code.

3.06 QUIET OPERATION

- A. All equipment and material furnished by this Subcontractor shall operate under all conditions of load without objectionable noises or vibrations, which, in the opinion of the Architect, is objectionable. Where sound or vibrations conditions arise which are considered objectionable by the Architect, this Subcontractor shall eliminate same in a manner approved by the Architect.

3.07 TESTS

- A. Furnish all labor, material, instruments, supplies, and services and bear all costs for the accomplishment of tests herein specified. Correct all defects appearing under test, and repeat the tests until no defects are disclosed. Leave the equipment clean and ready for use.

3.08 FINAL INSPECTION AND TEST

- A. Prior to test, feeders and branches shall be continuous from service contact point to each outlet; all panels, feeders and devices connected and fuse in place. Test system free from short circuits and grounds with insulation resistances not less than outlined in the National Electrical Code. Provide testing equipment necessary and conduct test in presence of the Owner's authorized representative.

3.09 GUARANTEE

- A. All materials, items of equipment and workmanship furnished under this Section shall carry the standard warranty against all defects in materials and workmanship for a period of not less than one (1) year from the date of final acceptance of the work.

3.10 SLEEVES AND OPENINGS

- A. Sleeves and openings for piping through walls, floors and other parts of the structure shall be provided at all points shown on the Contract Drawings and where indicated by the Department. The conduit shall go through the sleeve consisting of the next size conduit that will provide clearance. Sleeve ends shall be flush with surfaces.

3.11 WIRING METHODS

- A. Rigid steel conduit shall be used for all refrigeration equipment and pump wiring.

3.12 SUPERINTENDENCE OF WORK

- A. The Electrical Subcontractor shall give his personnel superintendence to the work and shall retain at the job tie during the period of construction, a competent foreman, satisfactory to the Department, who shall be in full charge of the work under this Section.

3.13 PROTECTION

- A. The Electrical Subcontractor shall be responsible for his work and equipment until finally

inspected, tested and accepted; careful storage of materials and equipment which are not immediately installed after delivery to site; and closure of open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

3.14 SPECIAL COORDINATION INSTRUCTIONS:

A. Coordination with the work of other trades is referred to within various parts of this Section of the Specifications. The following special instructions shall also be carefully noted:

1. This Subcontractor shall obtain from the Refrigeration Contractor copies of all shop drawing prints showing the piping installation as it will be put in place on the project. These drawings shall be thoroughly checked by this Subcontractor, and the routing of all conduits and installation of all outlets and electrical equipment shall be coordinated with the piping so as to prevent any installation conflict. Such coordination shall be done prior to roughing-in conduits, outlets and electrical equipment.
2. If any discrepancy is found to exist between the electrical plans and any other drawings associated with the project, notify the Department at once and have location verified before work is installed. Any reasonable change in location of equipment prior to installation shall not involve additional expense to the Owner. The term "reasonable" shall be interpreted at moving outlets or equipment locations a maximum of ten (10) feet in any direction from the location indicated on the Drawings.
3. All feeder, branch circuit or auxiliary system wiring passing through pull boxes and/or being made up in panelboards shall be properly grouped, bound and tied together in a neat and orderly manner, in keeping with the highest standards of the trade, with plastic cable ties. Loose ends of the cable ties shall be properly trimmed after making up same. Cable ties shall be TY-Raps as manufactured by Thomas & Betts, or Holub Industries, Inc., Quick-Wrap, or Burndy Unirap, or equal.
4. Branch circuits and auxiliary system wiring shall be peeled out of the wiring gutters of the terminal cabinets and panels at 90 degrees to circuit breakers and terminal lugs for connecting to same.
5. At all points where steel support channels are cut and the unprotected steel is epoxed, two (2) coats of any approved rust preventative paint shall be applied to the bare surfaces, after proper cleaning. This requirement shall also apply to exposed job-cut threads of rigid steel conduit.
6. Color and type of rust preventative paint shall be as directed by the Department. In general, the paint for metals which are galvanized shall be aluminum paint and others will be of a zinc chromate type, or as otherwise approved.
7. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws, and other such items, shall be of a galvanized or cadmium plated finish, or of other approved rust-inhibiting coatings. Care should be taken that fixtures shall not be installed on both sides of existing or new building expansion joints.
8. The Electrical Contractor shall provide all materials, equipment and workmanship to provide for adequate protection of all electrical equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The Subcontractor shall also be responsible for damage which he causes to be done to the work of other trades and shall remedy any such injury at his own expense.
9. Specific reference is made to Article 380-8 of the National Electrical Code, relating to accessibility and mounting heights of circuit breakers. It shall be herein understood that this article shall also apply to the mounting heights of circuit breakers in panelboards. Circuit breakers in panelboards shall be located so that they may be operated from a

readily accessible place and shall be so installed that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, will not be more than 6-1/2 (six and one-half) feet above the finished floor or working platform. It shall also be herein understood that this requirement shall take precedence over any contradictory notes, dimensions or details which may be indicated on the Contract Drawings. All panelboards shall be mounted at a height to conform to this requirement.

3.15 SECONDARY ELECTRICAL SERVICE:

- A. The existing building utilization voltage is 277/480 volts, 3-phase, 4-wire, originating at building pad mounted transformer.
- B. shall furnish and install meters, current transformers, and test switches for installation by this Contractor.
- C. The Contractor shall make final connection to the pad mounted transformer.

3.16 AS BUILT DRAWINGS

- A. Operating and instruction manuals shall be submitted prior to testing of the system, four (4) complete sets of operating and instruction manuals shall be delivered to the Owner upon completion.
- B. A complete set of reproducible Mylar as-builts, showing installed wiring and color coding and wire tag notations, exact locations of all installed equipment, specific interconnections between all equipment and internal wiring of the equipment shall be delivered to the Owner upon completion of the system.
- C. Complete, simple comprehensive, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and a complete trouble shooting manual explaining what might be wrong if a certain malfunction occurs and explaining how to tests the primary internal part of each piece of equipment, shall be delivered to the Owner upon completion of the system.
- D. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
 - 1. Instruction on replacing any components of the system, including internal parts.
 - 2. Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.
 - 3. A complete list of all equipment and components with information as to the address and phone number of both the manufacturer and local supplier of each item.

END OF SECTION