

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. All basic instructions of the project including scope and project electrical requirements.

1.2 RELATED SECTIONS

- A. All of the Division 26 Sections relate.

1.3 QUALIFICATIONS

- A. Electrical Contractor shall be established with a minimum of 10 years in the area with a minimum of five years experience in general electrical work and working knowledge of electrical requirements of the California Electrical and Energy Codes.
- B. All electrical equipment shall be of a manufacturer as specified or approved equal.

1.4 REFERENCES

- A. California Electrical Code 2019 Edition
- B. California Building Code 2019 Edition
- C. California Mechanical Code 2019 Edition
- D. California Fire Code 2019 Edition.

PART 2 - SCOPE AND PROJECT ELECTRICAL REQUIREMENTS

2.1 PROVISIONS

- A. The General Conditions, Supplemental Conditions and Division 1, General Requirements, are a part of this section and the Contract for this work and apply to this Section as fully as if repeated herein.

2.2 SCOPE

- A. Provide all labor, materials, tools, plant equipment, transportation and perform all operations necessary for and completion of all electrical work whether specifically mentioned or not; all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof. Some of the items of work specified herein are as follows.
 - 1. Study work and related drawings and specifications of all other crafts whose work abuts, adjoins, or in any manner is affected by work of this Section. Consult with other trades and with them expedite and coordinate material and labor to avoid omissions and delays.
 - 2. Complete system of 208/120 volt, three phase, four wire, wiring distributions including all branch circuits and outlets as shown on the drawings.

3. Provide all labor and materials to perform demolition and/or remodel of areas shown on the drawings. Work to include removal of equipment as shown on electrical and mechanical plans.
 4. Excavation, backfill, framing and other associated work required for the installation of the electrical systems.
 5. Submission of shop drawings.
 6. Record drawings.
 7. Tests.
 8. Prepare day-by-day record of "as built" changes as specified hereinafter.
- B. WORK NOT INCLUDED: The following work as outlined is not included in the Electrical Contract; however, this Contractor shall cooperate with the other contractors involved and shall be responsible to give complete directions on sizes of openings, locations, etc., and to insure that the completed electrical installation shall be of good workmanship and in accordance with drawings and specifications.
1. Equipment or work indicated "NIC" or "By others."

2.3 QUALITY ASSURANCE

- A. QUALIFICATIONS OF INSTALLERS: For the actual fabrication, installation and testing of the electrical work, use only personnel who are thoroughly trained and experienced in the skills required and who are completely familiar with the manufacturer's recommended methods of installation, the equipment to be utilized, and the requirements of this work.
- B. PERMITS AND ORDINANCES: Comply with all codes, ordinances, and authorities having jurisdiction, including all local ordinances, the California Electrical Code, and the California Building Code. Electrical Contractor shall procure and pay for all licenses, etc. required to carry on and complete the work. Additionally:
1. Comply with pertinent requirements of Underwriters' Laboratories, incorporated for all items installed for which UL standards have been established.

2.4 REVIEW SUBMITTALS

- A. MATERIALS LIST: Submit to the Architect for review, a complete materials list covering all materials to be furnished under this Section. This submittal shall specifically include:
1. Panelboards.
 2. UPS.

3. Basic electrical materials.
 - B. For ease of maintenance and parts replacement, to the maximum extent possible use equipment of a single manufacturer. The Architect reserves the right to reject any Materials List which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers and to require that the source of materials be unified to the maximum extent possible.
 - C. When specific names are used in connection with materials, they are used as standards only, but this implies no right upon the part of the Contractor to use other materials or methods unless approved as equal in quality and utility by the Architect in writing and in accordance with provisions for substitutions previously stipulated in these specifications.
 - D. Shop drawings and all supporting data shall be submitted as instruments of the Contractor. Contractor shall place his stamp on each sheet of submittal documents, thereby stating that the equipment meets all requirements of the conditions. At least one set of submittals shall have check marks at each item indicating that the Contractor has verified compliance with the above requirements.
 - E. Should the original submittal of a proposed substitution be rejected, the specified item shall be furnished.
 - F. Panelboard submittals shall be arranged to show bussing circuit numbers with respective branch circuit devices similar to schedules on drawings. Switchboard and motor control center submittals shall show elevations indicating layout of devices, metering, etc. Device ratings, circuit numbers and nameplates shall be in table form. Terminal cabinet submittals shall include elevations with terminal strip mounting arrangement.
 - G. Unless otherwise shown or specified, material shall be new, full weight, standard, the best quality of its' kind and satisfactory to the Architect. Materials shall be stored and protected as necessary and/or required by the Architect, and the Contractor shall be entirely responsible for damage or loss from any cause. Unless otherwise shown or specified, major equipment shall be the product of a manufacturer who has for a period of not less than five (5) years, been in successful manufacture of the equipment and who has nationally distributed catalog covering ratings and specifications of said equipment.
 - H. Electrical materials shall bear the label of, or be listed by, the Underwriters' Laboratories unless of a type for which label or listing service is not provided.
 - I. Materials and components shall conform to industrial standards including:
 - N.E.M.A. - National Electrical Manufacturers' Association
 - A.S.A. - American Standards Association
 - A.S.T.M. - American Society of Testing Materials
 - I.P.C.E.A. - Insulated Power Cable Engineers' Association
 - C.B.M. - Certified Ballast Manufacturers
 - J. Samples of fixtures, materials and equipment shall be submitted for approval of Architect if requested.

