

SECTION 260001

ELECTRICAL

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Time, Manner and Requirements for Submitting Sub-Bids:
1. Sub-bids for work under this Section shall be for the complete work and shall be filed as stipulated in the "INSTRUCTIONS TO BIDDERS".
  2. Each sub-bid submitted for work under this Section shall be filed as required by Section 44F of Chapter 149 of the General Laws, as amended.
- C. Sub Sub-Bid Requirements
1. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
  2. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein:
  - 3.
- | <u>CLASSES OF WORK</u>         | <u>REFERENCE DOCUMENTS</u> |
|--------------------------------|----------------------------|
| Fire Alarm                     | Paragraph 2.17             |
| Data/Telecommunications        | 270100 & 270200            |
| Audio Visual Systems           | 274100                     |
| Electronic Safety and Security | All sections of Div 28     |
- D. Reference specifications: The Work of this Filed Sub-Bid is shown in all the specification sections in Division 26, 27, and 28.

- E. Reference Drawings: The Work of this Filed Sub-Bid is shown on the all of the following drawings: E000, E101, E102, E211, E212, E213, E221, E222, E223, E311, E312, E313, E321, E322, E323, E331, E332, E333, E350, E411, E412, E413, E421, E422, E423, E501, E600, E601, E700, E702, E703, E704, E705, E800, E801, E802, E803, E804, E805, E805, E807, E808, G000, G001, G002, C100, C400, C401, L000, L301, L302, L601, S001, S002, S200, S201, S202, S210, S211, S212, S213, S214, S215, S216, S217, A020, A200, A030, A031, A201, A211, A212, A213, A214, A215, A216, A217, A300, A310, A311, A312, A313, A314, A420, A421, A422, A423, A424, A425, A500, A501, A502, A503, A504, A505, A506, A510, A511, A512, A513, A514, A520, A521, A558, A600, A700, A701, A702, A703, A704, A710, A711, FS100, FS101, FS102, FS103, AV000-AV001, AV100-AV105, AV200-AV205, AV300-AV302, AV400, AV500, AV600, SE000, SE100-SE108, SE200-SE203, SE300-SE306, SE400-SE403, SE500-SE501, T211, T212, T213, T221, T222, T223, T400, T500, T501, T502, T503.

## 1.2 SCOPE OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, which includes:
1. All the work of all Division 26 specification sections.
  2. All the work of all Division 27 specification sections.
  3. All the work of all Division 28 specification sections.
  4. Primary electric service duct bank. Refer to Paragraph 3.15.
  5. Wood pole with primary fused cutouts per UNITIL requirements (Refer to Paragraph 2.34).
  6. Secondary electric service including underground conduit bank and secondary service entrance feeders, from the utility company pad mounted transformer, building grounding electrode and main service disconnect.
  7. Interior secondary distribution systems including main switchboard, dry type indoor transformers, all distribution panelboards and branch panelboards.
  8. Grounding and bonding of all electrical systems and equipment.
  9. Conduit.
  10. Wire and cable.
  11. Branch circuit wiring to all outlets, and devices.
  12. Engine Generator System.
  13. Automatic Transfer Switches.
  14. Manual Transfer Switch (Storm Switch).
  15. Outlets, floor boxes, and devices.
  16. Floor boxes.
  17. Ceiling fans.
  18. Poke thru floor boxes.
  19. Cord reels.
  20. Lighting fixtures, lamps and controls.
  21. Lighting Control System.
  22. Wiring and conduit to HVAC, plumbing and fire protection equipment.
  23. Wiring and conduit for all kitchen equipment and classroom appliances.
  24. Nameplates and tags.
  25. Fire Alarm and Voice Evacuation System.
  26. Bidirectional Amplifier System.
  27. Emergency two way communication system.

28. EPO push button station.
29. Electric Vehicle Charging Station.
30. Motor Starters.
31. Lighting pole and vehicle charging station foundations.
32. Transformer pad
33. Penetration Firestopping. Owner's Project Manager will hire third party independent testing agency to perform destructive testing in line with requirements of the 9th edition of the building code. Trade contractors should include repair of destructive test penetrations after testing is complete. All partitions and floor assemblies are to be considered rated for the purpose of sealing penetrations
34. Cutting and patch.
35. Coordination between electrical and other trades.
36. Utility Rebate Submissions (See Section "Lighting Fixtures" and Section "Utility Rebate").
37. Testing of all electrical systems.
38. Provide commissioning documentation and technical support in accordance with the requirements of 018100 –COMMISSIONING. Requirements for commissioning, prefunctional checklist, O&M and LEED Manuals, and training.

B. Alternates, refer to specification Section 01 23 00 - Alternates:

1. Add Alternate #1: VRF System for 1st floor administration office.
2. Add Alternate #2: VAVs on return ductwork.

1.3 Examination of Site and Documents

- A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority (Owner) will not be responsible for errors, omissions and/or charges for extra work arising from Contractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that he is familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.
- B. Pre-Bid Conference: Bidders are strongly encouraged to attend the Pre-Bid conference; refer to Advertisement for Bids for time and date.

1.4 SUBMITTALS

- A. Material and equipment requiring shop drawing and product data submittal shall include but shall not be limited to:
1. Wood pole with primary fused cutouts per UNITIL requirements.
  2. Main Switchboard.
  3. Distribution panelboards, and branch panelboards.
  4. Dry type Transformers.
  5. Conduit.
  6. Wire and cable.
  7. Outlets, floor boxes, and devices.

8. Floor boxes.
  9. Poke thru floor boxes.
  10. Ceiling fans.
  11. Cord reels.
  12. Surface metal raceway and dual channel raceway.
  13. Lighting fixtures.
  14. Lighting Control System.
  15. Fire Alarm and Voice Evacuation System.
  16. Bidirectional Amplifier System.
  17. Engine Generator System.
  18. Emergency two way communication system.
  19. Electric Vehicle Charging Station.
  20. Automatic Transfer Switches.
  21. Motor Starters.
  22. EPO push button station.
  23. Lighting pole and vehicle charging station foundations.
  24. Transformer pad
  25. Penetration Firestopping
  26. Utility Rebate Submissions (See Section 2.13 Lighting Fixtures and Section 3.1 Utility Rebate).
  27. Completed Prefunctional Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of 018100 – COMMISSIONING.
- B. Prior to layout of MDF room, contractor shall submit to the Engineer and the Fitchburg's Information Technology manager a proposed layout of the MDF room using equipment proposed on the project. The layout shall include Rack layouts of all patch panels and the electrical subcontractor's cabling management plan for labeling and terminating all cabling. The drawings indicate special purpose power for UPS equipment and the electrical subcontractor shall confirm exact plug configuration (NEMA Configuration). The MDF layout, cabling management plan, and UPS receptacle configurations shall be submitted for approval prior to any communication cabling or power circuit routing.
- C. Generator shop drawings shall include the following additional information:
1. Unit drawings of all major components showing exact dimension data.
  2. Catalog information on the engine, generator, battery charger, vibration isolators, exhaust silencer, flexible exhaust connector, automatic transfer switch.
  3. A complete bill of material indicating exactly what is to be provided.
  4. A list of at least two similar installation using the same major components as specified herein.
  5. Estimated time, in calendar days, for delivery after approval and release is received.
  6. Furnish engine heat rejection data to jacket water, exhaust, and ambient and total DB measurement of engine, generator, and radiator measured at 23 feet. Mechanical noise shall not exceed 88 DBA at 23 feet and exhaust noise shall not exceed 94 DBA at 23 feet before the exhaust silencer. Exhaust flow shall not exceed 2500 CFM.

7. Any notation marked on submission of the equipment is outlines in this section by reviewing authority must be responded to in writing, by the equipment manufacturer.
8. Complete engineering submittal, catalog cuts, wiring diagrams, interface drawings, unit drawings, A.C. & D.C. schematics, termination chamber drawings, terminal strip drawings, foundation plan, annunciator panel layout and wiring, must accommodate all shop drawings.

#### 1.5 GUARANTEE/WARRANTY

- A. Manufacturer(s) and Contractor shall provide their standard guarantees/ warranties for their work under this Section. Such guarantees/warranties shall be in addition to and not instead of all other liabilities, which the manufacturer(s) and Contractor may have by law, or by other provisions of the Contract Documents.
- B. The guarantee/warranty shall be in addition to and not instead of all other liabilities which manufacturer(s); Contractor may have by law or by other provisions of the Contract Documents.

#### 1.6 REFERENCES

- A. National standards referenced herein are included to establish recognized quality only.

1. Massachusetts State Building Code, 9th Edition, 780c CMR
2. Massachusetts Fire Alarm Code, 527 CMR 1
3. Massachusetts State Electrical Code 527 CMR 12
4. Massachusetts State Energy Conservation Code
5. National Electrical Safety Code – C2-1997
6. National Fire Protection Association (NFPA) 1, 70, 72 & 101
7. International Energy and Conservation Code
8. International Fire Code
9. International Building Code
10. Local Ordinances
11. IES – for lighting system
12. NEMA, UL, ANSI for materials and equipment
13. Americans with Disabilities Act (ADA)

- B. Reference Sections

- |     |                |  |
|-----|----------------|--|
| 1.  | Section 083110 | Access Doors and Frames                  |
| 2.  | Section 083310 | Overhead Coiling Doors                   |
| 3.  | Section 087100 | Door Hardware                            |
| 4.  | Section 113100 | Appliances                               |
| 5.  | Section 114000 | Foodservice Equipment                    |
| 6.  | Section 115210 | Projection Screens                       |
| 7.  | Section 116623 | Athletic Equipment                       |
| 8.  | Section 142100 | Traction Elevators                       |
| 9.  | Section 210001 | Fire Protection                          |
| 10. | Section 220001 | Plumbing                                 |
| 11. | Section 230001 | Heating Ventilating and Air Conditioning |

#### 1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Refer to contract general requirements for requirements pertaining to Product Delivery, Storage and Handling.

#### 1.8 RECORD DRAWINGS

- A. Record Drawings shall be submitted at the completion of the Project and conform to the contract general requirements.

#### 1.9 OPERATING AND MAINTENANCE (O&M) DATA

- A. O&M data is to be provided for equipment supplied in a coordinated and organized form.
- B. Refer to contract special provisions for submittal procedures pertaining to operating and maintenance data.

#### 1.10 COORDINATION AMONG SUB CONTRACTORS.

- A. The below coordination items are not intended to include all coordination necessary between trades. The intent is to bring attention to specific systems and installations commonly differing among projects. This contractor shall review all specification sections cited in the Referenced Sections above.
- B. Utility transformer Pad and Generator Pad. Division 26 shall provide utility transformer pad and generator pad. The General Contractor shall provide bollards around pads.
- C. Exterior lighting pole and electric vehicle charging station pole foundations shall be provided by Division 26.
- D. Firestopping: Firestopping shall be provided by the Division 26.
- E. Access Doors (Section 083110): Division 26 shall furnish all access doors and Division 8 shall install access doors. Furnish access doors where electrical work installed behind walls or non accessible ceilings requires access.
- F. Door Hardware (Section 087100): Division 8 shall provide all electrified door hardware, and power transfer hinges,. Division 26 & 28 shall provide all wiring. Division 26 & 28 shall mount power supplies and key switches in location indicated on drawing and as modified in field by Division 8 or Architect. Attend pre-installation meetings for coordination.
- G. Overhead Coiling doors (Section 083310): Division 8 shall provide all door and door control equipment. Division 26 shall provide all wiring. Where coiling door has loose control devices requiring wiring such as key switches or push buttons, Division 26 shall mount devices and connect per manufacturer's instructions. Attend pre-installation meetings for coordination.
- H. Foodservice Equipment (114000): Division 11 shall provide a utility distribution system which is prewired to power equipment under the hood. Division 26 shall power all kitchen equipment. Division 26 shall provide 3 phase power to the utility distribution system. The utility distribution system has a shunt trip circuit breaker and Division 26 shall provide wiring to shunt trip circuit breaker for shut down Div 11 shall provide hood and hood control system. Division 26 shall provide wiring to hood system for controls as indicated on electrical drawings. Division 26 shall install and wire miscellaneous components furnished by Div 11 for the walk-in coolers and freezer.

- I. Projection Screens (115210): Division 11 shall provide projection screens and controllers.. Division 26 shall provide all wiring. Division 26 shall provide all wiring. Division 26 shall mount loose control devices, key switches and connect manufacturer's instructions.
- J. Athletic Equipment (116623): Division 11 shall provide dividers, scoreboard, and motorized back board including all control devices such as key switches and operators. and controllers.. Division 26 shall provide all wiring. Division 26 shall mount controllers in location and connect per manufacturer's instructions.

#### 1.11 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 23 for rough-in requirements.

#### 1.12 SURVEYS AND MEASUREMENTS

- A. Base measurements, both horizontal and vertical, on established benchmarks. Work shall agree with these established lines and levels. Verify measurements at site and check the corrections of same as related to the work.
- B. Should the electrical subcontractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, he shall notify the ARCHITECT OR ENGINEER.

#### 1.13 SEQUENCING

- A. Coordinate work of this Trade-Contract with that of other trades, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.
- B. Do not order or deliver any materials until all submittals, required in the listed Specification Sections included as part of this work, have been received and approved.
- C. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

#### 1.14 ELECTRICAL INSTALLATIONS

- A. Coordinate electrical equipment and materials installation with other building components. Fully coordinate work with that of other trades. Furnish information in writing that is needed for the coordination of clearances, with the work of others, and such information shall be given in a timely fashion so as not to impede the progress of two or more trades. Confer and resolve the conflict immediately.
- B. Verify all dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.

- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
- G. Where mounting heights are not detailed or dimensioned, the exact location shall be determined on the job, install electrical services and overhead equipment to provide the maximum headroom possible.
- H. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- I. Coordinate connection of electrical systems with utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- J. ARCHITECT OR ENGINEER reserves the right to revise drawings from time to time to indicate changes in work. When revised drawings are issued, notify ARCHITECT OR ENGINEER in writing that revised drawings involve addition or deduction of a specific amount of money to contract price. Do not proceed with revised work without prior review by ARCHITECT, ENGINEER or Owner of cost or revised work.

#### 1.15 CLEANING

- A. Upon completion of work, the electrical subcontractor shall clean, polish and leave bright, fixtures and lamps, and shall remove dust, dirt, debris and loose plaster from panelboards, controls, and switchboards. Unused openings in pullboxes, junction boxes, equipment and raceways shall be capped or closed by an approved means. Replace all inoperative lamps and lamps that have been used during construction.

#### 1.16 SERVICE VOLTAGE

- A. Voltage to the building is 480/277V, 3-phase, 4-wire.
- B. Special voltages and phase characteristics shall be provided where shown. Requirements for transformers and wiring are as indicated on drawings.

#### 1.17 CODES, RULES, PERMITS, FEES

- A. Give necessary notices, obtain permits and pay government, city, town, and state sales taxes, fees, and other costs in connection with work, file necessary approvals of departments having jurisdiction, obtain required certificates of inspection for work.
- B. Materials shall be new and of current productions and shall conform to standards of Underwriters' Laboratories, incorporated in every case where such standard, listing or label has been established for the particular type material in question.



- C. The installation shall be performed in accordance with and shall conform in all respects to applicable requirements of latest National Electrical Code, rules and regulations governing installation of electrical work in the locality of the work, applicable requirements state and local authorities having jurisdiction.

#### 1.18 SPARE PARTS

- A. Provide the following spare devices and equipment to Owner for spare stock. The below devices are in addition to the Discretionary Placement Devices called out in Part 3:
  - 1. 15 of each of the following fire alarm devices; smoke detectors, pull stations, speaker/strobes.
  - 2. 15 set of overload relays for each motor starter.
  - 3. 15 sets of each type of fuse.
  - 4. 15 additional exit signs per floor.

### PART 2 - PRODUCTS

#### 2.1 RACEWAYS

- A. Electrical metallic tubing (EMT) shall be zinc-coated steel that conforms to industry standards, by Republic Steel, Allied Tube and Conduit, Triangle/PWC or approved equal. EMT couplings and connectors shall be of the compression type.
- B. Rigid Steel Conduit (RSC), couplings and elbows: ANSI C80.1 and UL 6; hot-dip galvanized, rigid mild steel, zinc-coated on interior and exterior surfaces.
- C. Liquid-Tight Flexible Conduit: Plastic or plenum-rated jacket material, flexible, galvanized steel, Sealtite Type EF for general service areas or Type HC for high temperature locations.
- D. Flexible metallic conduit shall be galvanized, spiral wrapped metallic conduit (Greenfield) or liquid-tight flexible metallic conduit as specified for specific equipment.
- E. Nonmetallic Conduit and Tubing
  - 1. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
  - 2. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Conduit fire seal fittings shall have heat-activated intumescent material for fire rating equal to or higher than that of floor or wall by O.Z./Gedney or approved equal.
- G. No aluminum conduit shall be used.
- H. Special Fittings: Furnish conduit sealing, explosion proof, dust proof, and other types of special fittings as required by the drawings and these specifications, consistent with the area and equipment with which they are associated, and in accordance with the following requirements:
  - 1. Fittings installed outdoors or in damp locations shall be sealed and gasketed.
  - 2. Outdoor fittings shall be of heavy cast construction.
  - 3. Hazardous area fittings and conduit sealing shall conform with Massachusetts Electrical Code requirements for the area classification.

