

SECTION 16050

ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1. WORK INCLUDED

A. Complying with the applicable provisions of the General Conditions, Supplementary Conditions and other provisions of the Contract Documents that apply to the Work included in Division 16.

B. Complying with requirements of codes and regulatory agencies.

C. LEED & ENERGY STAR DESIGNATION

1. It is the objective to utilize products and electrical systems that utilize as little electrical energy as possible. Design of facility is intended to look like a historical post and beam constructed barn with fixtures, devices and exposed systems that match the building concept.

2. Project is intended to be Gold certification from LEED.

3. Project intent is to use as much regional product as possible

4. The use re-cycled products and equipment where available is encouraged.

5. The project is to provide high level performance electrical systems as selected including; service, branch circuits for the lighting, heating system, and related receptacles. Provide light fixtures, lamps, ballasts, conduit, disconnect switches, switches, receptacles and branch circuit wiring as indicated and to provide all labor, materials, equipment, appliances and tools and perform all work necessary for the complete execution of the electrical work as shown on the Drawings, required by the Specifications and work not specifically shown or specified, yet required to insure proper and complete operation of all systems and to satisfy the design intent inherent in the Work and to comply with all applicable codes, regulations.

2. WORK NOT INCLUDED BY DIVISION 16

A. Digging, backfilling, blasting, pumping, shoring, concrete and work furnished by other trades.

B. Furnishing and/or installing temperature control for mechanical trades.

C. Furnishing and/or installing control devices for mechanical trades unless specified herein or on the Drawings.

D. Work specifically indicated to be done by OWNER or others.

3. REFERENCE STANDARDS

A. National Electrical Code (N.E.C.).

B. National Electrical Safety Code (NESC).

C. International Building Code (IBC).

D. Local ordinances and regulations.

E. National Fire Codes - NFPA.

F. The Standard Specifications which are referred to herein shall be the latest revisions of such Specifications.

G. It shall be understood that all codes and standards mentioned shall be those in force at the time the Contract is signed. If any code is changed during the construction period, these Specifications may be changed by mutual agreement between the ARCHITECT and CONTRACTOR.

4. QUALITY ASSURANCE

A. Codes and Standards:

1. Comply with National Electrical Code requirements for electrical materials and installations.
 2. Keep copy of National Electrical Code in field office for duration of project.
 3. In each case, codes are minimum requirements.
- B. The CONTRACTOR shall submit proof that the items which he proposes to furnish under this specification conform to the standards of Underwriters Laboratories, Inc. (UL), Factory Mutual Engineering Corp. (FM), or Warnock Hersey Inc. (WH). The labels of these three organizations shall be accepted as conforming to this requirement. In lieu of the label, the CONTRACTOR may submit a written certification from any nationally recognized testing agency, adequately equipped and competent to perform such services, that the item has been tested and conforms to the standards including methods of test, of the testing organization(s).
- C. Qualifications of Installers:
1. For the actual fabrication, installation and testing of the work of this Section use only thoroughly trained and experienced personnel who are completely familiar with the requirements for this work and with the installation recommendations of the manufacturers of the specified items. CONTRACTOR shall be one that is regularly engaged in this type of work.
 2. In the acceptance or rejection of the installed electrical system, no allowance will be made for lack of skill on the part of installers.
 3. The CONTRACTOR shall not be relieved from complying with any of the requirements of the Specifications or Drawings which may be in excess of and not contrary to the requirements of the above mentioned rules.
- D. Inspection Certificates:
1. Deliver to the ARCHITECT two (2) copies of the Electrical Inspector's certificate of approval showing acceptability of work done under this Contract.
 2. Deliver to the ARCHITECT two (2) copies of any other certificates of approval.
5. SUBMITTALS
- A. Submit complete catalog information and shop drawings for all materials and equipment. Copies of all documents shall be provided to the ARCHITECT for approval (number of copies per architectural documents). In general, those items include but are not limited to the following:
1. Circuit breaker panelboards and disconnect switches.
 2. Transfer switches.
 3. Lighting fixtures.
 4. Lightning protection system.
 5. TVSS surge protection for main panel.
 6. Wiring devices including receptacles/switches/device covers.
 7. Wire and cables.
 8. Conduits.
- B. All shop drawings shall be checked for accuracy and Contract requirements before the submittal to the ARCHITECT. Shop drawings shall bear the signature of the CONTRACTOR and date checked, and shall be accompanied by a statement that the Drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted by the CONTRACTOR will be returned to him without approval.
- C. The ARCHITECT'S review will be only for conformance with the design concept of the project and compliance with the Specifications and Contract Drawings. The ARCHITECT'S approval shall in no way relieve the CONTRACTOR from the responsibility of, or the necessity of,

furnishing materials and workmanship required by the Contract Drawings and Specifications which may not be indicated on the shop drawings.