2.5 PRODUCT HANDLING

- A. DELIVER AND STORAGE: Deliver material in time to insure uninterrupted progress of the work. Materials shall be stored in a manner to preclude damage and permit ready access for inspection and identification of each shipment. Materials shall be kept free from dirt, grease and other foreign matter, and shall be protected from corrosion. Materials showing evidence of damage will be rejected and shall be immediately removed from the work.
- B. PROTECTION: Use all means necessary to protect the electrical work and fixtures before, during, and after installation and to protect the installed work and materials of all other trades.
- C. REPLACEMENTS: In the event of damage to either the work or materials hereunder or the work and/or materials of other trades, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional expense to the Owner.

2.6 JOB CONDITIONS

- A. EXAMINATION OF SITE: Contractor shall be held to have visited the site and satisfied himself as to the conditions under which the work is to be performed. Contractor shall check all existing conditions which may affect the work under this Section. No allowances will subsequently be made on behalf of the Contractor for any extra expense to which Contractor may be put due to any failure or neglect relative to the discovery of conditions affecting the work under this Section.
- B. SPECIFICATION AND CONTRACT DRAWINGS: Accuracy of data given herein and on the drawings are as exact as could be secured, but their extreme accuracy is not guaranteed. The drawings and specifications are for the assistance and guidance of the Contractor and exact locations, distances, levels, etc., will be governed by the building and the Contractor shall accept same with this understanding.
 - 1. Drawings and specifications may be superseded by later detail specifications and detail drawings prepared by the Architect, and the Contract shall conform to them and to such reasonable changes in the Contract Drawings as may be called for by those revised drawings without extra cost to the Owner. Where work called for exceeds code requirements, drawings and specifications shall take precedence.
 - 2. Layouts of equipment, accessories and wiring systems are diagrammatic (not pictorial), but shall be followed as closely as possible. Architectural, structural and other mechanical drawings shall be examined, noting all conditions that may affect this work. Report conflicting conditions to the Architect for adjustment before proceeding with work.
 - 2. Should Contractor proceed with work without so reporting matter, he does so on his own responsibility, and shall alter work if directed by the Architect, at his own expense. Right is reserved to make minor changes in locations of equipment and wiring systems shown, providing change is ordered before conduit runs and/or work directly connected to same is installed and no extra materials are required.

- C. RELOCATION BY OWNER: The Owner reserves the right to make minor changes in locations of equipment, lighting, and any other component of the electrical work under this Section, providing such change is ordered before conduit runs and/or work directly connected to same is installed and no extra materials are required, all at no extra cost to the Owner.
- D. WORKING SPACE: Adequate working space shall be provided around electrical equipment in strict compliance with the Electrical Safety Orders. In general provide six and one half feet (6' - 6") of headroom and thirty-six inches (36") minimum clear work space in front of panelboards and controls for 120 volts and forty-two inches (42") 480 volts.
- E. EQUIPMENT IDENTIFICATION: Nameplates shall be installed on electrical equipment. Equipment to be so labeled shall include the following:
1. Individual enclosures such as disconnect switches, time switches, push buttons, contactors, relays, motor starters, etc.
 2. Group mounted equipment such as panelboards and switchboard.
 3. Individual circuit breakers on switchboards.
 4. Each panel shall be labeled to provide the following information minimum:
 - (a) Panel name.
 - (b) Size of feeder feeding the panel.
 - (c) Rated voltage, amps and phases.