## 2.2 OUTLET BOXES

- A. Outlet boxes on concealed work shall be sized as required by the number of devices indicated on the plans, galvanized pressed steel with plaster rings as required. Outlet boxes for exposed conduit work shall be cast aluminum alloy with cast aluminum alloy covers. All outlet boxes to be recessed where possible including in concrete blocks.
- B. Outlet boxes on existing walls shall be surface metal type, with White finish, or finish matching device color. Outlet boxes intended for concealed construction will not be acceptable if mounted exposed on walls.
- C. Where installed in plaster, boxes shall be fitted with galvanized steel plaster covers of required depth to finish flush with finished wall or ceiling.
- D. Switch boxes, receptacle boxes and other outlet boxes shall be sized as required with plaster rings or gang cover as required.
- E. Cast-Metal Outlet and Device Boxes: Provide for wet locations, corrosive locations, and all locations where RGS conduit is required. Boxes shall be NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Outlet boxes shall be by Steel City Electric Company, Appleton Electric Company, National Electric Products Company or approved equal. Boxes on opposite sides of wall or partition shall not be installed back-to-back, even if shown that way on the plans. Boxes shall be offset 6" CL to CL.
- G. Outlet boxes for various systems and components shall be as required by manufacturer.
- H. Plastic boxes are not acceptable.

## 2.3 FLOOR BOXES

- A. Cast-Iron Floor Boxes: Equal to Wiremold Series RFB flush, recessed floor boxes; manufactured from cast-iron and approved for use in above grade and on-grade floor applications. Paint interior and exterior of boxes. Minimum depth of deep boxes shall be 3-7/16 inches [87mm].
- B. Manufactured from stamped steel and painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and approved for use on grade and above grade floors. The box shall be 13-1/8" L x 13-1/8" W x 4-1/16" H [333mm x 333mm x 103mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The box shall permit feed through removable barriers from adjacent compartments. Four (4) compartments shall have a minimum wiring capacity of 75 cu in [1230cu cm]. Four (4) compartments shall have a minimum of 3-1/2 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: six 3/4-inch [19.1mm], ten (10) 1-inch [25mm], and eight (8) 1-1/4-inch [32mm]. The box shall have two removable knockout plates that can be replaced with a 2-inch trade size conduit hub (2HUB). The box shall be fully adjustable, providing a maximum of 2-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

- C. Boxes shall have brass covers and flanges. The covers shall have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors.

## 2.4 POKE THRU DEVICES

- A. Poke-thru device shall have been examined and tested by Underwriters Laboratories Inc. to comply with UL514A and/or UL514C and Canadian Standard C22.2, No. 18-98 and bear the U.S. and Canadian UL Listing Mark. Poke-thru device shall also have been tested by UL and classified for fire resistance and bear the U.S. and Canadian UL Classification Mark. The poke-thru device shall conform to the standards set in the National Electrical Code, Section 300-21.
  - 1. Poke-thru devices shall be classified for use in 1, 1-1/2, or 2-hour rated floors and 1, 1-1/2, or 2 hour rated floors employing unprotected steel floor units and concrete toppings (D900 Series designs), or concrete floors with suspended ceilings. Fire resistive designs with suspended ceilings shall have provisions for accessibility in the ceiling below the poke-thru device fittings.
  - 2. Poke-thru device shall have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors.
  - 3. Poke-thru device shall be suitable for use in air handling spaces in accordance with Section 300-22C of the National Electrical Code.
- B. Poke-thru device assemblies shall consist of an insert and an activation cover. Assembly length: 16-3/4 inches (425mm).
  - 1. Insert: Insert body shall recess the devices a minimum of 2-3/4 inches (69mm) and have a polyester based backing enamel finished interior; ivory color. Furnish with necessary channels to provide complete separation of power and communication services. Provide three (3) compartments that allow for up to three (3) duplex receptacles that can be wired as a standard receptacle or isolated ground and/or 12 communication ports and/or 10 Legrand AVIP AV devices or 10 Extron® Electronics MAAP™ and/or two AAP™ devices.
  - 2. Body consists of an intumescent firestop material to maintain fire rating of the floor slab. Hold intumescent material securely in place in insert body. Intumescent material will not have to be adjusted to maintain fire rating of the unit and the floor slab. Provide insert with a retaining feature to hold the poke-thru device in the floor slab without additional fasteners. Poke-thru insert shall also consist of a 3/4-inch trade size conduit stub that is connected to the insert body and a 24.5 cu in (402ml) stamped steel junction box for wire splicing and connections. Stamped steel junction box shall also contain the means necessary to electrically ground the poke-thru device to the system ground.
  - 3. Activation Cover: Manufactured of die-cast aluminum alloy; finished in powder-coated brass. Provide with two (2) gaskets (one (1) for surface and one (1) for flush) to go under the trim flange to maintain scrub water tightness. Activation cover is 7-1/4 inches (184mm) in diameter. Provide cover with spring-loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.
  - 4. Communication Modules Mounting Accessories: Provide activation unit with three locations to mount communication connectors. Mount connectors using a

mounting bracket capable of accepting up to 12 Ortonics® TracJack™ Category 6 insert modules or TechChoice™ Category 6 discrete keystone connectors. Also provide unit with two (2) Category 6 discrete keystone connectors and two (2) industry standard keystones and accommodate a mechanism to permit protection of communication cabling. Fabricate mechanism from stamped steel construction. Mechanism shall accept both flexible and rigid 3/4-inch, 1-1/4-inch or two-inch trade size conduit.

## 2.5 JUNCTION BOXES, PULL BOXES AND CABLE TROUGHS

- A. Provide code gauge galvanized steel junction and pull boxes for conduit 1-1/4 in. trade size and larger, where indicated and as necessary to facilitate installation, of required dimensions, with accessible removable screw-on covers. Provide junction and pull boxes in special sizes and shapes determined in field where necessary.
- B. Junction box covers shall be readily accessible.
- C. Sheet metal pull boxes shall be supported adequately to maintain shape. Larger boxes shall have structural steel bracing welded into rigid assembly formed adequately to maintain alignment in shipment and installation. Secure covers with corrosion-resistant screws or bolts.
  - 1. Pull boxes exposed to rain or in wet locations shall be weatherproof.
  - 2. Provide clamps, grids and other appurtenances to secure cables. No cable shall be unsupported for more than 30 inches.
  - 3. No pull box shall be within 2 feet of another.

## 2.6 WIRE AND CABLE 600 V INSULATION

- A. Provide single-conductor, annealed copper wire and cable with insulation rated 600 V, of sizes specified and scheduled on Drawings, by Rome, Okonite or approved equal, for secondary service, feeders, branch and system wiring. Wire insulated for 300 V may be used where voltage is less than 100V, if isolated from higher voltages. Wire sizes shown and specified are American Wire Gauge for copper.
- B. All wiring shall be copper.
- C. Wire #10 and larger shall be stranded; #12 and smaller shall be solid. Wire and cable shall have THW, THHN, THWN or XHHW insulation as required.
- D. Motor control circuits and signal wiring may be #14 if NEC requirements are met. Branch circuits longer than 75 ft. for 120 V shall be at least #10 from panel. Electrical contractor shall be responsible for voltage drop adjustments.
- E. Wiring within light fixtures and other high-temperature equipment shall have 150 degrees C insulation as required by NEC.
- F. Minimum size wiring for power and lighting circuits shall be No. 12 AWG. Control wiring and low voltage systems shall be minimum No. 14 AWG.
- G. Splices and Terminations
  - 1. Make splices in branch circuit wiring with UL-listed, solder less connectors rated 600V, of sizes and types required by manufacturer's recommendation with temperature rating equal to those of wires. Splice connectors shall be screw-on.

Insulate splices with integral covers or with plastic or rubber friction tape to preserve characteristics of wire and cable insulation.

2. Provide standard bolt-on lugs with hex screws to attach copper wire and cable to Panelboards, switchboards, disconnect switches and electrical equipment.
3. Ampacity of splices and connectors shall be equal to those of associated wires and cables.

## 2.7 TYPE MI CABLE ASSEMBLY

- A. Mineral-Insulated Metal-Sheathed Fire-Resistive Cables (Type MI) shall consist of a factory assembly of one or more solid copper conductors insulated with highly-compressed magnesium oxide and enclosed in a seamless, liquid-and -gas-tight continuous copper sheath. Cables shall be rated for 600 volts. Cable shall comply with Article 330 of the National Electrical Code. Cables shall be classified by Underwriters Laboratories, Inc. as having a 2-hour fire resistive rating. Cable terminations shall be made with UL listed mineral-insulated cable fittings suitable for terminations on standard lugs. Provide all necessary accessories, splices, and mounting hardware as required. Cables shall be as manufactured by Pyrotenax USA, Inc. or approved equal.
- B. Type MI cable assemblies shall be delivered from the manufacturer with ends temporarily sealed against moisture ingress. When cables are cut in the field, the ends are to be sealed per manufacturer's requirements, but as a minimum, by means of standard sealing compound and PVC tape. Cables will be stored in a dry location.

## 2.8 FEEDER IDENTIFICATION

- A. Provide laminated phenolic identifying tags pressure-sensitive labels for cables, feeders, and power circuits in pull boxes, panelboards, at cable termination and in other locations.
- B. Tags or labels shall be incised to show ½ inch high black letter on a white background. The operating voltage of the specific feeder and/or branch circuit shall determine background color. Suspended tags with two 1/32-inch diameter nylon 55-pound test shall be attached monofilament line or two slip-free plastic cable lacing units.

## 2.9 COLOR CODING

- A. Colors shall be factory-applied entire length of conductors by one of the following methods except as noted and limited below:
  1. Solid color compound.
  2. Solid color coating.
- B. Branch circuit conductors #12 and #10 shall have solid color compound, solid color coating or colored fibrous covering. Neutrals and equipment grounds shall have solid compound or solid color coating (white, gray and green).

## 2.10 WIRE PULLING EQUIPMENT

- A. Provide polyethylene ropes for pulling wire.

- B. Provide fish wires all empty conduit systems required, without splices and with ample exposed lengths at each end.
- C. Provide wire pulling lubricants that meet applicable UL requirements as necessary.

## 2.11 WIRING DEVICES

- A. Provide UL listed, heavy duty, specification grade wiring devices by single manufacturer: Arrow-Hart (Division of Crouse-Hinds), Leviton, Hubbell, Wiremold or approved equal. Devices shall be White.
- B. Toggle Switches:
  - 1. Single-pole shall be 20A. 120-277 V AC.
  - 2. Double-pole shall be 20A. 120-277 V AC.
  - 3. Three-way shall be 20A. 120-277 V AC.
  - 4. Four-way shall be 20A. 120-277 V AC.
- C. Receptacles:
  - 1. All receptacles shall be tamper resistant "TR" type.
  - 2. Duplex shall be TR, 125 V, 20 A, 2-pole, 3 W, grounding.
  - 3. GFI Devices shall be TR, 125 V, 20 A, 2-pole, 3 W, grounding.
  - 4. USB Devices shall be duplex, TR, 125 V, 20 A, 2-pole, 3 W, grounding with 2, USB charging ports.
  - 5. Receptacles indicated with "PL" on plans for plug load control shall be permanently marked with a symbol and the word "controlled" in accordance with NEC 406.

## 2.12 WIRING DEVICE PLATES

- A. Provide device plates by Arrow-Hart, Bryant, Hubbell, Wiremold or approved equal.
- B. All device plates shall be White. In all other areas faceplates shall be plastic, color to match device.
- C. Device plates shall be by manufacturer of wiring devices.
- D. Device plates shall be provided with 1/4-inch letters, indicating panelboard and circuit number applied to coverplate of all devices.
- E. Outlets shall be flush to surface and square.
- F. All switches and receptacles shown for one location shall be grouped under one faceplate.
- G. All exterior devices shall be provided with clear, plastic In-Use covers.

## 2.13 PUSH BUTTONS (FOR MAIN CIRCUIT BREAKER, PV SYSTEM, AND GENERATOR LOCATED AT FIRE ALARM CONTROL PANEL)

- A. Emergency Stop push buttons, red mushroom maintained contact push button, pull to reset, 2 normally open and 2 normally closed contacts, 10amp, 120V contact ratings, plastic flip up cover over push button, mounted in flush box with stainless steel cover plate.

- B. Provide identity of control of respective push button on coverplate.
- C. GE CR 104 series, Schneider Electrical 9001 series, or equal.

#### 2.14 RETRACTABLE CORD REEL

- A. Manufacturers: Subject to compliance with requirements, provide retractable cord reel from one of the following:
  - 1. Cox Reel.
  - 2. Hannay.
  - 3. Gleason Reel.
- B. Equal to Cox Reel PC series, 20' cord length, heavy duty #12AWG conductor, 5' lead cable, cord guide arm, 1/4" steel base, 1" solid steel axle with lubricated precision bearings.
- C. Spring retraction using tune and matched cartridge style spring motor, non-corrosive stainless steel spring with pawl and zinc plated ratchet.
- D. Provided with grounded GFI quad receptacle.

#### 2.15 LIGHTING FIXTURES

- A. All fixtures shall have technologies which meet the requirements of Utility's prescriptive rebate program. Fixtures shall have CEE rating and meet NEMA Premium ratings.
- B. Provide lighting fixtures, equipment and components where shown on Drawings, as listed in fixture schedule and as specified, wired and assembled. Provide approved aligned canopies, hangers and other appurtenances as required.
- C. Verify ceiling constructions, and provide fixtures, ballasts, frames, rings and other accessories suitable for construction encountered.
- D. Coordinate installation of fixtures with installation of ceiling materials and suspension system.
  - 1. In no case shall lighting fixtures be suspended or supported from conduit or duct. Fixtures shall be supported from structural members only. All fixtures shall be supported at four points.
  - 2. Provide unistrut below ducts from which to hang fixtures when fixture locations coincide with duct runs. Provide threaded rods to support unistrut.
  - 3. Investigate lighting fixture locations and supports to ensure that no interference exists between lighting fixture, supports and other equipment.
  - 4. Refer to fixture schedule for specific lamp requirements.
- E. Emergency Exit Signs: Indicated on drawings. Electrical Contractor to coordinate wall mount arrangement.
- F. Fixtures shall be 82 CRI @ 3500K.

#### 2.16 LIGHTING CONTROL SYSTEM

- A. The lighting control system is a networked, distributed intelligent control system. The system design is based on Osram Encelium wired system. Acceptable alternatives include Acuity nLight and Hubbell NX providing the same features and functions.
- B. Refer to lighting control details for additional requirements.
- C. Provide factory supervisions, testing and programming.
- D. Light Management System: Distributed WAN/LAN network. Global controller/routers, individually addressable system field devices not integral to luminaires, sensors, switches, relays, and ancillary devices required for an operable system.
  - 1. WAN/LAN Start-Up: Control system manufacturer or certified contractors.
  - 2. System: Non-proprietary 0-10V dimming, DALI or fixed output ballasts and/or 0-10V LED drivers, occupancy sensors, daylight sensors, etc.
  - 3. UL 924 Listed Devices: Able to control 120 V, 277 V, and 347 V loads.
  - 4. System Software Interface: Able to notify communication failures to system users
- E. Provide system with Daylight Harvesting.
  - 1. Central Controller Unit: Rationalizes natural light changes when available.
    - a. Maintains light levels during fluctuating ambient conditions where 0 to 10 V, DALI dimming ballasts and/or drivers exist.
  - 2. Fixed output ballasts and/or drivers: Energize when natural light falls below foot-candle levels specified. Utilize light level inputs from common and/or remote sensor locations to minimize number of photo sensors required. Operate with multiple users in harmony and not react adversely to manual override inputs.
- F. Installation Mode: Test if devices are wired correctly by pressing any button on the Wallstation or sensor which triggers load controllers on the channel to change the dimming level by 25 percent. Every press triggers this function to enable testing of the AC line wiring, dimming wiring and communication integrity over GreenBus II lines.
- G. Manual Pairing: Pair room or zone devices to gain manual control (on, off and dimming) and occupancy time outs. Holding any button on a Wallstation or sensor for 10 seconds enters system into Manual Pairing mode. System then guides user by blinking the load controllers on the GreenBus II wiring scheme identifying and pairing them to the Wallstation or sensor.
- H. Vacancy Recovery: If sensor times out in manual-on, occupant can turn lights on using occ sensor. Vacancy Recovery Time: Configure during system programming.
- I. Fade Rates: Configurable fade rates for occupancy time-outs and/or manual control
- J. High end of individual lights can be tuned/trimmed.
- K. 2-Stage Off: Lights go to low-dim level before end of schedule or occupancy time out.
- L. Manager Recovery from Power Failure: When power is restored, in 3 seconds lights return to same levels (dimmed setting, full on, or full off) as prior to interruption.
- M. Time Clock Scheduling: Programmable for scheduling lights to a specific level.
  - 1. Programming: User friendly, Outlook style interface for schedules.