- D. All such equipment and materials installed without the approval of the ARCHITECT shall be subject to removal and shall be replaced with materials so approved by the ARCHITECT, at the CONTRACTOR'S expense.
6. FINAL SUBMITTALS
- A. Project Record Documents:
 - 1. During progress of the Work, maintain an accurate record of the installation of the electrical system, locating each circuit precisely by dimensions.
 - 2. Upon completion of the electrical installation, transfer all record data to prints of the original Drawings. Deliver to the ARCHITECT one copy of these prints.
 - B. As a requisite for final acceptance, the following are required:
 - 1. Deliver to the ARCHITECT two (2) copies of the Electrical Inspector's Certificate of Approval showing acceptability of work done under this Contract for presentation to the OWNER.
 - 2. Deliver to the ARCHITECT two (2) copies of any other Certificates of Approval for presentation to the OWNER.
7. PRODUCT DELIVERY, STORAGE AND HANDLING
- A. Protection: Use all means necessary to protect electrical system materials before, during and after installation and to protect the installed work and materials of all other trades.
 - B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the ARCHITECT and at no additional cost to the OWNER. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the ARCHITECT at the cost and expense of the CONTRACTOR, or shall be replaced by the CONTRACTOR at his own expense.
 - C. Protect the work of other trades. Restore any damage caused to other trades to the condition existing prior to damage at no additional cost to the OWNER.
 - D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.
8. PROJECT CONDITIONS
- A. Project Description:
 - 1. The project is to provide new electrical service, main panel and new branch circuits for the lighting and related receptacles. Provide light fixtures, lamps, ballasts, conduit, disconnect switches, switches, receptacles and branch circuit wiring as indicated and to provide all labor, materials, equipment, appliances and tools and perform all work necessary for the complete execution of the electrical work as shown on the Drawings, required by the Specifications and work not specifically shown or specified, yet required to insure proper and complete operation of all systems and to satisfy the design intent inherent in the Work and to comply with all applicable codes, regulations.
 - 2. All material removed, including conduit, wire and related electrical equipment is to be disposed of by the CONTRACTOR in a legal manner that complies with all rules and regulations of the State of New Hampshire.
 - B. Existing Conditions:
 - 1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. CONTRACTOR shall inventory the existing conditions of the facility and upgrade all wiring and electrical systems that are defective, this includes the branch circuit wiring, lighting, receptacles and related electrical systems.

2. Verify that the electrical installation may be made in complete accordance with all pertinent codes and regulations and the design.
 3. In the event of discrepancy, immediately notify the ARCHITECT.
 4. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- C. Coordination:
1. Coordinate the installation of electrical items with the schedules for work of other trades to prevent unnecessary delays in the total work.
 2. Any changes shall be done at the CONTRACTOR'S expense.
 3. Where electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment.
 4. Any work installed contrary to or without acceptance by the ARCHITECT shall be subject to change as directed by the ARCHITECT, and no extra compensation will be allowed the CONTRACTOR for making these changes.
- D. Accuracy of Data:
1. The Drawings are diagrammatic and functional only, and are not intended to show exact circuit layouts, number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Install additional circuits wherever needed to conform to the specific requirements of the equipment.
 2. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Field measurements shall take precedence over scaled dimensions from Drawings. Exact locations shall be as accepted by the ARCHITECT'S FIELD REPRESENTATIVE during construction. Obtain in the field all information relevant to the placing of electrical work and, in case of any interference with other work, proceed as directed by the ARCHITECT'S FIELD REPRESENTATIVE and furnish all labor and materials necessary to complete the work in an acceptable manner.
 3. Check with ARCHITECT'S FIELD REPRESENTATIVE before installation of work for equipment not specified as to location or for work that interferes with other trades.
9. DEFINITIONS
- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. Indicated: The term Aindicated@ refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as Ashown,@ Anoted,@ Ascheduled@ and Aspecified@ are used it is to help the reader locate the reference; no limitation on location is intended.
- C. Directed: Terms such as Adirected,@ Arequested,@ Aauthorized,@ Aselected,@ Aapproved,@ Arequired@ and Apermitted@ mean Adirected by the ARCHITECT,@ Arequested by the ARCHITECT@ and similar phrases.
- D. Approve: The term Aapproved,@ when used in conjunction with the ARCHITECT=S action on the CONTRACTOR=S submittals, applications and requests, is limited to the ARCHITECT=S duties and responsibilities as stated in the Conditions of the Contract.
- E. Regulations: The term Aregulations@ includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as rules, conventions and agreements within the construction industry that control performance of the Work.
- F. Furnish: The term Afurnish@ is used to mean Asupply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation and similar operations.@