Nameplates shall adequately describe the item and its' function or use of the particular equipment involved. Nameplate material shall be laminated phenolic plastic, black front and back with white core. Engraving shall be through the outer layer. Embossed plastic pressure sensitive labels are not acceptable.

In lieu of plastic plates, device plates shall be engraved directly with lettering filled with black enamel.

Power." Additionally, panels and transfer/bypass switches shall also be labeled "Life Safety Branch", "Critical Power Branch" or "Equipment Branch" as applicable.

- F. ELECTRICAL WORK FOR EQUIPMENT FURNISHED BY OTHERS:
1. Work is shown on drawings according to best information available at time drawings was prepared; but this Contractor shall obtain accurate information on equipment power requirements and connection points from Contractors furnishing the actual equipment and shall install electrical work to suit at no extra cost to Owner. Should Contractor proceed with work without first verifying accuracy of the plans, he does so on his own risk and shall alter work if required at his own expense.
- G. CLEANING: After all work has been accomplished such as sanding, painting, etc., lighting fixtures, panelboards, and switchboards shall be cleaned to remove all dust,

dirt, grease, paint or other marks. All electrical equipment shall be left in a clean condition inside and outside, satisfactory to the Architect.

- H. FLASHING AND SEALING: Flash and counterflash roof and wall penetrations in manner described under other applicable sections of this specification and as approved by the Architect. Conduits, ducts, etc. passing through finished walls shall be fitted with steel escutcheon plates, chrome or paint finish as directed. Conduits which penetrate floor slabs and concrete or masonry walls shall be grouted and sealed watertight at penetration in addition to escutcheon plate trim.
- I. COOPERATION AND COORDINATION: Cooperate and coordinate with other crafts in putting the installation in place at a time when the space required by this installation is accessible. Works done without regard to other crafts shall be moved at the Contractor's expense.

2.7 COMPLETION

- A. Upon completion of work covered by this Contract, furnish the Architect with As-Built plans, as required by the General Conditions, upon which shall be shown all changes of feeders, panels, circuits, light fixtures, etc., within building and installed under this contract, which are not in accord with these drawings for the work. Diazo sepia transparencies will not be acceptable.
- B. In addition, furnish one tracing showing all outside utility lines, transformer pad, pullboxes, etc., installed under this Contract. Locate and dimension all work with reference to permanent landmarks.
- C. All symbols and designations used in preparing "Record" drawings shall match those used in contract drawings.
- D. Properly identify all stubs for future connections, as to locations and use, by setting of concrete marker at finished grade in the manner suitable to the Architect.
- E. GUARANTEE: Acceptance of the Contract for this work includes this guarantee: The Contractor guarantees that he has performed the work in accordance with the Contract Documents. Contractor agrees to replace or repair, as new, any defective work, materials, or part which may appear within one year of final acceptance, if in the opinion of the Architect or the Owner the defect is due to workmanship or material.

Warranties, guarantees, certificates, etc. that are furnished and available for equipment and materials furnished and installed under this Section shall be properly filled out as of the date of the acceptance of the completed work by the Owner and shall be delivered to the Architect.

- F. TESTING: The entire electrical installation shall be free from short circuits and improper grounds. Test all ground fault protection equipment where so provided. Test all wiring and connections for continuity and grounds before any fixtures or equipment are connected and where such tests indicate faulty insulation or other defects, they shall be located, repaired and retested at the Contractor's expense. Electrical load shall be balanced at the panelboards.
 - 1. Demonstrate to the Owner and the Architect, that the entire installation is complete, in proper operating condition and that the Contract has been properly and fully executed. Provide all instruments to make such tests.

- G. ACCEPTANCE BY GOVERNING AUTHORITIES: Upon the completion of the electrical work, and as a condition of its acceptance, this Contractor shall obtain final inspections and acceptance from local building inspection agencies, utility companies, and/or other governing authorities. Deliver to the Owner and the Architect verification of such acceptance.

- H. CLEANING UP: Keep the premises in a neat, safe and orderly condition at all times during the execution of the electrical work. Areas adjacent to the electrical work, both interior and exterior shall be free from accumulations of debris and/or shipping containers and packing. All refuse shall be removed to the area of the job site set aside for its storage.