2. Override: Manual adjustments via Wallstations temporarily override status imposed by time clock schedule.
  3. Response to Power Failure: Time clock will execute schedules that would still be in progress had they begun during the power outage.
  4. Flick Warning: Prior to a scheduled lights-off event or expiry of a temporary override, system provides 2 short light level drops warning affected occupants. Flick Warning Time: Programmable via software; between 1 and 5 minutes.
  5. Automatically turn on or wait for an input: A luminaire group can be turn on automatically in response to a scheduled event or a Wallstation signal to turn luminaire group on, and stay on, for remainder of scheduled event.
  6. Support BMS Schedules/Calendars
- N. Automatic Load Shed Mode: When activated, control unit reduces output to programmed electrical demand load. System will not shed more load than required. Load shedding Priority: Centrally configurable by control zone or by common uses with subsequent load shed priority groupings utilized until required defined load has been shed, for a defined period, or until demand response input has been removed.
1. Not Acceptable: Systems selecting a "load shed scene" where there is no guarantee the defined required load will be shed.
- O. Emergency Mode: When activated, will immediately adjust to, and remain at full light output until mode is deactivated. Setting overrides other inputs. Interface with building emergency monitoring system and not require multiple connections.
- P. Addressing: Centrally addressable ballasts and drivers, on a per luminaire, multiple luminaire, or zone basis. Utilize 0-10V dimming, fixed output ballasts or 0-10V LED Drivers connected to an Output Module. System will not require manual recording of addresses for purpose of start-up or reconfiguration.
- Q. Programmable Task Tuning:
1. Light level programmability available by individual luminaire.
- R. Continuous Dimming: Over a continuous range; individual or group of luminaires in response to user initiated or system generated signals.
- S. Unoccupied State: When occupancy status is vacant per occupancy sensors.
1. Lights turn off.
  2. Lights adjust to configurable dimmed light level.
- T. Occupied State: Create "comfort" or "support" zones ensuring occupants are not isolated by turning off lights in adjacent areas. Light paths to exit premises.
- U. Overlapping Zones: Create to ensure continuous lighting and safety of occupants as they move from one zone to another while minimizing energy use.
- V. Participation in Intelligent Building Framework: TCP/IP over Ethernet backbone.
1. Control units.
  2. System server communications.
- W. LAN Operations: Capable of operating independent of building's existing network infrastructure and not rely on tenant supplied PCs for operation.

- X. Network Security: Use firewall technologies and VLAN configuration methods to separate tenants from and ensure integrity of light management network.
- Y. Group (Zone) Configuration: Assign individual or group system components to zones via the Software. Rewiring is not needed when reconfiguring or re-zoning. Removal of covers, faceplates, ceiling tiles, etc. is not required.
- Z. Sensor Control Parameters: Occupancy sensor time delays and light level sensor parameters are to be configurable through software.
- AA. Automatic Time Adjustment: For leap year, daylight savings time, weekly routine, and holiday scheduling.
- BB. Contact Closure Input: System capable of receiving a momentary and sustained contact closure input from third party sources to control lighting zones.
- CC. Astronomical Clock: Luminaires switch ON/OFF with sunset and sunrise (option to select offset, depending on geographic location of building. An offset option available to turn schedule ON/OFF up to 12 hours before or after dusk or dawn.
- DD. Auto-configure lighting controls for spaces that have been combined or divided temporarily by moving wall or similar systems.
- EE. The system shall have resident White Light Color Tuning.
- FF. Automatically lock Wallstations and/or disable sensors based on one of the following inputs: Contact closure, a time schedule, or status of a monitored space.
- GG. BAS Interface: Light management system to be capable for BACnet:
- HH. AV Interface: Light management system capable of interfacing with audio-visual system (e.g., LCD Touch Screen Panel) via TCP/IP interface.
- II. AC Phase Cut Dimming Circuit Integration: System to have ability to control Incandescent, Fluorescent or LED lighting load otherwise controlled by manual AC Phase Cut Dimmers.
- JJ. Minimized system down time: Communication bus shall be able to self-diagnose and display communication shorts or open loops resulting in minimum system down time.
- KK. Lighting control system software:
  - 1. Central Lighting Control Software: Interactive, Web-based graphical user interface (GUI) showing floor plans and lighting
    - a. Navigational features listed below allow user's orientation within the controlled space, geographic heading and/or landmarks:
  - 2. Interactive, Vector based, Zoom, Rotate, Pan, and Tilt.
  - 3. Building operator to navigate through facility in two dimensional views, allowing fast and easy navigation.
  - 4. Display single floor views for easier system performance visualization of entire site as well as individual zones or spaces.
  - 5. Software Settings and Properties: Selectable per individual device, room based, floor based, or global building based.
  - 6. Lighting Control Software Interface: Provide status and enable configuration of system zones including selected individual luminaire availability, current light

- level, maximum light level, on/off status, occupancy status, and emergency mode (response to an emergency signal) status.
7. Display lighting system parameters such as Lighting Status (ON/OFF); Lighting Levels, Load Shedding Status, or Lighting Energy Consumption, Occupancy status in a colorized gradient ("weather" map) type of graphical representation.
  8. Energy Analysis Data: Exportable in CSV file formats.
  9. Allow import of native AutoCAD files.
  10. Reporting Feature: Native to lighting control software. Reports to be printable in printer friendly format and downloadable for use in spreadsheet applications, etc.
    - a. Report the following parameters for each device and zone individually.
    - b. Energy consumption broken down by energy management strategy.
    - c. Energy demand broken down by energy management strategy.
    - d. Occupancy data by zone.
    - e. Building wide occupancy status.
    - f. Time Schedule configuration status.
    - g. Lighting energy consumption in color gradient "weather map" type view.

#### LL. USER interfaces

1. Zone Control (ZC) Wallstations: Multi-Zone Controller Wallstation Series. Wall stations are used to activate or de-activate a lighting zone. Software configurable lighting control. ON/OFF switching for multiple lighting zones. Zone Status: Integrated LED indicators. White: ON. Blue: OFF. Available in a range of configurations for customized light level control. Stations shall be wired via low voltage connection to lighting management systems bus.
2. Scene Control (SC) Wallstations: Scene Dimming Wallstation. Multi-scene, single-zone dimming wallstations providing customized light level control in areas requiring architectural dimming. Scene controllers shall have number of scenes as indicated on drawings.
3. Tunable White (TW) Wallstation: Tunable-White Wallstation. Single zone low voltage wall mounted controllers providing local ON/OFF control over a lighting zone or multiple zones.

#### MM. Sensors

1. Low-Voltage Sensors: Low Voltage Occupancy and Daylight Sensor. Single and multi-technology sensors in various configurations and application types.
  - a. Single-Technology Passive Infra-Red (PIR) Sensors: For small and large spaces when major motion is available.
  - b. Multi-Technology: Adds active Ultrasonic (U/S) sensor to PIR sensor increasing minor motion sensitivity in applications like offices and restrooms.
  - c. Collect occupancy data from a lighted space and works with Encelium X Networked and Encelium Edge Standalone Wireless Light Management Systems via GreenBus II wire and/or ZigBee standards based mesh network.
2. Sensor Interface Module (SIM): Field Bus: GB2. A key component of the Encelium X Networked Light Management System (LMS). Connects via two ports that accept pre-terminated GreenBus II Communication Cable.

NN. Distributed Load Controllers

1. Connected Lighting Modules (CLM) Wireless: For individual luminaire control to spaces delivering flexibility to building managers for the life of the space. With controls inherently integrated, it significantly reduces electrical contractor labor hours. For the lighting OEM, it reduces component count and streamlines assembly.

OO. Luminaire Control Module (LCM): Individually Addressable.

1. Energy Management Equipment: Listed UL 916 and cULus.
2. Emergency Lighting Equipment: Listed UL 924 and cULus.
3. Heat and Smoke Release for Air-Handling Spaces: UL 2043.
4. FCC Part 15/ICES-003 Complies with the following electromagnetic requirements: EN 61000-4-2, EN 61000-4-4, and EN 61000-4-5
5. Install in accordance with applicable national and local electrical and building codes.
6. Adjust light levels to respond to variable lighting requirements
7. Customize lighting scenes for tailored experiences/tasks
8. Schedule Luminaire operation to low energy use during off-peak occupancy.
9. Individually Addressable: Control ballasts independently. Configure to best meet facility needs.
10. Switches a fixture ON or OFF via a relay contained in the module.
11. Low voltage dimming signal to any 0-10V dimming ballast/driver.
12. Connects to LED drivers without isolation between the dimming section and electrical output for added flexibility in LED driver options.
13. Operating Temperature: Minus 40 to 131 degrees F (Minus 40 to 55 degrees C).
14. Electronic Ballast: 2.5A 120-480 Vac
15. Ballast: 4.5A 120-480 Vac
16. General Purpose: 4.5A 120-480 Vac
17. Single 0-10V dimming output (IEC 60929 Annex E). Capable of sinking 25 mA Equivalent to 10 typical dimming ballasts/drivers.
18. Connects to Encelium X Networked Light Management System via two ports that accept pre-terminated GreenBus II Communication Cable.

PP. Area Lighting Control (ALC):

1. High power switching and dimming interface between a group of luminaires and the Encelium X Networked Light Management System (LMS).
2. Energy Management Equipment: UL 916 cULus Listed.
3. Emergency Lighting Equipment: UL 924 cULus Listed.
4. Heat and Smoke Release for Air-Handling Spaces: UL 2043
5. Environmental protection: Rated for damp location; RoHS compliant.
6. Radio Interference: FCC Part 15/ICES-003.
7. Individually Addressable: Switches single wired zone of multiple luminaires ON or OFF via integral high current relay while setting the zone's overall light level with 0-10V dimming output wired to fixtures' dimming ballasts or LED drivers.
8. Dimming Output: Fully isolated. Suitable for installation as a NEC Class 2 or Class 1 circuit.
9. Able to switch and dim many LED luminaires with 0-10V drivers compliant to the lighting industry's open standard IEC 60929 Annex E.
10. Can switch entire circuit of electrical loads. Suitable for general plug load control.

11. 20A 120-347 Vac Ballast.
12. 20A 120-347 Vac General Purpose.
13. 1.5 HP 120-277 Vac Motor.
14. Communication: Via NEC/CEC Class 2 communication wire.
15. ON/OFF Switching
16. Continuous 0-10V dimming output, (IEC 60929 Annex E); capable of sinking 30mA; corresponding to 30 typical ballasts/LED drivers.
17. Air Gap Off: Enforce physical disconnection of AC power to ballast or driver when "OFF" is selected either automatically or manually.
18. Memory: Retain system settings in non-volatile memory.
19. Connects to the Encelium X Networked Light Management System via two ports that accept pre-terminated GreenBus II Communication Cable.

QQ. WALL: Wireless Site Lighting Control Module.

1. Extends Encelium X Networked Light Management System's controls capability to building's surroundings or site such as parking lots and short pathways, via a wireless mesh network based on ZigBee standards.
2. Onboard photo sensor and input for external sensor.
3. UL/916/773 cULus listed
4. Meets ASHRAE Standard 90.1 and CEC Title 24 requirements
5. FCC Part 15/ICES-003
6. Operating Voltage: 120 to 347 V
7. Power Consumption at no Load: Less than 1.0 W
8. Surge Protection: 6kV, 3kA
9. Load Rating: 10A: Electronic driver/ballast, magnetic ballast, resistive load
10. Power Metering: V, I, P, Energy
11. Accuracy: Less than 2 percent from 0.5 to 10A load.
12. Accuracy: Less than 5 percent below 0.5 A
13. Single Dimming Output: 0-10V (IEC 60929 Annex E), DALI or DEXAL compatible
14. Sink / Source: 10 mA
15. Sensor Input: Maximum 20 mA; minimum 18 V; nominal 19.5 V
16. Input for external occupancy sensor.
17. Time schedule based control.
18. Daylight based control.
19. Astronomical schedule based control.
20. Occupancy based control.
21. Radio Frequency: 2.4 GHz.
22. Transmit Power: 20 dBm.
23. Line of sight between modules: Up to 1,000 ft ( ).
24. Operating Temp: Minus 40 to 150 degrees F (Minus 40 to 65 degrees C).
25. Relative humidity: 0 to 95 percent.
26. Ingress protection: IP66.
27. Base Diameter: 3.31 inches (84 mm). Height: 2.61 inches (66.4 mm).
28. Installs on top of a luminaire via an ANSI C136.41 compliant 3, 5 or 7-pin twist-lock connector.

RR. System Infrastructure and Accessories

1. System Support Unit (SSU): A key component in an Encelium X Networked Light Management System. It hosts the Polaris software giving Facility Managers and Building Operators ability to monitor and maintain their Encelium system.
2. UL 60950.
3. FCC (U.S. Only) Class A, DOC (Canada) Class A.
4. CAN/CSA-C22.2 No. 60950.
5. Enables operators to change or modify light settings, schedules, system settings and maintain the system.
6. Stores historical data relating to system performance like energy savings, occupancy usage.
7. Allows remote access for support.
8. Allows the end user to add additional functionality inherently built-in like BACnet demand response and AV interface.
9. Stores backup of the system on a regular basis.
10. Processor: Multi-Core Server.
11. Power Consumption: 1 x 400 W (non-redundant).
12. Input Ratings: 110/220V auto-ranging.
13. Mounting: Standard 19 inch (482.6 mm).

SS. System Support Unit - Virtual (SSU):

1. To support client IT requirements, the Encelium Light Management system can enable a virtual server. All functionalities of a standard hardware System Support Unit (SSU) can reside on a client server. This eliminates the need for dedicated server hardware.
2. Acts as database for data related to an Encelium X system installed in a facility.
3. Stores system settings and parameters, including attributes for zones, luminaires, sensors, zone controllers, and scene controllers.
4. Logs historical data regarding system's operational and energy savings results.
5. Encelium X Wireless Managers: Must be assigned static IP addresses to communication with the Virtual SSU.
6. The Virtual SSU provides the ability to remotely access a system to change system settings or configuration, analyze system performance or energy data or troubleshoot thereby providing quick and seamless customer support.
7. Building automation interfaces such as BACnet and A/V Interface are available upon request.
8. Minimum Requirements:
9. Processor: Intel Xeon E-2124 3.3 GHz 4 Core.
10. Hard Drive: 1 TB.
11. RAM: 8 GB or higher.
12. Supported Operating Systems:
13. Windows 10.
14. Windows Server 2019.
15. Other operating systems subject to approval by Encelium Light Management System Specialist.

TT. Dry Contact Input Interface (DCII):

1. Model EN-DCII-GB2. Enhances occupant experience by enabling integrations between Encelium Light Management System and third-party systems i.e., room

- booking systems in offices, AV in lecture halls, or bedside controls in patient rooms.
2. Based on the dry contact signal, the Encelium system sets lighting scenes that can include intensity or color temperature.
  3. Can use momentary hold signals to enable raise / lower functionality.

UU. Integrations:

1. Provide modules for the following integrations
  - a. AV interface module
  - b. BACnet interface module.
  - c. Shade integration module
  - d. Security system interface module
  - e. Fire alarm system interface module

VV. Encelium Systems and Software

1. Provide with Polaris monitor software, Web-based: Runs on HTML5 compatible browsers; Microsoft Edge, Google Chrome, Mozilla Firefox, and Safari. Supports Multiple Platforms and Devices: Runs from tablet, desktop, laptop, or smartphone. Touch gestures; pinch to zoom, drag to pan, etc. HTTPS. Industry-standard certificate-based encryption and authentication for security.
2. Functionality listed below must be available via a single application.
  - a. Using graphical floor plan view.
  - b. Graphical Floor Plan View: Pan and zoom allows easy navigation; dynamically adjust details presented based on zoom level.
  - c. Monitored for on/off status.
  - d. Turned on/off or set to a specific level.
  - e. Monitored for on/off status.
  - f. Turned on/off or set to specific level.
  - g. Areas may be set to predefined lighting scenes.
  - h. Scenes can be renamed and modified in real-time,
  - i. Can be monitored or disabled to override occupancy control or in case of occupancy sensor problems.
  - j. Enabled or disable Daylighting. Used to override control currently taking place in the space.
  - k. Daylight calibration can be adjusted for each daylit area.
  - l. Daylight status can be monitored.
  - m. Monitor energy savings due to daylight harvesting down to an individual area.
  - n. Scheduling: Using time of day and astronomic time clock events.
  - o. Adjust or disable occurrence of repeating scheduled event.
  - p. Monitor and adjust scheduled events with weekly calendar view.
  - q. Reporting Capability: Allow building manager to gather real-time and historical information about the system as follows:
  - r. Energy Reports: Compare cumulative energy used over a period of time for one or more areas. Capable of displaying:
  - s. Power Reports: Show power usage trend over a period of time for one or more areas.