- G. Install: The term Ainstall@ is used to describe operations at the Project Site including the actual Aunloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.@
 - H. Provide: The term Aprovide@ means Ato furnish and install, complete and ready for the intended use.@
 - I. Installer: An Ainstaller@ is the CONTRACTOR or another entity engaged by the CONTRACTOR, either as an employee, subcontractor, or contractor of lower tier, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term Aexperienced,@ when used with the term Ainstaller,@ means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
 - 2. Trades: Using terms such as Acarpentry@ is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as Acarpenter.@ It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
 - J. OWNER: The term Aowner@ is used to mean Bob and Sandy Green.
 - K. Remove: The term Aremove@ means to take away, to extract, do away with and eliminate from the Project Site. All removed materials, hardware, equipment, devices, poles and related items shall be disposed of in an approved and legal manner.
 - L. Testing Laboratories: A Atesting laboratory@ is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
10. INDUSTRY STANDARDS
- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
 - B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents.
 - C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards may establish different or conflicting requirements for minimum quantities or quality levels. Refer requirements that are different but apparently equal and uncertainties to the ARCHITECT for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the ARCHITECT for a decision before proceeding.
 - D. Copies of Standards: Each entity engaged in construction of the Project is required to be familiar with industry standards applicable to that entity=s construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed for performance of a required construction activity, the CONTRACTOR shall obtain copies directly from the publication source.
 - E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Names and addresses can be furnished to the CONTRACTOR if requested.

11. WARRANTY

- A. Guarantee all work performed and materials and equipment installed to the full extent required by the Drawings and Specifications to be free from inherent defects of material and workmanship for a period of one (1) year from the date of final acceptance.
- B. Replace any material and equipment prior to the final acceptance which is corroded or otherwise damaged through the mechanical contractor=s failure to properly operate and maintain the installation during construction or retesting.
- C. Keep the work in repair and replace any defective materials, equipment or workmanship upon notice from the ARCHITECT or OWNER=S representative for a period of one year from date of acceptance.
- D. Consider defective all material or equipment requiring excessive service during the first year of operation.
- E. The date of acceptance of the project appears on the ARCHITECT=S certificate of substantial completion.

12. INSURANCE

- A. The CONTRACTOR shall, during the life of the Contract, maintain in force such insurance as is required of the General Contractor in the General Conditions of the Contract; and shall furnish the General Contractor and the OWNER with certification of such insurance before beginning work on this section of the Contract.

13. COOPERATION BETWEEN TRADES

- A. The CONTRACTOR shall provide full information sufficiently in advance of this work so that all necessary work by other trades may be planned and installed without any delays or conflicts. The CONTRACTOR shall furnish and locate all sleeves, supports, and anchors. Failure of the CONTRACTOR to give timely notice of and to locate openings and furnish sleeves for his work shall cause him the extra expense of cutting these openings, all at no additional expense to the OWNER. The CONTRACTOR shall locate all necessary access panels, wall and floor sleeves, and conduit penetrations through roof to complete work in advance without delay to the other trades.
- B. It is not the intention of the Drawings to show every item, piece of equipment, and detail. Provide complete operating systems.
- C. Install work as closely as possible to layouts shown on Drawings. Modify work as necessary to meet job conditions and to clear other equipment. Consult ARCHITECT before making changes which affect the function of systems or appearance.
- D. Dimensions, elevations, and locations are shown approximately. Verify all measurements in the field prior to installation.
- E. ARCHITECT reserves the right to order changes in layout of such items as lighting layouts, and equipment, if such changes do not substantially affect costs and if affected items have not been fabricated or installed.