- I. Operations and Maintenance Manuals:
 - 1. Submit the following prior to final acceptance and request for final payment for Division 26 work, in conformance with the Project Closeout requirements of the General Provisions.
 - a. As-Built Drawings.
 - b. Operation and Maintenance manuals.
 - 2. Provide four complete sets of Operation and Maintenance Manuals including, but not limited to, the following:
 - a. Shop Drawings and Installation, Operation and Maintenance Manuals for all power distribution and control equipment including service and distribution equipment, branch panels, etc.
 - 3. Assemble each set in standard hardback, 3-ring binders. Do not exceed binder fill of 50 percent: i.e., 1-inch thickness of paper in 2-inch binder. Use tabular dividers to organize the materials in the same order as this Specification. Mark each divider according to (sub) section number and name.

PART 3 - EXECUTION

3.1 PREPARATION

- A. REVIEW OF DEVELOPED CONDITIONS: Prior to the installation of any electrical system, under this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where the work hereunder can properly commence.

Verify that all electrical work can be performed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

- B. DISCREPANCIES: In the event of discrepancies, immediately notify the Architect. Do not proceed with the installation of work hereunder in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 EXECUTION

- A. NAMEPLATES: Install engraved nameplates for each electrical device, disconnect control station, etc. Designation shall be as directed by the Engineer. Nameplates shall be securely fastened to the equipment with adhesive.
- B. WEATHERPROOF CONSTRUCTION:
 - a. All wiring or equipment installed exterior to buildings or in wet or damp locations shall be weatherproof construction to suit the service conditions.
 - b. Outlet boxes shall be gasketed; electrical metallic tubing shall have compression type fittings; lighting fixtures shall be designed for exterior installation.
 - c. All exterior mounted equipment shall be corrosion resistant and constructed in accordance with NEMA standards for the service conditions encountered.
- D. STRUCTURAL REQUIREMENTS: Installation under this Section shall comply with the Uniform Building Code and Title 24.
- E. MANUFACTURER'S DIRECTIONS: Follow manufacturer's directions where these directions cover points not included in the drawings or in the specifications.
- F. WORKMANSHIP: Workmanship shall be of the best quality and shall be performed by craftsmen to insure long and trouble-free service. The requirements of the Codes and Safety Orders are minimum standards.
- G. CUTTING AND PATCHING: This Contractor shall be responsible for all cutting and patching required for the installation of the electrical work under this Section. The actual cutting and patching work shall be executed by the appropriate trade involved under the supervision of the General Contractor, but the cost of such cutting and patching shall be borne by this Contractor.
 - 1. Neither holes or notches shall be made in any structural member without the written approval of the Structural Engineer for each specific location.
 - 2. This Contractor shall arrange for, and bear all costs for, all necessary sleeves or openings in masonry, concrete, or other structural elements where such are permitted by the Structural Engineer.
- H. EXCAVATION AND BACKFILL: Perform excavation and backfill required for electrical Installation. Restore surfaces, roadways, walks, curbs, walls, existing underground installations of original condition in an acceptable manner.
 - 1. Excavation: Dig trenches straight and true to line and grade, with bottom smoothed of any rock points. Support conduit for entire length on undisturbed, original earth. Minimum conduit depth of pipe crown shall be twenty four inches (24") below finished or natural grade.
 - 2. Backfill: All backfill material, placement and compaction shall conform to applicable requirements of Site Work, Section 1.

- I. All equipment shall be installed with U. L. labeling and listing.

END OF SECTION

SECTION 26 05 10.01: ELECTRICAL SUBMITTALS

PART 1 - GENERAL

1.1 SUBMITTAL FORM AND PROCEDURES:

A. See Division 01.

1.2 SUBMITTALS REQUIRED:

A. Provide submittals for the following items:

1. Basic Electrical Materials.
2. Panel boards.
3. UPS.
4. See individual sections for additional submittal requirements under that section.

END OF SECTION

SECTION 26 05 19: LOW VOLTAGE ELECTRICAL POWER
CONDUCTORS AND CABLES (600 V AND LESS)

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide electrical materials, installation and testing.

1.02 DESCRIPTION

- A. This section describes requirements for wire and cable.

1.03 RELATED WORK

- A. Section 26 05 33: Raceways and Fittings.

1.04 REFERENCE STANDARDS

- A. IETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; Latest Edition..

1.05 SUBMITTALS

- A. Provide submittals for items listed documenting compliance with specification requirements.
- B. Product Data:
 - 1. Electrical Materials: Manufacturer's current published catalog sheets.