- t. Energy Savings by Strategy Report: Show for any area broken down by strategy (tuning, occupancy, daylighting, scheduled events, , and load shedding).
- u. Sensor Level Report: Shows light level in footcandles of any photosensor in the system.
- v. Alert Activity Report: Capable of generating historical reports of alert activity within the system.
- w. Diagnostics: Allow building manager to check the status of equipment in the lighting control system.
- x. Wallstation Lock/Unlock: Allow building manager to lock Wallstations preventing building occupants from activating their programming (button presses), until they are unlocked.
- y. Keypads: Lockable, ensuring occupants cannot alter light and shade levels in a space during specific events or business hours.
- z. Keypads: Unlock after events and after hours for maintenance, cleaning, security, and others.

## 2.17 FIRE ALARM VOICE EVACUATION SYSTEM

- A. Provide automatic and manual, analog addressable, supervised fire alarm and voice evacuation system. Equipment shall be UL-listed and shall meet requirements of the Fitchburg Fire Department, Local and State of Massachusetts requirements.
- B. Submit shop drawings as specified. Shop drawings shall include connections to existing system, terminal-to-terminal wiring schematics, exact color coding, location and function of each device and appropriate specification data sheets. Drawings indicating one line risers and typical wiring diagrams will not be accepted. Record drawings shall be forwarded to Owner before acceptance of building.
- C. System shall operate from 3-wire AC supply, and battery backup on failure of normal system.
- D. System shall report to the fire department through a radio master box by AES Corporation: NO SUBSTITUTIONS. Radio master box shall be 8 zone with integral local annunciator, full data module, backlit LCD display, red enclosure. Unit shall be powered from the fire alarm system. Unit shall be AEC 7707P-88-ULP-M. Prior to order, contact Fitchburg Fire Department, Fire Prevention department to confirm specific unit.
- E. System Operation - Alarm Mode
  - 1. Initiation of fire alarm manual station or automatic actuation of heat detector, smoke detector, sprinkler flow switch or kitchen hood suppression system shall cause:
    - a. Indication of the general alarm condition at the FACP and the annunciator.
    - b. Identification of the device that is the source of the alarm at the FACP and the annunciator.
    - c. Activation of the fire alarm speakers.
    - d. Activation of the fire alarm visual devices. System shall be wired and capable of silencing speakers while maintaining visuals.
    - e. Initiation of elevators' automatic recall operation.



- f. Release doors on magnetic door hold opens.
  - g. Shut down ceiling fans in classrooms.
  - h. Shunt public address system announcements.
  - i. Transmission of alarm signal to the local fire department.
  - j. Activation of exterior Red beacon.
2. Auxiliary Functions:
- a. Activation of duct smoke detector associated with HVAC units shall automatically shut down associated air handling unit.
  - b. Activation of duct smoke detector associated smoke dampers shall automatically shut damper.
  - c. Activation of smoke detector in elevator machine room shall activate motorized louvers at the top of the elevator shaft.
  - d. Activation of general alarm shall release doors on magnetic door hold opens.
  - e. Activation of general alarm shall shut down ceiling fans in classrooms.
  - f. Activation of general alarm shall shunt public address system announcements.
- F. System Operation - Supervisory Mode
- 1. Activation of duct smoke detectors for HVAC unit shut down and smoke damper operation shall cause a supervisory condition on the system.
  - 2. Activation of sprinkler system tamper switches shall cause a supervisory condition on the system.
  - 3. System Carbon Monoxide for occupants.
  - 4. Carbon Monoxide System for kitchen hood exhaust fan interlock shall, to provide supervisory alarm as indicated.
- G. System Operation - Trouble Mode
- 1. Operating power failure, ground faults or opens on station detector circuits, horn circuits or circuits connecting control panel to Fire Alarm Monitoring System Loop shall cause audible trouble signal to sound and trouble lamp to light until circuits are restored to normal.
  - 2. Audible trouble signal shall be capable of being silenced with trouble signal silencing switch, but lamp shall not be capable of being extinguished until circuits are normal. Restoring circuits to normal after silencing switch has been operated shall cause lamp to extinguish and audible signal to resound until switch is restored to normal.
- H. Intelligent System Devices: Each device shall retain operating characteristics in non-volatile memory and conduct algorithms to distinguish real fire conditions from unwanted nuisance alarms. All analog devices shall provide LED indicators to distinctively indicate active communication and alarm condition. Devices shall be interchangeable with twist-lock bases which may include a supervised remote LED output, fault isolation circuitry, or an auxiliary relay contact. In the event of an addressable loop communications failure, devices shall remain capable of initiating an alarm sequence.
- 1. Photoelectric Smoke Detector: photoelectric smoke detectors.
  - 2. Carbon monoxide detector: ceiling mounted, UL 2075, UL S1115, CSFM 5278-0028:0511, 10 year CO cell with end-of-life warning. Note that the project

- includes two types of carbon monoxide detection. Ceiling area CO detectors are located in selected areas and these devices are connected to the fire alarm system SLC loop. The kitchen hood has a separate CO detection system furnished by Div 21 and installed and wired by Div 26 for exhaust fan interlock. The kitchen hood CO system shall be connected to the fire alarm system thru a monitor module.
3. Analog Heat Detectors: Provide Analog Heat Detectors fixed temperature/rate-of-rise operation. Analog heat detectors shall be rated for 70 foot spacing and will cause an alarm when the temperature reaches 65 degrees above ambient. The fixed temperature rating shall be 135 degrees and the rate of rise shall be rated for 15 degrees per minute.
  4. Analog Duct Smoke Detector: Analog photoelectric duct smoke detectors mounted in air ducts where shown and required. Each detector shall be supplied with duct mounting plate, remote test station/indicator and sampling tubes sized according to duct width. Provide the required auxiliary relay outputs or addressable relay control modules with each detector in order to accomplish the required HVAC control and override functions. Provide wall mounted remote key operated test station with each duct smoke detector.
  5. Intelligent Manual Pull Stations: Provide intelligent addressable manual stations. The station shall be double action type with screw terminals, toggle switch, and integral addressable electronics. The station shall be constructed of red Lexan with white raised letters and a key reset switch. The station shall be keyed alike to the FACP.
  6. Monitor Module: Provide addressable input monitor modules to monitor related systems or integrate conventional initiating devices onto the addressable loop.
  7. Control Module: Provide addressable output control modules to supervise and control conventional devices (indicating circuits, flow switch, tamper switch, AHUs, door holders) over the addressable loop. Control modules shall provide a supervised output rated for 1 or 2 amps @ 24VDC, as required.
  8. Isolation Modules: Provide Isolator Modules to protect circuit integrity in the event of a wiring fault. Provide a minimum of one module per floor.
- I. Visual Alarm Devices: 24-V d.c. strobe lights with clear polycarbonate lens and high-intensity xenon flash tube, factory-wired to screw terminals; and as follows.
1. Strobe Lamps: Peak intensity 75 candela, unless shown otherwise on the drawings. Intensity shall be field selectable 15/75, 30/75, 75, and 110cd.
  2. All strobes shall comply with requirements of MAAB.
  3. Fire alarm Audio and Visual indicators shall be separately circuited. Fire alarm Visuals devices (or strobes) shall have clear Lexan lens with red lettering.
  4. Device housings shall be White with Red lettering.
  5. Exterior Beacons: Equal to Klaxon Signals "Flashguard" series. UV stabilized polycarbonate housing, IP65 rated, LED, field settable for static or flashing operation. Provide Red lens for Fire alarm.
- J. Speakers: Speaker frequency response: 250-13,000 Hz. Optimized for voice intelligibility. 4-inch (102mm) mylar cone, sealed back construction, rated for 8 watts, 8 ohm voice coil. Speaker taps shall be field changeable with selectable 1/4, 1/2, 1, or 2 watt taps. Devices shall be wall mounted. Device housings shall be White with Red lettering.

- K. Combination Alarm Devices: Audible and visible alarm device in a single mounting assembly, wall mounted.
1. Strobe Lamp: Per paragraph I.1, I.2 above.
  2. Speaker: Frequency response: 250-13,000 Hz. Optimized for voice intelligibility. 4-inch (102mm) mylar cone, sealed back construction, rated for 8 watts, 8 ohm voice coil. Speaker taps shall be field changeable with selectable  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1, or 2 watt taps.
  3. Mounting: Flush mounted on wall or in ceiling.
  4. Device housings shall be White with Red lettering.
- L. Door Holders: Provide 120V magnetic door holders where shown.
- M. Fire alarm control panel (FACP)
1. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
  2. Cabinet: Lockable steel enclosure. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of panels as well as field wiring. Identify each enclosure by an engraved, red-laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1 inch high. Identify individual components and modules within the cabinets with permanent labels.
  3. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in cards. Construction requiring removal of field wiring for module replacement is not acceptable.
  4. Control Modules: Types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals notify of alarm, supervisory, and trouble conditions. Each type of audible alarm has a distinctly different sound.
  5. Provide preamplifiers, amplifiers, and tone generators. Provide backup units to automatically activate if primary equipment fails. Amplifiers shall be sized to accommodate all speakers indicated on the drawings with speaker set to 1watt plus an additional 25% amplifier capacity. System shall have 2 channels to allow multiple audio messages to be delivered to different speaker zones.
  6. FACP shall have digital alarm communicator transmitter for transmission to central alarm station service, complying with UL 632 and be listed and labeled by an NRTL.
  7. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm or trouble condition still exists.
  8. Alphanumeric Display and System Controls: Arrange to provide the basic interface between human operator at FACP and addressable system components, including annunciation, supervision, and control. A display with a minimum of 32 characters displays alarm, supervisory, and component status messages and indicates control commands to be entered into the system for control of smoke detector sensitivity and other parameters. Arrange keypad for use in entering and executing control commands.

9. Telephone Interface Card: The system shall have a telephone interface card which allows all speakers to be accessed by the building's PBX system. The interface shall allow multiple keystrokes of telephone handsets to access all speaker zones through the building PBX.
- N. Device Guards: Provide clear Lexan (StopperII) covers where required over manual pull stations. Each shall have an integral audible device which shall sound when lifted, and shall be powered from the external 24Vdc system power.
- O. Fire Alarm Annunciator (FAA): Provide remote annunciator(s) with alphanumeric display and control functions for indoor installation where shown on the plan. The annunciator shall have a microphone handset and all speaker zone selector switches and all call for allowing manual voice instructions. Annunciator shall include LCD display, and key pad to indicate alarm and trouble messages, their address, and system status. Indicating lights include individual LED indicators for each type of alarm and supervisory device and a LED to indicate trouble. Alarm reset switch and trouble buzzer shall be provided. Notification appliances can be deactivated by pressing the "Alarm Silence" switch. Pressing the "System Reset" switch restores the system to normal operation. When system activity is normal, the LCD displays the time, date and "System is Normal".  
Annunciator Enclosure: Semi-flush mounting, with stainless steel or brushed aluminum face plate.
- P. Radio Masterbox by AES Corporation: NO SUBSTITUTIONS. Radio master box shall be 8 zone with integral local annunciator, full data module, backlit LCD display, red enclosure. Unit shall be powered from the fire alarm system. Unit shall be AEC 7707P-88-ULP-M. Prior to order, contact Fitchburg Fire Department, Fire Prevention department to confirm specific unit.
- Q. Emergency Power Supply
1. General: Components include valve-regulated, recombinant lead acid battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years minimum.
  2. Battery capacity is adequate to operate the complete alarm system in normal or supervisory (nonalarm) mode for a period of 60 hours. At the end of this period, the battery has sufficient capacity to operate the system, including alarm-indicating devices in either alarm or supervisory mode for a period of 15 minutes.
  3. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining the batteries at full charge. In the event batteries are fully discharged, the charger recharges them fully within four hours. Charger output is supervised as part of system power supply supervision.
  4. Automatic transfer switch transfers the load to the battery without loss of signals or status indications when normal power fails.
- R. Fire Alarm Map: Provide fire alarm map showing all building floors and locating all initiation devices. Map shall be computer generated (such as AutoCAD) with text no smaller than 10 point. Hand written text will not be acceptable. All initiation devices must be located on Map along with their address matching how they will be annunciated on the FACP. Submit draft version of Map to the Fitchburg Fire Department for their review and make all modifications as directed. Mount Map in framed format at location of FACP or as directed by the fire department. The bid documents in AutoCAD 2019 format will

be made available to the electrical contractor for the purposes of generating this Map, but all conversions to compatible AutoCAD formats, additions of text, and manipulations of AutoCAD drawings are the responsibility of the electrical contractor.

S. Wiring:

1. Signaling line circuits and notification appliance circuits shall meet Class A wiring approaches.
2. Wiring shall meet requirements of NEC, Article 760, Fire Protective Systems for Building Fire Alarm Systems, and as shown on Drawings. Wires for local fire alarm system shall be color-coded to correspond with manufacturers wiring schematics submitted with shop drawings, sized as recommended by manufacturer of fire alarm system and installed in conduit. Combined cross sectional area of conductors or cables shall not exceed percentage of fill specified in Table 1, Chapter 9 of NEC. Conduit size shall be coordinated with fire alarm manufacturer.
3. Fire alarm system wires in junction boxes shall be permanently tagged and identified. Each junction box capacity shall be 40% greater than that required for associated fire alarm system wires. Each junction box shall be painted fire alarm red and identified with white markings FIRE ALARM SYSTEM. Provide terminal blocks in all fire alarm junction boxes sufficient to terminate all wires in box plus 20% spare terminals.
4. Provide, in accordance with manufacturer's instructions, wiring, conduit and outlet boxes required for erection of complete system as specified and as shown on Drawings.
5. Make corrections within control equipment and devices with T&B Stakon spade terminals. Wiring within control equipment shall be secured with T&B Ty-raps and placed in wiring gutters.
6. Wiring shall be in conduit of same approved type as used for electric light and power wiring. Wires shall be at least #14 AWG, with type THWN insulation.
7. Final connections between equipment and wiring system shall be made under supervision of manufacturer's representative.
8. Fire alarm equipment shall be flush to surface where possible.

T. Fire Alarm Inspection and Testing Agreement

1. Prior to final testing and facility tie-in, provide fire alarm inspection and testing agreement in accordance with the Local Fire Department.

2.18 BI-DIRECTIONAL AMPLIFIER (BDA) SYSTEM

- A. System shall provide reliable Firefighter communications at the specified level within 95% of a building's floor area and also 95% of the stairwells.
- B. In-building radiation shall provide a signal strength that meets the following:
  1. A minimum signal strength of -95 dBm available in 95% of the area of each floor when transmitted from the Fitchburg Fire Department.
  2. A minimum signal strength of -95 dBm received at the FIRE DEPARTMENT SYSTEM from 95% of the area of each floor of the building.
- C. Provide an FCC Certificated Class B Bi-Directional UHF Amplifier(s) as indicated.
  1. The distribution system shall utilize a radiating cable system.

2. The input and output pass band of BDA shall have a center frequency of 484.7375 +/- 62.5KHz.
  3. There shall be no connectivity between the in-building radiation system and the fire alarm system.
  4. The system as installed must comply with all applicable sections of FCC Rules Part 22, Part 90 and Part 101.
- D. The system shall be capable of operating on an independent battery for at least 2 hours and emergency generator capable of running 12 hours at full load.
1. The battery system shall automatically charge in the presence of external power input.
- E. Compliance testing for an in-building radiation system is required, upon completion of installation.
1. Provide in-building radiation system tested to insure that two-way coverage on each floor of the building meets or exceeds the required 95%.
  2. Each floor of the building shall be divided into a grid of approximately twenty (20) equal areas. A maximum of one (1) area will be allowed to fail the test per floor. A spot located approximately in the center of a grid area will be selected for the test. Once the spot has been selected, prospecting for a better spot within the grid area will not be permitted. Field strength testing instruments are to be recently calibrated (1 year) and of the frequency selective type incorporating a flexible antenna similar to the ones used on the hand held transceivers.
  3. All compliance testing to be done with 50 ohm loads in place of the donor antenna to avoid interference to Fire Alarm. The Fitchburg Fire Department Communications Section is to be notified prior to any testing.
  4. Measure and document gain values of all amplifiers and submit to owner so that the measurements can be verified each year during the annual tests.
- F. Test all active components of the system, including but not limited to amplifier, power supplies, and back-up batteries, a minimum of once every twelve (12) months.
1. Amplifiers shall be tested to insure that the gain is the same as it was upon initial installation and acceptance.
  2. Back-up batteries and power supplies shall be tested under load for a period of one (1) hour to verify that they will operate during an actual power outage.
  3. Active components shall be checked to determine that they are operating within the manufacturer's specifications for their intended purpose.
  4. Documentation of the test shall be maintained on site and a copy forwarded to the Fitchburg Fire Department Radio Supervisor.
- G. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radiotelephone Operator License or equivalent.
- H. Install the bi-directional amplifier in a NEMA 4 painted steel cabinet. The color will be FIRE ENGINE RED and bear the lettering as follows: FITCHBURG FIRE DEPT. RADIO in bright yellow. The maintenance vendor and telephone number will be marked on the cabinet. The cabinet will have a locking mechanism to keep the unit secure.
- I. Connection to primary power will be hard with metallic conduit. Each bi-directional amplifier shall be powered by its own twenty (20) ampere circuit, circuits breakers shall be locked on.