PART 2 PRODUCTS

1. MATERIALS

- A. All other materials, not specifically described but required for a complete and operable electrical installation, shall be new, first quality of their respective kinds, and as selected by the CONTRACTOR subject to the acceptance by the ARCHITECT.

2. INTERCHANGEABILITY

- A. In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, and other items is essential. All similar items shall be of the same manufacturer, type, model and dimensions.
- B. For ease of maintenance and parts replacement, to the maximum extent possible, use equipment of a single manufacturer.

- C. The ARCHITECT reserves the right to reject any submittal which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.
3. ACCESSIBILITY
- A. Verify the sufficiency and the size of shafts and chases, and adequate clearance in double partitions and hung ceilings for the proper installation of the work. Coordinate and cooperate with all other trades whose work is within the same space.
 - B. Locate all equipment which must be serviced, operated, or maintained in full accessible positions. Equipment shall include but not be limited to motors, controllers, and panels.
4. CONNECTIONS TO EQUIPMENT AND FIXTURES
- A. Rough-in and make final connections of electrical to all equipment furnished under other sections. Connections shall include necessary disconnect switches, etc. CONTRACTOR shall obtain approved rough-in drawings for equipment before starting work. Rough-in work done without approved drawings shall be relocated at Contractor's expense.
5. PAINTING AND CLEANING
- A. Painting shall be under the Architectural Sections except as stated below.
 - B. Metal surfaces (conduit hangers, supports, etc.) exposed to outdoors shall be given two (2) coats of rust inhibiting paint by the installing CONTRACTOR per manufacturer's instructions.
6. ELECTRICAL EQUIPMENT CLEARANCES
- A. General Requirements: Provide clearance spaces between and around mechanical and electrical equipment for operation, maintenance and replacement of equipment. Minimum clearances for each item or piece of equipment shall be as stated in the manufacturer's printed recommendations or as shown on the manufacturer's printed drawings. Coordinate clearance requirements among various pieces of equipment that will be installed in close proximity with one another to eliminate equipment conflicts and interference. Prepare and submit shop drawings showing proposed equipment layouts and clearances if requested by the ARCHITECT.
 - B. N.E.C. Code clearances shall be maintained at all times and shall be considered the minimum clearances allowed.
7. BUILDING WIRING
- A. Feeder wiring shall be type THHN/THWN, copper. UL Listed 600V. Utilize EMT for all branch circuits and feeders. All conduits will be sealed with approved sealing material Ideal Duct Seal or approved equal. Duct seal shall be a permanently soft, non-toxic compound that shall be installed where circuits enter and exit panelboard, devices (all light switches and receptacles) and equipment. **Coordinate all cable and wiring layouts with the ARCHITECT prior to any rough-in.** CONTRACTOR shall work with the ARCHITECT/OWNER and perform a minimum of two walk thru secessions to establish exact placement of all fixtures and devices prior to any rough-in.
 - B. Concealed branch circuit wiring and all exposed wiring (basement only) shall utilize EMT. **Type MC and NMC wiring shall not be permitted.** Minimum size: # 12 AWG with ground. Coordinate all cable and wiring layouts with the ARCHITECT prior to any rough-in.
 - C. Branch circuit wiring in conduit shall be type THHN-THWN. Minimum size: # 12 AWG with ground.
8. WIRING DEVICES
- A. Installation:
 - 1. The location of all devices shall be subject to the acceptance of the ARCHITECT. The Drawings show approximate locations only.
 - 1. Install cover plates on wiring devices. All devices shall be specification grade LEVITON 5362 SERIES and 1221 SERIES – 20A. Color by ARCHITECT. Where GFCI devices are indicated they shall be of non-LED type.