PART 2 - PRODUCTS

2.01 ALL CONDUCTORS AND CABLES

- A. Provide products that comply with requirements of CEC.
- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:

1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B 3, ASTM B 8, or ASTM B 787/B 787M unless otherwise indicated.

H. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code:
 - a. Equipment Ground, All Systems: Green.

2.02 WIRE AND CABLE

A. Conductor: Insulated copper, individual conductors, 98 percent conductivity, stranded.

1. Power conductors, #12 AWG, minimum to #10AWG, stranded.
2. Power Conductors, #8 to 750MCM, stranded.

B. Insulation:

1. Rated 600 volts as follows:

<u>Item</u>	<u>Size (AWG)</u>	<u>Insulation Type</u>
Branch Circuits (except underground)	#12 to #4/0	THWN/THHN-2
Underground Branch Circuits	#12 to #4/0	XHHW-2
Fixture Taps	#12	XHHW-2 or THHN/THWN-2
Feeders (except underground)	#12 to #4/0	THWN/THHN-2
Underground Feeders	to #750 MCM	XHHW-2
	#12 to #750 MCM	XHHW-2
Grounding	All	THHN/THWN-2

2.03 WIRE CONNECTIONS

A. Connect wire to binding post screw, stud, bolt or bus as follows:

1. #10 AWG and smaller conductors, compression type, nylon, self-insulated grip spade lugs, T & B "Sta-Kon", Buchanan "Termend", Panduit "Pan-Term", or equal.
2. #8 AWG to #750 MCM copper conductors, solderless lug type connectors, with hex-head or allen type compression set screws with configuration to suit application, T & B "Locktite", Burndy "QA", OZ Type "XL" or "XLH", or equal.

B. Conductor Taps: #8 through #4 copper conductors, split-bolt, Kearney.

- C. Splice wire as follows:
 - 1. #10 AWG and smaller conductors, twist-on solder-less, insulated spring connectors, 3M "Scotchlocks", T & B "Piggys" or equal.
 - 2. #8 AWG to #750 MCM copper conductors, two-way connectors, OZ type "XW", Burndy or equal.
 - 3. In underground pull-boxes, cast resin epoxy, Scotch.
- D. Size, install and tighten wire terminal and splice connectors in accordance with manufacturer's recommendations.

2.04 TAPE

- A. Wire Splices: Vinyl plastic electrical tape, 8.5-mil and 4.0-mil, Scotch 33.
- B. Conduit Wrapping: 10-mil vinyl wrapping tape, Manville, Minnesota Mining and Manufacturing Company.

2.05 WIRING ACCESSORIES

- A. Identify conductors with self-adhesive vinyl cloth markers, sized to fit the conductor insulation, with machine printed black marking, W.H. Brady, Thomas and Betts, or equal.

PART 3 - EXECUTION

3.01 INSULATED CONDUCTORS AND CABLE

- A. Exercise extreme care when pulling conductors and cable into conduits to avoid kinking, twisting, nicking or scratching of the insulation or the placement of extreme stress on the conductors or cable. When required, utilize UL approved pulling compounds to assist in pulling conductors.
- B. Color code conductors by phase sequence A-B-C when looking into the front of the equipment from left-to-right, top-to-bottom or front-to-back. Provide conductors with the appropriate phase color or mark conductors with a minimum of 6 inches of phase tape on ends connected to terminals. Phase code conductors as listed:

<u>Voltage</u>	<u>Phase A</u>	<u>Phase B</u>	<u>Phase C</u>	<u>Neutral</u>	<u>Ground</u>
120/208	Black	Red	Blue	White	Green
277/480	Brown	Orange	Yellow	Grey	Green
120/240	Black	Red	Orange	White	Green

- C. Identify all conductors with their respective circuit numbers at all boxes and terminals.
- D. Connections:
 - 1. Use twist-on solder-less connectors for splicing receptacle and lighting circuits #10 AWG wire size and smaller.

2. Splice #12 and #10 AWG stranded conductors with compression connectors.
3. Terminate conductors at motors with bolted connections, insulated with plastic tape.
4. For conductor taps #8 through #4 AWG, provide split bolt service connectors.
5. For splices larger than #10 AWG, insulate and smooth the splice with insulation putty, tape with one half-lapped layer of 8.5-mil vinyl plastic electrical tape and two half-lapped layers of 7.0-mil vinyl plastic electrical tape.
6. Use cast resin epoxy splices for splices in underground pullboxes.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section describes requirements for grounding of the power and communications systems.