- J. Each amplifier unit will have a monitoring system that monitors amplifier operation and primary power. A failure will activate an audible device and white strobe light. The audible signal may be silenced but the strobe light must remain illuminated until the fault has been corrected.
- K. The strobe light will be located in a public space authorized by the Fitchburg Fire Department Radio Supervisor. A sign will be located at the strobe light with the name and telephone number of the equipment maintenance contractor. The Fitchburg Fire Department must be notified of any failures that extend past the two (2) hour time limit.
  - 1. Connect system to the fire alarm system for supervision and monitoring of trouble.
- L. Assembly and installation of all components of the BDA System shall comply with all applicable sections of the National Electrical Code. Survivability from attack by fire shall meet NFPA 72, National Fire Alarm Code, Section 6.9.4.3, 2002 edition.
- M. Electrical Contractor will be issued call signs for communicating with the Fitchburg Fire Department personnel on the Fitchburg Fire Radio System. These call signs are to be used only by properly licensed individuals.

## 2.19 EMERGENCY PHONE SYSTEM

- A. Provide an emergency two way communication system for communication between elevator lobbies and central. station. System shall comply with the requirements of IBC 2015 1009.8. The system shall consist of flush mounted call stations, command unit and all wiring for complete operation. The system shall be based on Talk-A-Phone AOR-8 series command unit with AOR-CSE-FM call stations.
- B. Provide the service of a factory authorized representative to program, test, and commission system.
- C. The command unit shall:
  - 1. Be an indoor-rated emergency communications system device comprised of a local command unit phone, a monitoring panel, a strobe/sounder, and an uninterruptible power supply (UPS).
  - 2. Be half duplex in operation.
  - 3. Be programmable through the local command unit phone.
  - 4. Be programmable from a remote location if a connection to the public switched telephone network (PSTN) is made available.
  - 5. Support and provide power to each analog call station for up to eight (8) units as an area of refuge (or area of rescue assistance) station used for emergency communications.
  - 6. Provide analog call stations with the ability to establish communication with either an attendant at the local command unit phone or an attendant through a PSTN connection.
  - 7. Provide an audible and visual indication of a system ground fault.
  - 8. Provide an audible and visual indication of open faults and short faults that occur on an analog call station conductive pathway.
  - 9. Have a monitoring panel that provides a visual indication on the activation status and trouble status of the analog call stations.

10. The command unit enclosure shall: Be constructed of 16 Ga. cold-rolled steel (CRS). Be powder coated black with a textured finish. Measure 14.50" W x 26.67" H x 4.25" D. Have mounting holes on the rear and two sides of the enclosure.
11. The command unit shall have a monitoring panel to provide a visual indication on the activation status of analog call stations. The monitoring panel shall:
  - a. Have one (1) LED for each analog call station to indicate activation status—for a total of eight (8) LEDs.
  - b. Have one (1) LED for each analog call station to indicate trouble status in the event an open fault or a short fault occurs on an analog call station conductive pathway—for a total of eight (8) LEDs.
  - c. Have one (1) LED to indicate the power status.
  - d. Have one (1) LED to indicate the status of a connection to the PSTN.
  - e. Have one (1) LED to indicate the status of a connection to the local command unit phone.
  - f. Have one (1) LED to indicate a fault when there is a loss in primary power provided to the UPS.
  - g. Be protected by an acrylic window.
12. The local command unit phone shall:
  - a. Have a handset with a coiled cord.
  - b. Have a keypad with a standard 12-button layout.
13. The strobe/sounder shall:
  - a. Be a combined unit that supports wall mounting.
  - b. Have a strobe rating of 15 candelas.
  - c. Have eight (8) audible signal options.
  - d. Have an audio output ranging from 80 to 92 dBA at 10-feet (UL Reverberant); performance is dependent on selected audible signal.
14. Local Command Unit Phone
  - a. Receive calls from one (1) of the eight (8) analog call stations.
  - b. When an incoming call has been received, the local command unit phone shall audibly ring.
  - c. When an incoming call has been received, the assigned line indicator button LED shall illuminate and flash.
  - d. Originate calls selectively to one (1) of the eight (8) analog call stations.
15. Call Routing
  - a. The command unit shall be configurable with one of the following call routing procedures:
    - (1) Only route calls to the local command unit phone.
    - (2) Only route calls through a PSTN connection.
    - (3) Route calls to the local command unit phone as primary, PSTN connection as secondary.
    - (4) Route calls to the PSTN connection as primary, local command unit phone as secondary.
  - b. The command unit shall be capable of queueing calls on a "first in, first out" (FIFO) basis.



- (1) When a call is in session, subsequent calls shall be placed into a FIFO queue.
- (2) When a call is completed, the next call in queue shall be automatically placed to either an attendant at the local command unit phone or an attendant through a PSTN connection.
  - (a) When the attendant terminates a call, the analog call station shall automatically return to an on-hook condition.

16. Visual Indicators (Monitoring Panel)

- a. When the command unit is powered, the power status LED shall be solidly illuminated.
- b. When there is a power fault, the power status LED shall be unlit.
- c. When an analog call station has been activated but not connected to either an attendant at the local command unit phone or an attendant through a PSTN connection, the respective analog call station LED shall be solidly illuminated.
- d. When an analog call station has been activated and the call has been answered by either an attendant at the local command unit phone or an attendant through a PSTN connection, the respective analog call station LED shall be solidly illuminated.
- e. Queued calls shall be indicated through the respective flashing analog call station LED.
- f. When an open fault or short fault occurs on an analog call station conductive pathway, the respective trouble LED shall be solidly illuminated.
- g. When a system ground fault occurs, all trouble LEDs shall flash simultaneously.
- h. When there is a call connection attempt through the PSTN port, the PSTN LED shall flash.
- i. When there is an active call connection through the PSTN port, the PSTN LED shall be solidly illuminated.
- j. When there is a call connection attempt through the local command unit phone port, the local command unit phone LED shall flash.
- k. When there is an active call connection through the local command unit phone port, the local command unit phone LED shall be solidly illuminated.
- l. When there is a loss in primary power provided to the UPS, a dedicated LED shall be solidly illuminated.
- m. When an analog call station is activated, the strobe shall flash and continue for the entire duration of the call.
- n. When an analog call station is activated, the sounder shall emit its configured audible signal.
- o. When the call has been answered and a connection established with an attendant, the sounder shall deactivate.

17. Audible Indicator (Analog Call Station Prerecorded Voice Message)

- a. An attendant at the local command unit phone or an attendant through a PSTN connection shall be capable of receiving a prerecorded voice message from the analog call station.

- b. This prerecorded voice message shall notify the attendant of the analog call station location by playing at the beginning of the phone conversation.
18. Audible Indicator (Fault Siren)
- a. When an open fault or short fault occurs on an analog call station conductive pathway, the fault siren shall emit an audible signal.
  - b. When a system ground fault occurs, the fault siren shall emit an audible signal.
19. Trouble Reset Switch
- a. Deactivate the fault siren when any open faults, short faults, and system ground faults have been corrected.
  - b. Deactivate trouble LEDs when any open faults, short faults, and system ground faults have been corrected.
- D. Call Station: Equal to Talk-A-Phone AOR-CSE-FM-1RO. The call station shall be fully compliant with IBC, ADAAG, ICC A117.1 Ch. 7, and NFPA 72. The call station shall be flush mounted with vandal resistant stainless steel faceplate and metal button. The call station shall be powered by the Command Control unit phone line. The call station shall have a push button hands-free call. Two (2) LED indicators for hearing impaired (calling, answered). Built-in auto-dialer can dial up to five (5) numbers. If first number does not answer or is busy, dials second number. If second number does not answer or is busy, dials third number—and so on. Auto-answer on inbound calls allows security to monitor and initiate calls with the call station. Automatically inform attendant of the location of call station through recorded message that plays at the beginning of the call. Provide with relay output.

## 2.20 CEILING FAN

- A. Equal to Big Ass I6- MK-I61-051800A729V54, 60" diameter, 120V, flush mounted, 9676 CFM, 35W, 34lb, white finish. Provide with viable speed wired controller equal to Big Ass C-BTWC-03-04-00-US and fire relay option RIBU1C.
- B. Fans to be U.L. listed with matching U.L. listed solid state controls. All motors to be direct-drive permanent split capacitor type, with permanently sealed ball bearings. All motors to have built in, self-resetting(internal) thermal overload protector.
- C. All fans to have factory installed Secondary Support Cable Assembly connected to motor shaft, with minimum 6 feet galvanized cable 1/8" 7x7 with rated breaking strength of 1700 lbs. and must comply with CSA std. C22.2Sept. 1986. Fan blades to be straight with contoured shaped design for maximum efficiency.
- D. Fans used with motor speed controls must be labeled in accordance with U.L. 507 "Suitable for use with solid state motor speed controls".
- E. Provide ceiling fan rated outlet box supported independent of ceiling system.
- F. Provide 0-10V wiring in 1/2" conduit to fan controller.
- G. Provide wiring in 1/2" conduit in between fan relay kit to fire alarm relay for fan shutdown.

## 2.21 MOTOR STARTERS

- A. Manufacturer; Furnish motor starters manufactured by one of the following:
1. Allen-Bradley Co.
  2. General Electric
  3. Square D Company
  4. Cutler-Hammer
- B. Provide combination magnetic motor starters with electrically operated, electrically held controller and fusible disconnect switch as shown on the drawings. Include the following accessories and features:
1. Control transformer: Internally mounted in the starter enclosure, with fuses to protect control wiring; with rating as follows. Coordinate secondary voltage with Div 22 and 23 for powering of control circuits:
    - a. Size 1 starter: 75 VA
    - b. Size 2 starter: 100 VA
    - c. Size 3 starter: 50 VA
  2. Thermal Overload Relays: Provide internal ambient-compensated thermal overload sensing device in each phase of the multi-phase motor starters. Unless shown otherwise, provide manual reset type. Size thermal overload relays for 125 percent of the actual motor full load current.
  3. Status indicating lamps: Red for "Run" and green for "Stop."
  4. Selector Switch: Three position type; "Hand-Off-Automatic."
  5. Auxiliary Contacts: Provide at least two NO and two NC unused contacts in each starter.
  6. Fuses: Provide fuses equal to current rating of motor circuit conductors.
  7. Phase loss protection: Provide protection relay for the starters size 2 and larger.
  8. Time relay with adjustable delay after energization (on delay) for the starters size 2 and larger.
- C. Provide three-pole magnetic motor starters for operation at 208 volt or 480 volt, 3-phase, 60 hertz where shown otherwise on the Drawings. Refer to mechanical drawings for motor size and voltage.
1. Non-reversing, single-speed type, unless shown otherwise on the drawings.
  2. Full voltage, across-the-line type for motors 40 HP and smaller. Furnish reduced voltage (wye-delta) type for motors 50 HP and larger.
  3. 2-speed, two windings type starter when motor two-speed operation is required by Division 22 & 23. Provide internal time delay relay for transition from high to low speed.
  4. Size motor-starters rated 208 volts as follows. Refer to mechanical and geothermal drawings for actual motor sizes:
    - a. 1/2 HP to 3 HP: NEMA Size 0.
    - b. 5 HP to 7.5 HP: NEMA Size 1.
    - c. 10 HP: NEMA Size 2.
    - d. 15 HP to 25 HP: NEMA Size 3.
  5. Enclose each motor starter in a suitable metal enclosure, type NEMA 1 for dry indoor locations and type NEMA 3R for wet or outdoor locations (or where shown with a "WP" subscript).

D. Manual Starters

1. Manual Starters: Toggle-switch operated starter with thermal overload protection in each phase. Include the following accessories and features:
  - a. Quick-break operation mechanism.
  - b. Silver contacts.
  - c. Pressure-type terminal contacts.
  - d. Bi-metallic overload device.
2. Enclose each motor starter in a NEMA standard enclosure suitable for the environment in which the starter is installed.

2.22 MAIN SWITCHBOARD

- A. The switchboard shall be of the free standing deadfront, front accessible, totally metal enclosed externally operable type, and shall consist of an assembly of standardized vertical sections, each having rigid frame construction of heavy gauge formed steel. Each section shall be thoroughly rustproofed, primed and painted to provide an overall even appearance. Adjacent vertical sections shall be arranged for bolting together. Welded construction will be permitted only for individual vertical sections. Switchboards shall include all protective devices and equipment as listed on the drawings with the necessary interconnections, instrumentation and control wiring. All switchboard sections shall align on front and rear. Provide service entrance label and provide necessary applicable service entrance features per NEC and local Code requirements. The switchboard assembly shall be UL listed for integrated short circuit rating exceeding the "Power System Studies" but shall be as a minimum rated for 65,000 amps RMS symmetrical 480VAC, 3 phase, 60 Hertz.
- B. Its arrangement shall be such that their lowest current carrying parts are at least 12 inches above finished floor, and its height is no more than 90 inches.
- C. It shall comply with the latest applicable standards of NEC, NEMA, and UL having all main overcurrent and switching devices individually mounted and front accessible only. All branch overcurrent and switching devices shall be individually compartmentalized and shall be front accessible only.
- D. The distribution sections shall be segregated compartmentalized into barriered feeder breaker compartments section in the front, barriered bus section in the middle and barriered cable connection sections in the rear of the switchboard from a cross sectional view. The load side of the feeder breakers shall be bussed "run back" connected to the cable connection section.
- E. It shall have complete bussing suitable for main service supply characteristics.
- F. Polyester resin fiberglass barriers shall be thick enough for adequate mechanical strength, but in no case less than 1/4 inch. Openings on barriers allowing for the passage of bussing or cables from section to section shall be sealed tightly around the bus bars or cables with an approved, non hygroscopic, arc resistant high dielectric sealing material.
- G. It shall have a ground bar consisting of tin plated copper bar sized per N.E.C. but shall be minimum 1/4 inch by 2 inch run along the switchboard for its entire length. The ground bar shall be fastened and bonded to each vertical framing member of the

switchboard. The ground bar shall be bussed to the neutral bar with a disconnect bar link in the service entrance compartment.

- H. Switchboard bussing shall be suitable for the main service utilization characteristics and ampacity. Bussing shall be tin plated copper and shall conform to the following:
1. No individual bar shall be of a thickness of more than 1/4 inch. Where necessary for current capacity, multiple parallel bars shall be used. Parallel bars shall be separated by copper spacers or washers maintaining a spacing equal to bar thickness.
  2. Exclude divergent routing of electrically paralleled bars.
  3. Connections shall be made up with cadmium plated steel bolts and nuts utilizing "Belleville type" washers.
  4. The current density across bolted contact surfaces of bars shall not exceed 200 amps per square inch. Bolted contact surfaces of bars shall be silver or tin plated.
  5. Bracing protective devices shall be such as to withstand short circuit stresses equivalent to the switchboard integrated short circuit rating.
  6. Bussing designated as mains shall be run for the full extent indicated without reduction in size.
  7. Neutral bussing shall be sized at 200%.
  8. Neutral bussing shall extend the same length as the main phase bussing with which it is associated.
  9. Bars rather than those used for final individual tap connections to device stubs shall be mounted so that no uninsulated current carrying part (bus bar, nut, bolt, connector) is less than 2" from other such parts or ground. Individual tap connections shall be spaced in accordance with industry standard practice.
  10. Main bussing as indicated on the drawings with an ampere designation shall be sized based on UL and NEMA temperature rise.
  11. Each neutral bus shall be properly drilled and tapped for each outgoing feeder requiring a neutral connection.
  12. "Spaces only" for future overcurrent protection and switching devices shall be bussed for the maximum device that can be fitted into them. All hardware needed for installation of future device shall be supplied at this time.
  13. Bussing and arrangement of overcurrent and switching devices shall be bussed for the maximum device that can be fitted into them.
- I. Molded Case Circuit Breakers:
1. Main breaker shall be insulated case, spring assisted powered, stationary power breaker with ambient insensitive microprocessor digital true RMS sensing for long time, short time, instantaneous, and ground fault adjustable trip functions and integral ground fault test capability in compliance with NEC 230-95. all trip settings shall be adjustable.
  2. All breakers shall have available interrupting current (AIC) rating shall meet or exceed the switchboard assembly UL listed integrated short circuit rating.
- J. Transient Voltage Surge Suppression System (TVSS)
1. TVSS shall be listed in accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors, and UL 1283, Electromagnetic Interference Filters. The TVSS shall meet ANSI/IEEE C62.41 Category C3 classification for service

entrance protection with a maximum single impulse current rating of 240kA per phase.

K. Digital Power Meter

1. Equal to Eaton Power Xpert PXM 350 series digital power meter shall be true RMS type power monitor with features to record and communicate remotely the AC amperes on each phase, voltage, harmonic distortion, watts, volt amperes, bars, power factor, frequency, demand watts, demand volt ampere and watt hours; and capable of providing alarm status for phase loss, phase on balance, phase reversal and fully compatible with the building energy management system. Meter shall be networked with all other meters in panelboards and switchboard. Meter shall be capable of connecting to building Ethernet LAN and shall support Modbus RTU, and Modbus TCP. The meter shall be integrated into the switchboard with factory installed and wired current transformers. The meter shall be networked with all other panelboard digital meters.
2. Provide the services of factory authorized technician for the metering package to program system as directed by the Town of Fitchburg.
3. Provide manufacturers network gateways, equal to Eaton PXG 900.
4. Cable: RS 485 cable, 4 pair, #22, twisted shielded, plenum jacket.