2. Where groups of devices are shown, they shall be installed in approved metal gangable boxes with one piece faceplates. Faceplates shall be engraved with the control function of each device being controlled both in words and by approved symbol. Example "Receptacle Kitchen Counter". Type of faceplate as selected by Architect – finish equal to Pewter, Age Tin, Brass or Aged Steel as selected by the ARCHITECT. Custom plates shall be equal to products manufactured by Arnev Products, Inc web site: <http://www.arnev.com/anneathome/switchplates/index.htm> or approved equal product.
 3. CONTRACTOR shall install approved insulating gasket for all receptacles and lighting switches.
 4. Mount switches and receptacles at height shown on Drawings and as coordinated with casework, cabinets and counters.
 5. Coordinate switch and receptacle mounting locations with architectural detail/ mechanical equipment.
 6. For outlets mounted above counters, coordinate location and mounting heights with built-in units and ARCHITECT.
 7. Install all devices in handicapped units to comply with ADA and ARCHITECT=S requirements.
 8. CONTRACTOR TO INVESTIGATE THE AND BALANCE THE LOADS.
 9. COORDINATE ALL PLACEMENT OF LIGHTING FIXTURES AND DEVICES INCLUDING ALL CONDUITS ON THE FIRST AND SECOND FLOORS WITH THE ARCHITECT. NO LIGHTING OR DEVICES OR CONDUIT RUNS SHALL BE INSTALLED WITHOUT PRIOR APPROVAL BY THE ARCHITECT. ALL EXPOSED RACEWAYS WILL BE PAINTED AS DIRECTED BY THE ARCHITECT.
 10. THE ARCHITECT RESERVES THE RIGHT TO LOCATE ALL LIGHTING FIXTURES AND DEVICES INCLUDING RACEWAYS WITHIN A RADIUS OF 10FT FROM THE LOCATION SHOWN ON THE PLANS.
9. SERVICE ENTRANCE/MODIFICATIONS
- A. Work Included:
 1. The intent is that a 225A, 240/120 volt, single phase, three wire panelboard distribution system be established with sources from the hydro, the generator and from the photovoltaic system. Coordinate the placement of the panels with the ARCHITECT and OWNER. Size of service conductors as shown on the plans based upon length and voltage drop.
10. GROUNDING
- A. Work Included:
 1. Furnishing power system grounding and grounding electrode per N.E.C.
 2. Installation.
 3. Provide and install each electrical grounding system with assembly of materials required for complete installation including wires/cables, connectors, lugs, clamps, ground rods, bonding jumpers and accessories.
 4. Include a ground grid consisting of a copper ground wires placed directly in native material at a minimum of 2 feet from the foundation wall in direct contact with the earth. Use approved connectors and bond all grounds together underground using approved exothermic type connectors.
 5. Provide and install electrical grounding conductors for grounding connections matched to power supply wiring materials and sized according to N.E.C.
 6. Provide and install electrical connectors, lugs, clamps, bonding jumpers and accessories as recommended by the respective manufacturer for the particular application, unless other indicated.

7. Ground rods: Solid copper, 5/8-inch diameter by 8 feet long.

B. Grounding and Bonding Execution:

1. Ground main service entrance distribution panel ground bus or lug to neutral of incoming service, to enclosure, to building steel and to main cold water pipe. Install grounding bushings on service conduits.
2. Install bonding jumpers with ground clamps on water meter piping to electrically bypass water meter.
3. Install grounding bushings on conduits at both primary and secondary entrances to transformers. Ground transformer enclosures to bushings.
4. Install bonding jumper for flexible metal conduit unless fittings are approved for grounding or otherwise comply with N.E.C.
 - a. Size jumper to match over-current device.
 - b. Green insulation.
 - c. Connect to grounding bushing at each end.
5. Ground each metal lighting pole or standard with a common bare copper equipment grounding conductor run with the circuit conductors.
6. Ensure that entire electrical system is electrically continuous and permanently and effectively grounded, including all electrical equipment and motors.
7. Provide and install properly sized ground wire for use by the telephone company from the main service grounding electrode system to the telephone backboard service entrance. Coordinate with the telephone company on exact size and termination required.
8. Install and coordinate lightning protection system and TVSS for the service and the structure with the building grounding per N.E.C. requirements.