1.02 DESCRIPTION

- A. Provide all equipment and materials for a complete grounding system.
 - 1. Power System Grounding.
 - 2. Electrical Equipment and Raceway Grounding and bonding.

1.03 RELATE REQUIREMENTS

- A. Section 26 05 33 Raceways and Fittings.
- B. Sections 26 05 19: Low Voltage Cables.

1.04 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA).
- B. American National Standards Institute (ANSI).

1.05 SUBMITTALS

- A. Submit a complete set of marked-up record drawings to indicate installed location of system grounding electrode connections, and routing of grounding electrode conductor.
- B. Submit certified test results stating ground resistance from service neutral at service entrance and separately derived systems.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Thomas and Betts Appleton, Raco, Oz Gedney, Blackburn, or approved equal.

2.02 MATERIALS

- A. Ground Rods: Copper encased steel, 3/4 inch diameter, minimum length - 10 feet.
- B. Ground Clamp: Water pipe connection, bronze two-piece with serrated jaws, lug sized for grounding electrode conductor.
- C. Connectors, Compression Type: Bronze or Copper, pretreated with conductive paste, sized for conductor to which applied.
- D. Connectors, Exothermic Weld Type: Powder actuated weld. Bond made through exothermic reaction producing molten copper from premixed copper oxide and aluminum powder. Form bond in mold or crucible.

2.03 SECONDARY GROUNDING SYSTEM

- A. Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of electrical equipment, metallic raceways systems, grounding conductor in nonmetallic raceways and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment of each service and shall be extended to all required components of CEC Article 250.

2.04 GENERAL BRANCH CIRCUITS GROUNDING

- A. All grounding conductor wire shall be insulated green copper conductors.
- B. All conduit bushings shall be grounding type.
- C. All grounding connections shall be made with solderless lugs and nonferrous hardware.

PART 3 - EXECUTION

3.01 GENERAL BRANCH CIRCUITS AND FEEDERS

- A. All conduit systems, equipment housings, material housings, junction boxes, cabinets, motors, ducts, wireways, cable trays, light fixtures, portable equipment and all other conductive surfaces shall be solidly grounded in accordance with the California Electrical Code to form a continuous, permanent and effective grounding system.
- B. Install a separate green grounding conductor in all conduits, including feeder, branch circuit, and flexible; both metallic and non-metallic. The conduit systems shall not be used as the system equipment grounds. Size all grounding conductors per CEC Article 250 unless a larger ground is indicated on the drawings.
- C. All panelboards, junction boxes, pullboxes, wireways and equipment enclosures shall be bonded to the conduit systems.
- D. Isolated ground receptacles shall have both an isolated ground conductor and a separate equipment grounding conductor.

3.02 SEPARATELY DERIVED SOURCES

- A. All secondary neutrals for the 120/208 volt wye services of dry type transformers shall be grounded to building steel. Connection shall be made with cable sized according to Table 250-94(a) of the California Electrical Code. Extend separately derived insulated ground to the transformer in rigid steel conduit.

3.03 FLEXIBLE RACEWAY GROUNDING

- A. Install a ground conductor inside all flexible raceways (e.g. flexible steel, liquid tight). Bond the conductor to the enclosure or ground bus in the nearest box or access on either side of the flexible section. Size conductor as specified, indicated or required by code, whichever is larger.

3.04 GENERAL GROUNDING REQUIREMENTS

- A. All ground connectors shall be bronze of the clamp type. All clamp accessories such as bolts, nuts, and washers shall also bronze to assure a permanent corrosion-resistant assembly. Connector shall be as manufactured by Burndy Engineering Company, IlSCO Corporation, or equal. Make connections easily accessible for inspection, underground or concealed in floors or walls.
- B. All ground wire shall be insulated, unless otherwise indicated on the Drawings, extra flexible stranded copper cables. Grounding cables installed in earth shall be laid slack.
- C. Lighting and power panelboards shall be grounded by connecting a grounding conductor to the grounding stud and to the incoming and outgoing feeder conduits grounding bushings. Each grounding-type bushing shall have the maximum ground wire accommodation available in standard manufacturer for the particular conduit size. Connection to the bushing shall be with wire of this maximum size.