L. Manufacturers capable of meeting the specifications are:

1. Eaton, Square D, General Electric

M. All breakers 1200 ampere frame and above shall include arc flash reduction maintenance system. The ARMS shall be enabled/disabled via switch built into the front of the switchboard. Provide blue indicating lights.

## 2.23 PANELBOARDS

- A. Provide UL-listed safety dead front lighting and power Panelboards where shown on Drawings and as scheduled. Panelboards shall meet or exceed requirements of NEMA Standard Publication PB-1, and UL-50 and 67. Provide cabinets with flush hinges and combination catch and lock. Provide wiring gutters to accommodate large multiple feeder cables and lugs. Except as shown otherwise on Drawings, wiring gutters shall be at least 4 inch for 208 V panels. Buses shall be copper. Short circuit rating of panels shall be 42K amp IC unless otherwise indicated on the drawings.
- B. All panelboards up to 84x shall be single vertical tub type.
- C. Provide molded case, bolt-on, thermal-magnetic trip, single, two or three pole branch circuit breakers as shown on Drawings. Multiple pole breakers shall be single handle, common-trip, multi-handles and ties will not be accepted. All circuit breakers shall have short circuit rating (AIC) of the panel. Series rated are not acceptable.
- D. Main buswork of panels shall carry at least full rating of feeder over current device that supplies panel.
- E. Provide separate neutral ground bus for each panelboard. Neutral bus shall be insulated from panel enclosure. (Provide oversized neutral where indicated).
- F. Provide separate equipment ground bus for each panelboard. Ground bus shall be insulated from panel enclosure.

- G. Power and lighting panels shall have heavy-duty continuous, section vertical-hinged to box section for access to wiring gutters in addition to trim door.
- H. Provide surface metal tubs ready for painting mount panels on 5/8" outdoor plywood.
- I. Provide bus connections for future overcurrent device with suitable insulation and bracing to maintain proper short circuit rating and voltage clearances, where required on Drawings. Provide for ready insertion of future breaker.
- J. Provide typed panel directories, secured to inside of panel doors that show use of each circuit and electrical characteristics of panelboard.
- K. Integral Digital Meter: Provide integral digital meter where indicated on the power riser diagram. Meter shall be equal to Eaton Power Xpert PXM 350 series, true RMS type power monitor with features to record and communicate remotely the AC amperes on each phase, voltage, harmonic distortion, watts, volt amperes, bars, power factor, frequency, demand watts, demand volt ampere and watt hours; and capable of providing alarm status for phase loss, phase on balance, phase reversal and fully compatible with the building energy management system. Meter shall be networked with all other meters in panelboards and switchboard. Meter shall be capable of connecting to building Ethernet LAN and shall support Modbus RTU, and Modbus TCP. The meter shall be integrated into the panelboards with factory installed and wired current transformers. The meter shall be networked with all other panelboard digital meters and the switchboard.
  - 1. Provide the services of factory authorized technician for the metering package to program system as directed by the Town of Fitchburg.
  - 2. Provide manufacturers network gateways, equal to Eaton PXG 900.
  - 3. Cable: RS 485 cable, 4 pair, #22, twisted shielded, plenum jacket.

## 2.24 ENCLOSED CIRCUIT BREAKERS

- A. Molded case, bolt-on, thermal-magnetic trip, single, two or three pole branch circuit breakers as shown on Drawings. Multiple pole breakers shall be single handle, common-trip, multi-handles and ties will not be accepted. All circuit breakers shall have short circuit rating (AIC) of the panel. Series rated are not acceptable.
- B. Provide NEMA 1 enclosure for circuit breaker.
- C. For circuit breakers indicated for elevator controllers, provide auxiliary Contact Kit consisting of two NO/NC (Form "C") auxiliary contact(s), arranged to activate when circuit breaker in the OFF position.

## 2.25 DISCONNECT SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. For switches indicated for elevator controllers and where indicated on drawings, provide auxiliary Contact Kit consisting of two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

## 2.26 ELECTRIC VEHICLE CHARGING STATION

- A. Freestanding pedestal, dual bollard charger, AC Level 2, 208 V, 7.2kW, 30A running current, 40A circuit breaker, network communications for payment, NEMA- 4X exterior housing, 23 foot cable Equal to Chargepoint CT4021-GW1 CPCLD-COMMERCIAL CPSUPPORT- ACTIVE CT4000-INSTALLVALID.
- B. SAE J1772 2010 EV conductive charge coupler
- C. NFPA- 70 National Electrical Code-, Article 625 Electric Vehicle Charging System
- D. UL- 2231 personnel protection systems for EV charging circuits
- E. UL 2594 EV supply equipment (outline of investigation)
- F. UL 1998 software in programmable components • CSA- C22.2 No. 107.1 • FCC compliant

## 2.27 DRY TYPE THREE PHASE TRANSFORMERS

- A. Provide indoor, ventilated, dry type, 3 phase transformers with primary delta high side rated for 480 volts and a wye connected low side rated for 120/208 volts, 3 phase, 4 wire, grounded neutral or as indicated.
- B. Transformers shall have copper windings.
- C. They shall have full capacity taps above and below normal as follows:

<u>Transformer Rating</u>	<u>Taps</u>
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15 KVA and less	Two-5% - FCBN
30 KVA and above	Two-2-1/2% FCAN and 4-2-1/2% FCBN

- D. Up to and including 15 KVA they shall be suitable for wall mounting. Larger than 15 KVA, shall be suitable for platform mounting.
- E. They shall have sheet metal casings which are coated inside and out with a rust inhibiting primer and finished with a factory coat of enamel.
- F. Floor or wall supported transformers shall be resiliently isolated from the building structure by means of neoprene vibration isolators.
- G. Ceiling supported transformers shall be resiliently suspended by means of spring hanger rod isolators providing.
- H. They shall be designed so that the full load temperature rise does not exceed 150oC, over a 40oC ambient for 15 KVA and above and 115oC for 3 KVA to 15 KVA sizes. The insulation system shall conform to NEMA ST20 Standards for a 220oC UL component recognized insulation system for 15 KVA and above and 185oC for below 15 KVA.
- I. Submit manufacturers certification that 75oC operating temperature wires connecting to their terminals will not be damaged under full load conditions if the ambient temperature is maintained at 40oC.
- J. Submit manufacturers certification that the sound outputs of transformers do not exceed the following levels based on NEMA standard testing procedures:



<u>TRANSFORMER RATING</u>	<u>DECIBEL SOUND OUTPUT</u>
9	40
15	45
30	45
45	45
75	50
112-1/2	50
150	50
300	55

- K. The center tap or neutral of the load side transformer windings shall be bonded to a lug and bolt inside the transformer casing. The bolt shall extend outside to serve as a system grounding stud. The bond to the bolt shall have an ampere capacity of no less than 20% of the capacity of a load side phase winding.
- L. All dry-type transformers where indicated on the drawings or herein specified shall be electro-statically shielded type, UL listed K factor transformers, rated K-4 minimum. UL listed K-4 rated transformers shall be listed for 115°C average temperature rise. K-Factor listed transformers rated at 150°C rise shall not be acceptable
- M. K-4 rated transformers shall have an impedance range of 3% to 5% and shall have a minimum reactance of 2% in order to help reduce neutral current when supplying loads with large amounts of third harmonic current.
- N. Submit manufacturers certification that peak excitation currents do not exceed twelve times full load current for transformers 30KVA and larger or thirty two times full load for transformers less than 30 KVA.
- O. Install transformers in accordance with the following:
  - 1. Wall or floor mount transformers 15 KVA and less. Floor mount transformers larger than 15 KVA.
  - 2. Make any required changes to transformer tap connections in accordance with instructions issued by the Engineer in the field.
- P. Dry type transformers shall be manufactured by Square D, Cutler Hammer, or General Electric.

## 2.28 ENGINE GENERATOR SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide diesel generator set of one of the following:
  - 1. Caterpillar Tractor Co.
  - 2. Onan Corp; Div of McGraw-Edison Co.
  - 3. Waukesha-Engine Div; Dresser Industries Inc.
- B. Furnish and install one (1) emergency and optional/standby electric generating system rated for continuous standby service as shown on the drawings. Voltage shall be 480 volts, 3 phase, 4 wire at 60 hertz. The system shall be a package of new and current equipment consisting of:
  - 1. A 4 cycle diesel engine driven electric plant to provide emergency electric power.
  - 2. Start stop control system.

3. Automatic and manual load transfer controls to provide automatic starting and stopping of the unit and switching of the loads.
  4. Mounted accessories as specified.
  5. Remote annunciator panel.
  6. Generator housekeeping concrete pad.
  7. Exhaust system and insulation.
  8. Sub-base fuel Storage system and piping.
- C. This system shall be built, tested and shipped by the manufacturer so there is one source of supply and responsibility. The performance of the electric plant shall be certified by an independent testing laboratory as to the plant's full power rating, stability and voltage and frequency regulation. Submit certificate of compliance with shop drawings. Furnish detailed summary of testing of unit of this rating in accordance with NFPA-110.
- D. The supplier of this equipment shall maintain a full time "in-house" parts and service organization within 100 miles of the job site. The manufacturer of this set shall have a minimum of five (5) years of experience in building similar units in this part of this country. This supplier shall have his name, address, and telephone number clearly and visibly located on all equipment. Service shall be available on a 24 hour a day, 7 day a week basis. The supplier shall be authorized by the engine generator manufacturer to provide service and warranty for all generator components.
- E. The operation of this unit shall be automatic such that upon the closing of a remote starting contact, the engine shall start and attain rated voltage and frequency within ten (10) seconds.
- F. Engine
1. The diesel engine shall be water cooled, 4 cycle industrial type with removable cylinder liners, 1800 rpm type. Other than 1800 rpm type engines or engines which utilize reduction from a higher rpm down to 1800 rpm shall not be approved.
  2. Lubrication shall be a full pressure system, using an engine driven gear type lube oil pump with replaceable element full flow lube oil filter. Lube oil cooler shall be provided.
  3. The engine mounted fuel system shall include all equipment normally supplied and recommended by the generator set manufacturer for emergency generator service. The engine mounted fuel system equipment shall include the following:
    - a. Fuel injection system.
    - b. Fuel transfer pump.
    - c. Duplex fuel filters (replaceable type).
    - d. Hand priming pump.
    - e. Flexible fuel connections.
    - f. In addition to the engine mounted fuel system, there shall be a sub base fuel tank system. The fuel tank system shall be a 1500 gallon UL listed tank, pressure tested, double walled, trim line construction, sub base fuel tank. All piping and venting shall be completed by the housing manufacturer prior to shipment. Tank system shall comply with all state and local codes. Provide one (1) full tank of fuel after testing at the completion of the project for each generator.

4. Governor: The engine shall be equipped with a hydraulic/electronic isochronous governor capable of maintaining the engine speed from no load to full load within plus or minus .25% of the synchronous speed.
  - a. Starting system: The engine shall have a 24 VDC starting system with starting motor and starter solenoid switch.
  - b. Batteries: One set of starting batteries with cables and steel battery rack and heater shall be included for each starter. Batteries shall be sized for operation at 20oF.
  - c. Batteries shall be heavy duty lead acid type, rated not less than 210 ampere hours each.
  - d. A float type battery charger shall maintain the starting batteries at full charge. The charger shall be suitable for wall mounting and shall have a cranking disconnect relay or current limiting feature. The charger shall be Charles AE2420, Lamarche A46 or equal. The charger shall have high and low voltage alarm relays, and have 20 amp output.
  - e. There shall be a belt driven battery charging alternator with regulator and charge rate ammeter for charging the batteries while the engine is running.
  - f. Heaters:
    - (1) Engine jacket water heaters and thermostats shall be provided to maintain the engine jacket water a temperature high enough to assure starting the engine and attaining rated voltage and frequency within 10 seconds. The jacket heaters shall be of the capacity recommended by the engine generator manufacturer to meet above conditions. Input voltage to the heaters shall be 208 volts, 1 phase, 60 cycles.
    - (2) Battery heater shall be thermostatically controlled and shall keep battery at optimum temperature for both operation and battery life.
5. Engine Cooling System:
  - a. Engine shall be provided with 130oF ambient unit mounted radiator. Radiator shall have sufficient capacity to dissipate not less than total British thermal units per hour rejected at 100% full load under the condition specified. Filler cap shall be designed for pressure relief.
  - b. Cooling system shall be provided with initial charge of permanent type anti freeze solution containing rust inhibitor.
  - c. Water cooled manifold shall be furnished.
6. The engine shall be equipped with safety shutdown contacts for:
  - a. Low lube oil pressure, prewarn and shutdown.
  - b. High jacket water temperature, prewarn and shutdown.
  - c. Overspeed.
  - d. Overcrank
  - e. Low water level, prewarn.
  - f. Low water temperature, prewarn.
- G. Generator Control Panel: The following electrical instruments and devices shall be included in the generator control panel:

1. Digital metering with:
  - a. voltmeter.
  - b. Ammeter.
  - c. KVAR meter.
  - d. power factor meter.
  - e. KW meter.
  - f. RWH meter.
2. Line circuit breakers.
3. Auto start circuitry.
4. NFPA 99 alarm and shutdown system.
5. Emergency stop pushbutton.
6. Provide programmable protective relay functions for under and over voltage and frequency, reverse power, overcurrent (phase and total), KW, and 3 spare LEDs.
7. The following engine instruments shall be included in the generator control panel:
  - a. Lube oil pressure.
  - b. Water temperature.
  - c. D.C. voltmeter.
  - d. Tachometer.
  - e. Any other instruments and devices considered necessary by the Manufacturer shall be included.

#### H. Exhaust System

1. An exhaust silencer suitable for critical type silencing (complete with condensate drains) shall be supplied of the size recommended by the generator set manufacturer. Silencer shall be equal to Maxim Model M51. An octave band center frequency, in hertz, data sheet shall accompany all muffler shop drawings. Silencer shall include side inlet and companion flanges, nuts, boxes, and gaskets.
2. A section of seamless, flexible stainless steel exhaust piping of the size and type recommended by the generator set manufacturer.

#### I. Mounting

1. The engine and generator shall be close coupled and mounted on a structural steel base designed to maintain proper alignment of the unit.
2. The unit shall be certified by the manufacturer to be free from any critical torsional vibrations within a range of plus or minus 10% of synchronous speed.
3. Vibration isolators of spring type shall be supplied with the unit. The number of isolators shall be as recommended by the generator set manufacturer, and shall be mounted within the enclosure.
4. Vibration isolators shall be Ace Mountings or equal.

#### J. Generator

1. Rating as shown on the drawings and with the following characteristics.
2. Type revolving field, 4 pole, single bearing, drip proof, 93% efficiency at nameplate rating.
3. Exciter - brushless, direct connected, fully tropicalized, SCR rectifiers, static voltage regulator, rheostat, excellent motor starting capability.

4. Voltage Regulation - Plus or minus 1/2% of any preset value over the three phase load range. Instantaneous voltage dip or rise when measured with an oscilloscope, will not exceed 20% upon full load application, and will return to preset value within 0.5 seconds. Voltage regulator shall be three phase sensing, provide volts/hertz regulation, provide overvoltage and undervoltage protection, and shall include a solid state circuit to remove excitation when generator is overloaded for more than 10 seconds.
5. Waveform: Deviation factor of output voltage will not exceed 5% and the value of any individual harmonic will not exceed 2% of the fundamental when operating with an unbalanced load.
6. Temperature Rise - Temperature rise of any component will not exceed the rise permitted by NEMA standards.
7. Rotor: One piece lamination welded and secured to shaft by a key and press fit. Amortisseur windings installed and connected between poles as an aid to parallel operation and improve wave form during unbalanced loads. Field coil machine wound on insulated pole body and securely braced. Rotor statically and dynamically balanced.
8. Stator - One piece lamination welded together. Stator coils from wound and placed in insulated slots. Starter pressed and welded in a rigid steel frame.
9. Bearing - Double sealed ball bearing, lubricated for life.
10. Insulation - NEMA Class F insulation.
11. Varnish - Three coats modified polyester type, will not support fungus growth.
12. Cooling - Cast aluminum fan mounted on generator shaft.
13. Radio Suppression - Radiated or conducted radio interference will not affect normal commercial apparatus.

K. Remote Annunciator Panel

1. The engine generator shall be supplied with a flush mount remote annunciator panel with face plate, mounted to annunciation terminal strip, to give remote indication of the following:
  - a. Generator power.
  - b. Battery charger malfunction (red).
  - c. Annunciator "off" (red).
  - d. High jacket water temperature (prewarn - amber) (shutdown - red).
  - e. Low water temperature (prewarn amber).
  - f. Low oil pressure (prewarn - amber) (shutdown - red).
  - g. Low fuel/rupture.
  - h. Overspeed (red).
  - i. Overcrank (red).
  - j. Lamp test switch.