11. PANELBOARDS

- A. Panelboard shall be of a dead-front safety type and shall be of same manufacture complying with UL 67. Panels shall include UL label as well as UL listed short circuit rating (Integrated Equipment Rating). Square D type NQOD, General Electric, Seimens or approved equal.
- B. Panelboard bus shall be copper with 98% conductivity.
- C. All panelboard shall have a separate equipment grounding terminal strip and removable bonding jumper. Panelboard bus and circuit breaker ratings shall be minimum 10 KAIC. Panelboard covers shall be hinged to box, suitable for flush or surface mounting.
- D. Circuit breakers shall be bolt-in, thermal-magnetic type with quick-make, quick-break, trip-free mechanism, per Fed. Spec. W-C-375B.
- E. Furnish molded case circuit breakers in panelboard as required to serve the loads.
- F. Panelboard shall be use as service disconnecting means shall additionally conform to UL 869 and shall be installed in strict accordance with NEC 110 and 384. Provide mounting brackets, busbar drillings, and filler pieces for unused spaces. A directory of circuits shall be typewritten and permanently mounted on the inside of the door. A spare blank directory shall be included and installed behind the typed directory. A copy of each directory shall be printed on 8-1/2" x 11" paper for inclusion in the O&M manual. The directory shall include as a minimum the designation for the panel as indicated on the design drawings and the voltage, ampere and phase ratings. Panelboard shall be mounted plug and rigidly secured to the building or mounting surface without distorting or warping of the tub.
- G. SURGE SUPPRESSOR (TVSS). Panel mounted or externally mounted for service entrance protection shall meet the following:

1. SPD shall be listed in accordance with UL 1449 Second Edition to include Section 37.3 highest fault current category. SPD shall be UL 1283 listed. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems. SPD for service entrance applications shall be modular in design. Each mode including N-G shall be fused with a 200kAIC UL recognized surge rated fuse and incorporate a thermal cutout device. Service entrance SPD shall provide audible diagnostic monitoring by way of audible alarm. This alarm shall activate upon a fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's. SPD shall meet or exceed the following criteria: Minimum surge current capability (single pulse rated) per phase shall be: Service entrance applications: 240kA per phase. Distribution applications: 80kA per phase, UL 1449 Listed Suppression Voltage Ratings for service entrance. SPD shall have a minimum EMI/RFI filtering of -50dB at 100kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology. SPD shall be provided with one set of NO/NC dry contacts. SPD shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period. Unit shall not contain any parasitic loads (monitors) that may add a load to the electrical system. Unit shall be a static device.
 2. Approved Vendors: Advanced Protection Technologies TE/XGA/240 for service entrance, Current Technology, Inc, Cutler-Hammer, Inc.; Eaton Corporation, General Electric Company, LEA International, Leviton Mfg. Company Inc, Liebert Corporation; a division of Emerson, Siemens Energy & Automation, Inc, or Square D; Schneider Electric.
 3. One primary suppressor shall be installed external to the service entrance in accordance with manufacturer instructions.
 4. The SPD shall be installed on the load side. The SPD ground shall be bonded to the service entrance ground. One suppressor shall be installed external to each designated load including water pump. The surge suppression device shall be installed in accordance with manufacturer instructions.
 5. Testing: Perform the following field tests and inspections and prepare test reports:
 - a. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
 - b. Complete startup checks according to manufacturer's written instructions.
 - c. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 - d. Remove and replace malfunctioning units and retest as specified above.
12. LIGHTING
- A. Work Included:
 1. Furnishing interior light fixtures.
 2. Furnishing exterior light fixtures.
 3. Installation.
 - B. Lighting Narrative and Lighting Directive/Description:

1. Design of facility shallis a historical post and beam constructed barn with fixtures that match the building concept.
 2. Directive on lighting is to use as little electricity as possible.
 3. Gold certification from LEED.
 4. CONTRACTOR shall use as much regional product as possible
 5. CONTRACTOR shall use re-cycled products where available.
 6. LEED & ENERGY STAR DESIGNATION. It is the objective to utilize lighting products offered by Conant Custom Brass, an Energy Star Partner, to be able to label fluorescent luminaires when they are constructed from 75% recycled product such as schoolhouse historical glass or “original” RLM luminaires.
- C. Acceptable Manufacturers:
1. The fixtures shall be of an approved type of high energy efficient design.
 - a. As detailed on fixture schedule on Drawings. And as selected by the ARCHITECT/ OWNER/LIGHTING CONSULTANT.
- D. Quality Assurance shall be furnishing products and components that have been UL listed and labeled, including UL marks indicating special type usage where applicable Fixture Reference Standards as follows:
1. NEMA LE1 - Fluorescent Luminaries.
 2. UL 57 - Electric Lighting Fixtures.
 3. UL 935 - Fluorescent Lamp Ballasts.
 4. UL 1570 - Fluorescent Lighting Fixtures.
 5. UL 1571 - Incandescent Lighting Fixtures.
- E. Product Delivery, Storage and Handling:
1. Prevent physical or corrosive damage to lighting equipment at all times.
- F. Project Conditions:
1. Confirm compatibility and interface of other materials with luminaire and ceiling system. Report discrepancies to the ARCHITECT, and defer ordering until clarified.
 2. Supply plaster frames, trim rings and backboxes to other trades.
 3. Coordinate with other trades to avoid conflicts between luminaries, supports, fittings, and mechanical equipment.
- G. Acceptable Manufacturers:
1. Fixture types indicated on the drawings serve to indicate the type and quality desired and do not exclude the use of equal quality items by other manufacturers, subject to acceptance by ARCHITECT and OWNER.
 2. Lamps: Provide energy saving type lamps as scheduled on the Drawings.
 3. Ballasts:
 - a. Universal Mfg. Corp.
 - b. Advance Transformer Co.
 - c. General Electric Co. Lighting Business Group.
 - d. Osram/Sylvania.
 4. Substitutions: Products of equal quality, detail, function and performance may be proposed for substitution.

- a. If requested by ARCHITECT, submit samples of both specified and proposed fixtures for comparison.
- b. If requested by ARCHITECT, provide complete photometric data and heat dissipation reports from an independent testing laboratory.

H. Fluorescent Ballasts:

1. Fluorescent fixtures shall have rapid start as specified on fixture schedule, high power factor UL and ETL approved ballasts. Ballast sound rating shall be Class "A plus" or better and shall have Class "P" automatic thermal cut-out devices. Electronic ballasts shall conform to the following and shall only be provided for lighting fixtures with "Super T8" lamps.
2. Fluorescent ballasts shall be Universal Triad electronic type or approved equal for "Super T8". All other ballasts for compact fluorescent fixtures shall be an approved electronic type.
3. Ballast manufacturer shall have been producing ballasts for at least 10 years with a low failure rate.
4. Ballasts shall operate at an input frequency of 60 Hz and an input voltage of 108 to 132 (120V circuit).
5. Ballasts shall operate lamps at a frequency of 20 to 35 KHz with no detectable flicker.
6. Ballasts that operate as a parallel circuit shall permit other lamps to maintain full output after failure of companion lamp(s).
7. Rapid-Start ballasts shall provide soft/stable start of rapid-start lamps and maintain full cathode heat during operation.
8. Ballasts shall comply with FCC and NEMA limits governing EMI and RFI and shall not interfere with operation of other normal electrical equipment.
9. Ballasts shall meet any applicable ANSI standards (i.e. harmonic distortion, surge protection, etc.). Ballasts shall meet ANSI C82.11 limits for total harmonic distortion (THD).
10. Ballasts shall not be affected by lamp failure and shall deliver normal lamp life.
11. Ballasts shall be high power factor (90% or higher) and low ballast factor of .77 -.78 minimum.
12. Operating temperature shall not exceed 60EC at any point on the case during normal operation.
13. Ballasts shall be potted and in a steel case and shall contain no PCBs.
14. Ballasts shall be marked with manufacturer's name, part number, supply voltage, power factor, open circuit voltage, current draw for each lamp type and UL listing.
15. Exterior ballasts: As specified above, low temperature type, providing reliable starting to -20E F (-29EC).
16. Supply ballasts complete with heat radiators to prevent nuisance tripping.
17. Equip ballasts and capacitors with pressure relief devices to prevent rupturing.
18. Voltage rating shall be as indicated.