END OF SECTION 26 05 26

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. Raceways
- B. Conduit Fittings

1.2 RELATED SECTIONS

- A. Section 26 05 19: Low Voltage Cables
- B. Section 26 27 26: Wiring Devices

1.3 REFERENCES

- A. California Electrical Code 2019 Edition

PART 2- PRODUCTS

2.1 CONDUITS AND FITTINGS:

- A. All low voltage wiring shall be in raceways. Raceways shall be run underfloor, in walls, above ceilings or exposed as indicated on drawings. Acceptable raceway systems and their limitations of use are as follows:
 - 1. Rigid Steel Conduit may be used in all areas.
 - a. Standard weight, zinc coated on outside by hot dipping or sheradized process, with either zinc coating or other approved corrosion resistant coating on the inside.
 - b. Fittings shall be threaded and finished similar to conduit. Threadless fittings shall not be used.
 - 2. Electrical Metallic Tubing (EMT):
 - a. Rolled steel, zinc coated outside with either zinc-coating or other approved corrosion resistant coating on the inside.
 - b. Couplings shall be steel, rain compression type Appleton TWC-CS Series or equal.
 - c. Connectors shall be steel raintight compression type with insulated throat Appleton TW-CSI Series, Series or equal. Steel setscrew connectors may be used instead where such use is approved by code.
 - d. Zinc die-cast fittings are not permitted to be used anywhere on this project.
- e. May be used:
 - 1) Exposed along ceiling next to cable trays.
 - 2) Concealed in drywall partitions
 - 3) Concealed above furred ceilings.
 - 4) Exposed in Mechanical rooms.
- f. May not be used:
 - 1) Any location subject to physical damage.
 - 2) Any other areas not listed under (d) above unless specifically otherwise noted on the plans.

3. Flexible Metal Conduit may be used only for indoor final connections to mechanical equipment (not to exceed 36") and final connections to fluorescent lighting fixtures (not to exceed 72").
 - a. Minimum trade size - one-half inch (1/2").
 - b. Connectors - T & B "Tite Bite" insulated.
 - c. Suitable for connection of recessed fixtures, control and mechanical equipment. Not permitted where exposed to weather or other wet or corrosive conditions.
 - d. Length shall be a practical minimum, but to allow for movement of equipment connected without restricting flexibility of conduit.
 4. Liquid Tight Flexible Metal Conduit - Sealtight: May be used only for outdoor final connections to mechanical equipment.
 - a. Minimum trade size - one-half inch (1/2").
 - b. Connectors - Appleton STB Series through two inch trade size and ST Series with insulated bushings over two inch trade size. Appleton, Crouse-Hinds or equal may be used.
 - c. Length shall be practical minimum, but to allow for movement of equipment connected without restricting flexibility of Sealtight.
 5. Poly-Vinyl-Chloride Schedule 40
 - a. Underground
 6. Surface Wiremold
 - a. Shall be used for branch circuits in areas where existing wall or ceiling finishes are not being removed. Surface metal conduits are not acceptable in such cases.
 - b. Shall be metallic, finished, with matches boxes and accessories as Wiremold #V500 or V700, sized per Code for wire fill.
 7. MC Cable not allowed.
 8. AC Cable
 - a. Not permitted on this project.
 9. Type NM, NMC
 - a. Not permitted on this project.
- 2.2 BOXES: Boxes shall be of the shape and size best suited for the particular application and shall be supported directly to structural members, framing or blocking by means of screws, anchors, bolts or embedded in masonry.
- A. Switch and receptacle box shall be one piece drawn steel boxes or stamped steel boxes. Minimum size shall be four inches (4") square. Boxes shall be fitted with flush device covers, plaster rings, or tile switch rings in masonry. In areas where exposed wiring is permissible, boxes shall be fitted with surface type covers.
 - B. Lighting outlets shall be four inch (4") octagon.
 - C. Weatherproof boxes shall be Appleton FD Series and fitted with gasketed cast covers.
 - D. Telephone and television outlet boxes shall be 4-11/16" x 2-1/2" deep minimum, fitted with plaster rings.
 - E. Boxes for special equipment shall be suitable for the particular equipment.
 - F. Boxes shall be located and placed according to architectural and structural requirements.

2.3 FLOOR BOXES

- A. Boxes shall be single service or multi-service as noted on plans.
- B. Boxes shall be provided with all required accessories for a complete and working installation, including trim ring/coverplate.
- C. Provide minimum (2) duplex outlets in the box.
- D. Provide mounting brackets for communications outlets in multiservice boxes.
- E. Boxes shall be suitable for floors in which they are to be installed. Shall be such that covers can be completely closed after both power and data cords have been plugged in.
- F. As manufactured by Wiremold, Hubbell, Steel City or approved equal.