L. Load Bank

1. Permanent, outdoor, weatherproof, remote-controlled, forced-air-cooled, resistive unit capable of providing a balanced 3-phase, delta-connected load to generator set at 30 percent rated-system kW capacity.
2. Load bank shall be radiator mounted and integrated into generator enclosure.
3. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive

- on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases.
4. Load Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.
  5. Load-Bank Enclosures: NEMA 250, Type 3R, complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with 1/2-inch- (13-mm-) square, galvanized-steel mesh.
  6. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.
  7. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.
  8. Provide all power and control wiring between load bank and generator as required for complete operation.

M. Weatherproof Housing

1. The entire generator set shall be enclosed in a weatherproof enclosure constructed of aluminum throughout. The housing shall be designed to accommodate heavy snow loads and shall be equipped with motorized intake and exhaust louvers, pre-wired prior to shipment. Housing shall be Pritchard Brown #9930 or equal by Briggs & Stratton, Caterpillar or generator manufacturer, and shall be constructed per BOCA requirements and certified by a Structural Engineer Registered in the Commonwealth of Massachusetts.
2. Housing shall have (5) hinged, lockable, keyed alike doors with stainless steel hardware. The doors shall be so arranged as to provide access to vital parts of the generator set for service. Oil pan well and oil drain extension shall be included. Coolant drain and oil drain shall be extended outside housing with lockable rustproof valves.
3. Housing shall be prepainted with aluminum exterior, finish as selected by the Designer at the time of submission. Interior shall be anodized aluminum. Floor of enclosure shall be 3/16" diamond plate backed by 3/4" plywood for rigidity.
4. Housing shall include sound attenuation with thickness and type of sound insulation and intake and exhaust baffles necessary to achieve a sound level of 70 dB at 50'-0" in any direction. There shall be no puretone. Walls and ceiling shall be lined with perforated aluminum liner. Intake louvers shall be located on opposite sides of enclosure. Complete exhaust system shall be furnished, installed/insulated and mounted within the housing, by Housing Manufacturer prior to shipment.
5. Housing shall be equipped with indoor/outdoor, incandescent fixtures with lamps and on/off switch to operate on normal power or generator power and a DC lighting unit to operate on generator battery. DC lights shall have time switch.

6. Housing shall be completely wired prior to shipment including circuit breaker panelboard and step-down transformers, wired to battery charger, jacket water heaters and lighting. Service shall be 120/208V, 3 phase, 4 wire, 60 amp (minimum).
  7. Diesel fuel base tank shall be mounted beneath enclosure and prepiped and vented in accordance with UL prior to shipment.
  8. Provide minimum ten foot stainless steel exhaust stack including all supports.
- N. Submit detailed generator pad requirements with shop drawings. Refer to plans for minimum requirements.
- O. Quality Assurance
1. The supplier of the equipment shall provide with no additional charge and information or supervision required for the proper installation of the equipment and training of operating personnel.
  2. Tests:
    - a. Preliminary start up and operating tests of the generator system with the building load shall be conducted for one (1) hour duration to assure that the system is complete and in proper working order, that all adjustments have been made, and that all deficiencies have been corrected.
    - b. Engine alarm and shutdown features shall be function tested, including low oil pressure, high water temperature, overspeed and low water level.
    - c. Final tests to be witnessed by the A/E shall be scheduled only after preliminary tests have been successfully completed.
    - d. Upon completion of the preliminary test on the unit, a test run of three (3) hours duration shall be conducted by the equipment manufacturer's factory trained servicemen. At this time, adjustments shall be made for correct operation of the equipment and the following readings taken at 15 minute intervals:
      - (1) Ambient temperature
      - (2) Engine jacket water temperature
      - (3) Generator temperature
      - (4) Oil pressure
      - (5) Battery charger rate
      - (6) AC volts (all legs)
      - (7) AC amps (all legs)
      - (8) Engine air exhaust temperature
      - (9) Decibel readings with sound meter at 50 feet in all directions
- (a) This test shall be made with the door to the enclosure or room in which the generator is locked maintained in the closed position. The test shall be made by of a load bank sized at the full kilowatt rating of the generator. This load bank shall be furnished by the supplier of the engine generator unit and shall be connected to the generator terminals as one complete and full unit of kilowatt load. This load bank shall be applied to the generator terminals only after the generator has reached its full voltage output.

- P. Provide complete maintenance and service contract for period of 36 months from date of Substantial Completion. Price of maintenance and service contract shall be included in the Bid. Maintenance and service contract shall include the following:
  - 1. Regular lubrication, adjustment, cleaning, and check-up.
  - 2. Repair/replace worn parts at no cost to Owner.
- Q. Provide exhaustible materials and supplies not covered by warranty under maintenance contract.
- R. Include provision for 24 hour a day, seven day a week service with service response within two hours after first notification and need for service.
- S. The engine manufacturer shall provide the necessary lube oil for the crankcase and antifreeze for the cooling system to provide protection to -20°F.
- T. The Generator Distributor shall have an ISO 9002 Certified Quality Program in order to be considered as an acceptable supplier. Details of the Quality Certification shall be included with the Approval Submittal Documentation.

## 2.29 AUTOMATIC TRANSFER SWITCH

- A. Furnish the automatic transfer switches to automatically transfer between the normal and emergency power source.
  - 1. The automatic transfer switches covered by these specifications shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, U.L., IEEE and NEMA.
- B. General
  - 1. The automatic transfer switch shall be furnished as shown on the drawings. Voltage and continuous current ratings and number of poles shall be as shown.
  - 2. 35kAIC interrupting rating.
  - 3. On 3 phase, 4 wire systems, utilizing ground fault protection, a true 4 pole switch shall be supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
  - 4. The transfer switch shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12 gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.
  - 5. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.
  - 6. The transfer switch shall be top and bottom accessible.
  - 7. The main contacts shall be capable of being replaced without removing the main power cables.
  - 8. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
  - 9. All bolted bus connections shall have Belleville compression type washers.
  - 10. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
  - 11. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600 volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers



12. The switch shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.
13. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

C. Automatic Transfer Switch

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.
2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.
3. The transfer switch shall be equipped with a safe manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.

D. Automatic Transfer Switch Controls

1. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have a real time clock with Nicad battery back-up.
2. The CPU shall be equipped with self diagnostics with a watchdog/power fail circuit
3. The controller shall have password protection required to limit access to qualified and authorized personnel.
4. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.
5. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
6. The controller shall be capable of storing the following records in memory for access either locally or remotely:
  - a. Number of hours transfer switch is in the emergency position (total since record reset).
  - b. Number of hours emergency power is available (total since record reset).
  - c. Total transfer in either direction (total since record reset).
  - d. Date, time, and description of the last four source failures.
  - e. Date of the last exercise period.
  - f. Date of record reset.

E. Sequence of Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

F. Automatic Transfer Switch Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.
6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.

12. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.
13. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant, programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.
14. Two auxiliary contacts rated 10 Amp, 120 volts AC shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.
15. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.
16. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
17. A LCD readout shall display normal source and emergency source availability.

G. Service

1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.
2. The manufacture shall include an 800 telephone number, for field service contact, affixed to each enclosure.
3. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum 20 years.

2.30 MANUAL TRANSFER SWITCH (STORM SWITCH)

- A. The Manual Transfer Switch or Storm Switch shall be provided to allow temporary connection of a portable generator to allow maintenance on building's permanently installed generator.
- B. Manual transfer switch shall consist of (2) two mechanically-interlocked molded case circuit breakers, cam-style male connectors, power distribution block and grounding terminals, all housed within a padlockable enclosure.
- C. Manual transfer switch enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated galvaneal steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via a) drawn flange cable entry openings in the bottom of enclosure for wall mount units, or b) hinged lower door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication; color shall be wrinkle gray RAL 7035.
- D. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground, and shall also be provided for neutral if required. Each of the phase cam-style male connectors within the enclosure shall be factory-wired to a molded case circuit breaker. The ground cam-style

male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. The neutral cam-style male connectors, if required, shall be factory wired to a power distribution block. None of the cam-style male connectors shall be accessible unless both molded case circuit breakers are in the "OFF" position and the main access door is open.

- E. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.
- F. Molded case circuit breakers shall be UL Listed and the short circuit interrupt rating shall be a minimum of 35kAIC at 480VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall be fed from utility power; the other molded case circuit breaker shall be fed from the cam-style male connectors to supply power from a portable generator. Both molded case circuit breakers shall include UL Listed door-mounted operating mechanisms, preventing the opening of the main access door unless both breakers are in the "OFF" position. Both molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (2) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only one breaker can be closed at any given time.
- G. Manual transfer switch shall be suitable for use as service equipment in the USA as defined by the NEC.

#### 2.31 EPO PUSHBUTTON

- A. Push button shall be maintained contact, with lift up cover, turn-to-reset illuminated light "Emergency Stop" label, equal to STI Stopper series SS20A9ES-EN.

#### 2.32 PENETRATION FIRE STOPPING

- A. Basis of design: 3M™ Fire Barrier Sealant CP 25WB+.
- B. High-performance, intumescent latex-based sealant, non-halogen formula. Approved for the majority of caulk through penetration systems.
  - 1. Firestop tested up to 4 hours in accordance with ASTM E 814 (UL 1479).
  - 2. Acoustic barrier: STC-Rating of 54 when tested in a STC 54-rated wall assembly
    - Provides L-Rating (smoke seal).
  - 3. Intumescent: expands when heated to seal around items consumed by fire.
  - 4. Re-enterable/repairable.
  - 5. Halogen-free and no-sag formulation.
  - 6. Over 600 tested and listed systems.
  - 7. One-part system: no mixing or measuring required.
  - 8. Red color widely recognized as a firestop for inspections.
  - 9. High caulk rate: 1000g/min. with 1/4 in. nozzle opening.
- C. Owner's Project Manager will hire third party independent testing agency to perform destructive testing in line with requirements of the 9th edition of the building code. Trade contractors should include repair of destructive test penetrations after testing is complete. All partitions and floor assemblies are to be considered rated for the purpose of sealing penetrations.

### 2.33 SHORT CIRCUIT PROTECTION COORDINATION ARC FAULT STUDY

- A. Provide overcurrent device time-current coordination analysis to determine appropriate ampere ratings and settings for overcurrent protective devices to effect time and current coordination among devices, for maximum system protection and electrical service continuity.
- B. Short circuit study shall be provided prior to release of any switchboards, distribution panels, and/or panelboards.
- C. Short circuit study shall include:
  - 1. Power company's system characteristics.
  - 2. Base quantities selected.
  - 3. Impedance source data.
  - 4. Calculation method and tabulations.
  - 5. One line diagrams and impedance diagram.
  - 6. Conclusions and recommendations.
- D. Short circuit tabulations shall include fault impedances, X/R ratios, asymmetry factors, cable data, transformer data, and symmetrical and asymmetrical fault currents.
- E. Short circuit momentary duties, when applicable and interrupting duties shall be calculated on basis of assumed fault at each unit substation, switchboard, motor control center, distribution panel, lighting and/or power panel and other significant locations throughout system.
- F. Coordination studies shall include time-current curves graphically indicating coordination proposed for several systems, and centered on full-scale log-log paper. Time-current coordination graphs shall include:
  - 1. Complete Titles.
  - 2. Representative protective device curves and legends.
  - 3. Associated power company's relay or system characteristics.
  - 4. Significant motor starting characteristics.
  - 5. Complete parameters for power, network, and/or substation transformers.
  - 6. Complete operating bands for switchgear or switchboard, circuit breaker trip devices, for fuses, if applicable, and for associated system load protective devices.
  - 7. Transformer damage curves and magnetizing inrush points.
  - 8. Appropriate NEC and ANSI protection points.
- G. Coordination plots shall define types of protective devices selected, proposed coil taps, time dial settings, and pick-up settings required.
- H. Whenever possible, low voltage circuit breakers shall be separated from each other and associated primary protective device by 16 percent current margin for co-ordination and protection from secondary line-to-line faults.
- I. Ground fault coordination study shall indicate recommended time and current setting for each ground fault protective device and for proper coordination between mains and feeder protective devices, and between mains and tie breaker as applicable.

### 2.34 WOOD POLE WITH PRIMARY FUSED CUTOUTS

A. Wood Poles:

1. Wood pole shall be 30 overall length with a minimum burial depth of 5' 6".
2. ANSI O5.1; treated Southern Pine poles of minimum length as shown on the drawings, Class 2 minimum.
3. Select poles for straightness and minimum sweeps and short crooks.
4. Supply and install poles with wood preservative to meet the AWPAs U1 "utilization use category "UC4B" The pole supplier shall mark the pole in accordance with AWPAs requirements to indicate the preservative and use category.

B. Cross Arms

1. Cross-arms and Timbers: Straight-grained Southern Pine, free of twists to within 0.1 inch per foot of length, with bends and twists in only one direction.
2. Cross-arms and timbers shall be supplied with wood preservative treatment to meet the AWPAs U1 "utilization use category "UC4B". The supplier shall mark the cross-arms and timbers in accordance with AWPAs requirements to indicate the preservative and use category.
3. Cross-arm Dimensions: 4.25 x 5.25 inches x 9 feet.

C. Pole Hardware

1. Miscellaneous Pole Hardware: Hot-dipped galvanized after fabrication.
2. Cross-arm Braces: Structural steel zinc coated to ASTM A675.
3. Angle Braces: 60-inch span x 18 inches drop-formed in one piece from 1-3/4 x 1-3/4-inch angle.
4. Flat Braces: 1/4 x 1-1/4 inch.
5. Eye Bolts and Nuts: ANSI C135.4.
6. Anchor Rods and Nuts: ANSI C135.2.
7. Bolts and Nuts: ANSI C135.1.
8. Eye nuts and Eyelets: ANSI C135.5.
9. Ground Rods: ANSI C135.30.
10. Butt Plate: Copper.
11. Bolt-type Insulator Pins: ANSI C135.17.
12. Pole-top Insulator Pins: ANSI C135.22.
13. Spool Insulator Bolts: ANSI C135.31.
14. Hot-Line Clamps: Screw type with concealed threads. Fill thread chamber with corrosion-resistant compound.
15. Secondary Racks: Furnish with spool insulators.
16. Guy Strand: High strength 7-strand steel cable galvanized to ASTM A475, Class A or B.
17. Guy Termination: Automatic type.
18. Guy Guards: 8-foot long galvanized steel, colored yellow.
19. Ground Wire: Soft drawn copper conductors, 6 AWG minimum size.

D. Fused Cutouts

1. Fuse Cutouts: ANSI C37.42; drop-out, expulsion fused heavy-duty cutouts rated.
  - a. 14.4 kV nominal, 15 kV maximum, 110 kV BIL, 200 amperes RMS continuous, 12,000 amperes interrupting asymmetrical at 60 hertz.
2. Fuse links suitable for use in the above specified fuse cutouts. Fuse links rated: "K" speed

## PART 3 - EXECUTION

### 3.1 UTILITY REBATE FORM

- A. Fill out all utility rebate forms for Utility prescriptive rebate programs. This shall include lighting fixtures and controls. Arrange a meeting with Utility prior to submitting shop drawings for lighting equipment to discuss eligibility. Produce shop drawings which include all eligibility requirements for equipment. Before substantial completion of the project, or as recommended by Utility, submit rebate forms and arrange payment to the Owner. Obtain all necessary information from the owner to secure rebates.

### 3.2 SPECIAL RESPONSIBILITIES

- A. Coordination: Coordinate work of this Section with work of other Sections.
  - 1. Perform work so that progress of project, including work of other Sections, is not delayed.
  - 2. Provide information about items furnished under this Section to be installed under other Sections, as necessary.
  - 3. Obtain detailed information from manufacturers of equipment provided under this Section as to proper methods of installation.
  - 4. Obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or by Owner.
  - 5. Keep fully informed of shape, size and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
  - 6. Coordinate installation and pay back charges to city building and fire department.
- B. Maintenance of equipment and systems: Maintain Electrical equipment and systems until final acceptance by the Engineer and/or Owner, and ensure adequate protection of equipment and material during delivery, storage, installation and shutdown conditions. Responsibility shall include provisions required to meet conditions incidental to delays pending final test of systems and equipment under seasonal conditions.
- C. Use of premises:
  - 1. As required, during progress of work, remove and properly dispose of resultant dirt and debris, and keep premises reasonably clean. When work is complete, remove equipment and unused material and do cleaning and washing required, to provide acceptable appearance and operation of equipment.
  - 2. It shall be this electrical contractors' responsibility to store his materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
  - 3. Do not interfere with function of existing sewers and water and gas mains. Prevent debris from entering conduit. Confer with the Engineer as to disruption of electric services or other utilities because of testing or connection of new work to existing.
- D. Inspection by Architect: Periodic inspections by Architect or designated agent shall not be construed as supervision of actual construction, nor make either responsible for

providing safe place for performance of work of various trades or suppliers, or for visitors or occupants, or make either responsible for omission of safety devices called for by codes, ordinances, or specifications of equipment manufacturer.

E. Surveys and Measurements:

1. Base horizontal and vertical measurements on reference points established by Construction Manager and be responsible for correct laying out of work.
2. In the event of discrepancy between actual measurements and those indicated, notify Architect in writing and do not proceed with work until written instructions have been issued by Architect.