I. Installation:

1. Verify exact locations and elevations of lighting fixtures with ARCHITECT prior to installation, where dimensions are not indicated. Coordinate with other trades.
2. Mount fixtures level with edges aligned parallel to building walls, unless otherwise indicated. Center wall fixtures above mirrors, sinks, etc., when present.
3. Mount continuous rows of fixtures in straight line. Use alignment clips between reflectors, where applicable.

4. Securely mount fixtures tight to surface without distortion of surface.
 5. Furnish straps, mounting plates, nipples, brackets or accessories required for proper installation.
 6. Install lamps of the designated rating in accordance with manufacturer's instructions.
 7. Verify aiming of directional fixtures/lampheads with ARCHITECT prior to setting direction.
 8. All fixture wiring shall be in accordance with N.E.C. Art. 410 whenever high temperature insulation is required instead of normal branch circuit wiring.
 9. Install fixtures to dissipate ballast and lamp heat per manufacturer's instructions and UL listing requirements.
- J. Supports:
1. Wall mounted fixtures shall be supported in accordance with manufacturer's recommendations, including any recommended junction boxes and mounting hardware.
- K. Recessed Fixtures:
1. Install recessed fixtures to permit removal from below, to gain access to outlet or prewired fixture box.
 2. Connect recessed fixtures to boxes with 6 feet extra of flexible metal conduit and wiring with bonding jumper, to allow future adjustment of fixture location by ARCHITECT.
 3. Install insulation spacers if required to avoid heat build-up.
 4. Fire rated ceilings: Install back box constructed of ceiling material or equivalent protection as recommended by fixture manufacturer to maintain ceiling fire rating. Coordinate with ARCHITECT on fire rated ceiling types/locations.
- L. Alignment:
1. Align luminaries and clean diffusers prior to final acceptance.
 2. All fixtures shall be hung straight and true and shall be located symmetrically as indicated on the Drawings.
13. LIGHTNING PROTECTION SYSTEM
- A. Provide a complete lightning protection system for the building conforming to NFPA 780.
 - B. Shop Drawings: CONTRACTOR shall provide a detailed lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies. Provide qualification data on the firms and persons to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.
 - C. Certification, signed by CONTRACTOR, that the lightning protection system is designed and installed to meet the requirements of NFPA 780 and LPI. CONTRACTOR shall provide field inspection reports indicating compliance with specified requirements. The installer's Qualifications: Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer.
 - D. Listing and Labeling: As defined in NFPA 780, "Definitions" Article. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
 - E. Coordinate installation of air terminals attached to roof systems is in accordance with ARCHITECT and the roofing manufacturer.
 - F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Automatic Lightning Protection.
 2. ERICO International Corporation.
 3. Harger Lightning Protection, Inc.
 4. Heary Bros. Lightning Protection Co. Inc.
 5. Independent Protection Co.
 6. Robbins Lightning Inc.
 7. Thompson Lightning Protection, Inc.
- G. Comply with UL 96.
- H. Roof-Mounting Air Terminals: NFPA Class aluminum or copper.
- I. Stack and Chimney Mounting Air Terminals: Stainless steel, solid copper, or Monel metal.
- J. Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes: Comply with Grounding Section "Grounding and Bonding" and with standards referenced in this Section.
- K. Install lightning protection components and systems according to UL 96A and NFPA 780.
- L. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.
- M. Notify ARCHITECT at least 48 hours in advance of inspection before concealing lightning protection components.
- N. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.
- O. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at intervals.
- P. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- Q. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.
- R. UL Inspection: Provide inspections as required to obtain a UL Master Label for system and provide documentation as such.

PART 3 EXECUTION

1. INSTALLATION

- A. Install all equipment devices, wiring, related electricals and fixtures in complete accordance with the manufacturer's recommendations and all pertinent codes and regulations and as indicated on the CONTRACT DOCUMENTS.
- B. Thoroughly inspect all items of equipment and any items dented, scratched or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish.
 1. All items so repaired and refinished shall be brought to the attention of the ARCHITECT for inspection and approval.
- C. Upon completion of all installation, lamping, and testing, thoroughly inspect all exposed portions of the electrical installation and completely remove all exposed labels, soil, markings and foreign materials.

END OF SECTION