F. Fireproofing:

1. Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed before start of spray fiber work.
2. Work that interferes with proper application of fireproofing shall be installed after completion of spray fiber work.
3. Patching and repairing of spray fireproofing due to cutting or damaging to fireproofing during course of work of this Section shall be performed by installer of fireproofing and paid for under this Section.

G. Temporary Utilities: Refer to requirements of Division 1 regarding temporary facilities.

H. Unload electrical materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving electrical equipment on-site, in building or on roof.

I. Refer to NEC requirements for mounting heights of switches and circuit breakers. Do not exceed 6-1/2 ft. above finished floor or platform.

J. Mount groups of electrical equipment or devices in same area (that is, switches, receptacles, and other devices) on common centerlines aligned horizontally and vertically.

### 3.3 MATERIALS AND WORKMANSHIP

A. All receptacles and switches shall be flush mounted in wall, including all masonry walls, unless otherwise indicated.

B. Work shall be rectilinear and shall run perpendicular or parallel to general construction. Wiring shall be run concealed unless specified otherwise. Exposed conduit shall run flush to structure, parallel or perpendicular to walls. Install material and equipment according to manufacturer's recommended best practice so that complete installation operates safely and efficiently.

C. Except as specified otherwise, material or equipment specified and shown on Drawings shall be new and shall meet requirements of latest standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA and applicable NFPA documents, and shall be UL-approved where applicable.

D. Despite references in Specifications or on Drawings to material or piece of equipment by name, make or catalog number, such reference shall be interpreted as establishing standards of quality for materials and performance.

E. Finish of materials, components and equipment shall not be less than industry good practice.



- F. Owner will not be responsible for material and equipment before testing and acceptance.

### 3.4 TESTING, INSPECTION AND CLEANING

- A. The Commissioning Agent will observe startup and trade contractor testing of the below systems and equipment. Coordinate the startup and trade contractor testing schedules with the Engineer and Commissioning Agent. Provide a minimum of two (2) weeks prior notice.
  - 1. Generator system including ATS
  - 2. Lighting Control System
  - 3. Metering equipment and systems
  - 4. Fire Alarm System.
  - 5. Equipment in Division 27 and 28.
- B. Test and inspect work provided under this Section as required by Contract Documents, codes, standards and authorities that have jurisdiction, to satisfaction of the Authority's site personnel. Notify Architect and authorities at least 48 hours before testing or inspection. Do not cover work before testing or inspection.
- C. Employ the services of an independent Authority - approval testing company to perform specialized testing and to provide written certification for acceptance of specialized equipment and/or systems.
- D. Furnish Architect with certificates of testing and inspection for electrical systems, indicating approval of authorities that have jurisdiction and conformance with requirements of Contract Documents.
- E. Test wiring and connections for continuity and grounds before fixtures are connected; demonstrate insulation resistance by Megger test as required. Insulation resistance between conductors and grounds for secondary distributions systems shall meet NEC requirements.
- F. Verify and correct as necessary: voltages, tap settings, trip settings and phasing on equipment from secondary distribution system to points of use. Test secondary voltages at panelboards, and at other locations on distribution systems as necessary. Test secondary voltages under no-load and full-load conditions.
- G. Test lighting fixtures with specified lamps in place for 10 hours; check fixtures in sections. Do not operate lamps other than for testing before final inspection by Architect. Replace lamps and fixtures that fail within 90 days after acceptance by Architect within Contract Price.
- H. Provide necessary testing equipment and testing.
- I. Failure or defects in workmanship or materials revealed by tests or inspection shall be corrected promptly and retested. Replace defective material.
- J. After completion of project, clean the exterior surface of equipment included in this section, including concrete residue.

### 3.5 NAMEPLATES

- A. Provide nameplates in or on panelboards, junction boxes and cabinets, and for special purpose switches, motor disconnect switches, remote control stations, starters or other

controls furnished or installed under this Section. Nameplates shall designate equipment controlled and function.

- B. Nameplates shall be a minimum of 3 inches long by 1-1/2 inches wide, with white face and black lettering screw on type. No adhesives will be allowed.

### 3.6 WIRING METHODS

- A. Review architectural plan and reflected ceiling plans to determine extent of new ceiling and wall construction.
- B. Install wire and cable in approved raceways as specified and as approved by authorities that have jurisdiction. Surface metal raceways shall not be used unless explicitly specified and shown on Drawings. Do not use surface raceways on floor.
- C. Conduits installed on the interior of the exterior building walls shall be spaced off the wall surface a minimum of 1/4" using "Clamp-backs" or struts.
- D. All receptacles, switches and other devices on new walls, including masonry walls shall be flush mounted.
- E. Wire from point of service connection to receptacles, lighting fixtures, devices, equipment, outlets for future extension, and other electrical apparatus as shown on Drawings. Provide slack wire for connections. Tape ends of wires and provide blank covers for outlet boxes designated for future use. Do not install electrical outlets back to back on opposing sides of partitions.
- F. Conductors #10 and smaller in branch circuit panelboards, signal cabinets, and signal control boards, shall be bundled. Conductors larger than #10 in pull boxes shall be labeled in individual circuits.
- G. Two or more conduits installed instead of single conduit shall contain duplicate conductors, including neutrals and ground conductors where required; total capacity of duplicate conductors shall be at least equal to capacity of conductors replaced.
- H. Follow homerun circuit numbers shown on Drawings to connect circuits to panelboards. Where circuit numbers are indicated on devices but homerun symbols are not indicated, interconnect devices and provide homerun to panel indicated from nearest device. Connect each branch circuit homerun with two or more circuits and common neutral to circuit breaker or switch in three-wire or four wire branch circuit panelboard so that no two circuits are fed from same bus.
- I. Install connectors and couplings as recommended by manufacturers. Compression fittings shall not be used with rigid steel, intermediate metallic or aluminum conduit.
- J. Install sealing fittings at following points, and elsewhere as shown:
  - 1. Where conduits enter or leave hazardous areas equipped with explosion proof lighting fixtures, switches, receptacles, and other electrical devices.
  - 2. Where devices are called out on the drawings as explosion proof ("XP")
- K. Conduit in concrete shall be PVC, minimum Schedule 40. EMT shall not be installed underground, in slabs on grade, in wet locations, in hazardous areas, or for circuits operating at more than 600 V. Buried metallic conduit shall be rigid galvanized steel. Run conduit in slabs above bottom steel reinforcing, below top reinforcing and inside beam stirrup, wall reinforcements and column ties.

- L. Submit proposed penetrations points, size openings and penetration methods for approval.
- M. Provide flexible conduits for connections to electrical equipment and to equipment furnished under Division 21, 22, and 23 that are subject to movement, vibration or misalignment; where available space dictates; and where noise transmission must be eliminated or reduced.
- N. Provide cast metal outlet boxes for wet locations, corrosive locations, all locations where RGS conduit is required and for devices called out on drawings as explosionproof (“XP”) NEMA FB 1, ferrous alloy, Type FD, with gasketed cover
- O. Run concealed conduit and EMT in as direct lines as possible with minimum number of bends of longest possible radius. Run exposed conduit and EMT parallel to or at right angles to building lines. Ends shall be free from dents or flattening.
- P. Unless specified or shown on Drawings, install conduit and EMT concealed. Provide stand-off clips for conduits on exterior masonry walls.
- Q. Install conduit systems complete before drawing in conductors. Blow through and swab after plaster is finished and dry, and before conductors are installed.
- R. Expansion/Deflection Fittings: Conduit buried or secured rigidly on opposite sides of building expansion joints, seismic joints, and long runs of exposed conduit subject to stress shall have expansion fittings. Fittings shall safely deflect and expand to twice distance of structural movement.
- S. Provide separate external copper bonding jumper secured with grounding straps on each end of firing.
  - 1. Conduits buried in concrete shall cross building expansion joints at right angles; provide expansion fittings as required by manufacturer's instructions. Provide insulated bushings at ends of conduits.
- T. For all empty conduits called out on drawings, provide plastic bushings on conduit ends and pullstrings.
- U. Attach pull ropes to conductors with basket-weave grips on pulling eyes. Pull cables that share conduit at same time.
- V. Provide inserts, hangers, anchors and steel supports as necessary.
- W. Provide pull boxes, sized per Code for job conditions as necessary.
- X. For each device include costs of up to 75’ of associated wiring in EMT or surface metal raceway to FACP, fire alarm circuit, or unswitched portion of light circuit as appropriate. For the 10 data devices assume each device has a single data outlet and extend up to 200’ of cabling for each outlet back to a IDF and terminate on patch panel.

### 3.7 PANELBOARD MOUNTING

- A. Where panelboards and other cabinets are mounted to stud and gypsum construction, provide unistrut spanning studs for mounting support.

### 3.8 INSTALLATION OF LIGHT FIXTURES

- A. Do not install fixtures until work of other trades that may damage fixtures is completed.
- B. Investigate lighting fixture locations and supports to ensure that no interference exists with hangers, ducts, sprinklers, pipes and other equipment.
- C. Do not suspend or support lighting fixtures or safety chains from conduit or duct. Support fixtures with threaded rod from structural members only.
- D. Provide unistrut below ducts where fixture locations coincide with duct runs. Provide threaded rods to support unistrut.
- E. Patch spray-on fireproofing damaged during installation.
- F. Support surface-mounted luminaries at least two concealed points to prevent rotation.
- G. Mounting height of suspended or wall-mounted luminaries shall be shown on Drawings.

### 3.9 UNDERGROUND CONDUITS

- A. Steel conduits in ground or on vapor barrier shall be field coated with asphaltum or shall have additional outside factory coating of polyvinyl chloride or phenolic resin epoxy material or other equally flexible and chemical resistant material. Couplings and damaged areas of coated conduits shall be field coated with same compound as conduits. Joints shall be threaded.
- B. Joints in conduits and fittings shall be watertight and shall meet requirements of manufacturer's installation recommendations. Threaded portions of steel conduits not encased in concrete, and adjoining ends of conduits, couplings and fittings, shall be coated with asphaltum after installation. Connections between conduits of different types shall be made in approved manner, using adapters and other materials and methods recommended by conduit manufacturers.
- C. Where nonmetallic underground conduit enters building and continues inside to pull box, cabinet, or other electric apparatus, portion through floor or wall and within building shall be rigid galvanized steel. Provide adapter below floor or outside wall to connect plastic and metal conduit.
- D. Where underground conduit enters building through membrane waterproofed wall or floor, provide malleable iron seal with gland assembly and adjustable pressure bushings secured to masonry construction with one or more integral flanges. Membrane waterproofing shall be secured to device in watertight manner.
- E. Where underground conduit without concrete envelope enters building through non-waterproofed wall or floor, provide schedule 40 galvanized pipe sleeve. Fill space between conduit and sleeve with suitable plastic expansible compound or oakum and lead joint on each side of wall or floor.
- F. Excavation, shoring, bracing, backfilling and grading will be provided under Division 2. Trenches shall be evenly graded so that conduits slope uniformly at least 3 inches per 100 feet, without horizontal or vertical waves.

### 3.10 SLEEVES

- A. Provide Schedule 40 steel sleeves as required. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of conduit or cable.

- B. Fill for floor penetrations shall be fire-resistant, compatible with floor material and finished to prevent passage of water, smoke and fumes. Fill in walls shall be similar to wall material, shall be fire-resistant in fire walls, and shall prevent passage of air, smoke and fumes.
- C. Identify unused sleeves and slots for future installation.
- D. Lay out conduit and openings in advance, to permit provision in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.
- E. Sleeves for conduits that penetrate outside walls, basement slabs, footings and beams shall be waterproof.

### 3.11 MOTORS, CONNECTIONS AND CONTROLS

- A. Provide motor starters where indicated on the drawings. Refer to mechanical drawings for motor sizes and provide motor starters sized according Motor Starter paragraph.
- B. Provide and wire motor disconnect switches except as specified or indicated on Drawings.
- C. Motors 1/2 hp and larger shall be as scheduled; motors less than 1/2 hp shall be 120 V, single phase, 60 Hz, unless shown otherwise on Drawings.
- D. Mount motor starters on new 3/4 inch exterior grade plywood mounting board finished to match starter enclosures. Mount boards 60 inches above finished floor on solid walls or columns in spaces not normally occupied.
- E. Check electrical connections and sizing of motor circuit protection and prevent damage to motors and equipment from incorrect direction of rotation.
- F. Consult Drawings and Specifications and shop drawings for verifications of size, speed and operation for motors furnished under this Section and other Sections.
- G. Final connection to motors shall be made with flexible conduit (at least 16 in. long) with green ground wire installed.

### 3.12 GROUNDING

- A. Provide equipment grounding system meeting all requirements of the NEC. Refer to plumbing and civil drawings for incoming piping required to be grounded by the NEC. Equipment grounding system shall be designed so metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits operate continuously at ground potential and provide low impedance path for possible ground fault currents
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- D. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- E. System shall meet NEC requirements, modified as shown on Drawings and as specified.
- F. Provide separate green insulated equipment-grounding conductor for each single or three-phase feeder and each branch circuit. Install grounding conductor in common conduit with related phase or neutral conductors, or both. Parallel feeders installed in more than one raceway shall have individual full size green insulated equipment ground conductors.
- G. Determine number and sizes of screw terminals for equipment grounding bars in panelboards and other electrical equipment. Provide screw terminals for active circuits, spares and spaces.
- H. Provide green insulated grounding conductor in nonmetallic conduits or ducts unless specified otherwise.
- 3.13 INSTALLATION OF EQUIPMENT

- A. Avoid interferences with structure and with work of other Sections. Preserve adequate headroom and clear doors and passageways, and as required by codes. Installation shall permit clearance for access to equipment for repair, servicing and replacement.
- B. Install equipment to distribute equipment loads properly on building structural members provided for equipment support under other Sections. Roof mounted equipment shall be installed and supported on structural steel provided under other Sections.
- C. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall or ceiling mounting of equipment provided under this Section as shown on Drawings and as specified.
- D. Provide steel supports and hardware for proper installation of hangers, anchors, guides, and other devices.

- E. Provide catalog cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.
- F. Structural steel and hardware shall meet ASTM Standard Specifications requirements. Use of steel and hardware shall meet requirements of Code of Practice of American Institute of Steel Construction.
- G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that nullifies warrantee. Report in writing to Architect, before purchase or shipment of equipment involved, on conditions that may prevent proper installation.
- H. Repair damage to galvanized coatings with approved aluminum paint.

### 3.14 TRAINING

- A. Include training requirements for Generator, Fire Alarm, Lighting Control, EV charging station, Metering. Training shall be recorded and shall include a minimum of (2) 8 hours instruction for each system. Schedule all training sessions with Fitchburg Schools, include “off hours” as required to meet Fitchburg personnel schedules.

### 3.15 CLARIFICATION OF WORK RESPONSIBILITIES RELATED TO ELECTRIC SERVICE

- A. Service to the new Crocker School will be primary metered via a pad mounted transformer to be rented from UNITIL.
- B. Existing overhead 13.8kV primary services will be utilized to serve the new Crocker School.
- C. Electrical subcontractor shall be responsible for the following:
  - 1. Coordinate with UNITIL utility company for delivery of pad mounted transformer to be rented by Fitchburg.
  - 2. Coordinate with UNITIL the installation of the pad mounted transformer.
  - 3. Utility riser pole with fused cutouts per UNITIL standards.
  - 4. Primary service conduits from pad mounted transformer to and up riser pole per UNITIL standards.
  - 5. Primary cables from transformer to overhead services at riser pole including all termination under the supervision of UNITIL.
  - 6. Secondary service conduits from transformer pad to main switchboard, concrete encased.
  - 7. Secondary service cables from transformer to main switchboard including all terminations. Terminations at the pad mounted transformer shall be under the supervision of UNITIL.
  - 8. Per construction schedule, coordinate with UNITIL the disconnecting of the electric service to the existing Crocker School, including removal of all existing underground services for complete demolition of the existing school.
- D. UNITIL utility company will be responsible for the following:
  - 1. Replacement of existing riser pole presently serving the existing Crocker School.
  - 2. New riser pole(s) to extend existing overhead primary service to new riser pole by electrical subcontractor.
  - 3. Primary metering.

4. Supervision of primary and secondary cable terminations by electrical subcontractor.

### 3.16 WOOD POLE INSTALLATION

- A. Plug unused holes in poles using treated wood dowel pins. Treat field-cut gains and field-bored holes with preservative.
- B. Cut gains on face of pole, with gained surfaces in parallel planes.
- C. Shorten poles when required by cutting from top end. Apply AWPA rated wood preservative, rated for the AWPA specified utilization category of the pole, to the shortened end of pole.
- D. Dig setting holes large enough to permit use of tampers to full depth. Place earth in maximum 6-inch layers and pack to 45 percent density.
- E. Rake poles located at corners, angles, and dead ends so that poles are vertical after line installation.
- F. Set the cross-arms at right angles to line for straight runs; and to bisect the angle of turns in line direction.
- G. Provide two braces for each cross-arm.
- H. Mount 30' pole to a minimum depth of 5' 6" in normal firm ground, measured from lower side of pole

END OF SECTION