2.4 PULL OR JUNCTION BOXES

- A. Install where indicated, or as required by Code, pull boxes and junction boxes of sufficient size and capacity to facilitate all wiring. Boxes shall be fabricated of code gauge steel and sized to properly accommodate all conductors entering same.

2.4 SUPPORTS:

- A. Furnish all necessary foundations, supports, backing, etc., for all electrical enclosures, conduits and equipment. Attach all boxes, cabinets, etc. to wood with wood or lag screws, to metal with machine screws or bolts and to concrete with expansion anchors and machine screws or bolts.
- B. Electrical lighting fixtures weighing 50 lbs. or more shall not be installed using wood screws for supports to the ceiling. Each such fixture shall have pre-stretched galvanized wires or rods anchored to the roof or structural member of the building.
- C. All hangers and supports shall be designed and constructed for the intended purpose.
- D. Materials shall be as manufactured by Unistrut, Powerstrut, or approved equal.
- E. The use of makeshift materials such as wire or plumber's tape will not be permitted.
- F. Exposed horizontal runs of feeder raceways shall be mounted on trapeze type hangers, secured to the concrete slab with approved type drilled-in-place inserts.
- G. Vertical runs of feeder raceways shall be supported and fastened per Code.

2.5 TERMINAL CABINETS:

- A. Terminal cabinets shall be of panelboard type construction and finish.
- B. Trim shall be fitted with hinged door and flush latch.
- C. Doors shall provide maximum size openings to box interior.
- D. Boxes shall be provided with half inch (1/2") backboard having a two coat insulating varnish finish.
- E. Top of cabinet shall be 6'-6" above finished floor.
- F. Flush terminal cabinet installed adjacent to flush panelboards shall be of the same physical size and trim as the panelboard.
- G. Terminal cabinets shall be as manufactured by B-Line, Hoffman or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF RACEWAYS AND FITTINGS

- A. Conceal raceways within ceilings, walls, and floors except where exposed raceways are specifically permitted.
- B. Where conduit is allowed to be exposed, install the conduit parallel with or at right angles to structural members, walls, and lines of the building.
- C. Install where indicated, or as required by Code, pullboxes and junction boxes of sufficient size to facilitate wiring. Boxes shall be sized to properly accommodate all conductors entering same.
- D. Do not install conduit or tubing, which has been crushed or deformed.
- E. Run conductors of same circuit in same conduit. Run conductors of different voltage systems in separate conduits.
- F. Install no conductors until work, which might cause damage to such conductor or the conduit has been completed.
- G. Keep all conduits at least six inches away from the covering on hot water or steam pipes.
- H. Cap raceway ends during construction. Clean or replace conduits in which water or foreign matter have accumulated, to satisfaction of the Architect.
- I. Conduits shall be supported with straps, with galvanized malleable split ring and rod for individual runs or with Kindorf or Unistrut channel supports for multiple runs. Distance between supports shall not exceed 10 feet for rigid threaded galvanized conduits and concealed EMT Conduit and 5 feet for exposed surface mount EMT conduit. Conduits shall be supported independently of one another.
- J. Conduits run on roof shall be fastened to an ERICO pipe support set on roof, using galvanized double hole straps and screws. Multiple conduit runs shall be gathered neatly in straight liens and fastened individually to the pipe support. Conduits shall not be run on the roof except where specifically noted on the plans or approved by the Engineer and Architect.
- K. Conduits connected to boxes and cabinets shall be fitted with two locknuts and insulated bushing, OA "A" Series.
- L. Conduits not connected with locknuts and bushings shall be fitted with grounding bushing, OZ "BL" Series, U. L. approved and bonded.
- M. Conduit stubs underground shall be capped with coupling, nipple, coupling and plug.
- N. Conduits connected to boxes, cabinets, etc., exposed to weather or in areas subject to excessive moisture shall be fitted with watertight sealing hubs of steel or malleable iron with sealing ring and insulated throat, T & B 370 Series, Efcor 40-50B Series or equal.
- O. Install insulate bushings on each end of steel conduit 1-1/4" and larger.
- P. Conduit straps for individual runs shall be secured by toggle bolts on hollow masonry, expansion shields and machine bolts on solid concrete or masonry, machine screws or bolts on metal surfaces and wood screws on wood construction. The use of nails to anchor straps on wood construction is prohibited. Straps shall be two hole malleable iron or snap-type steel with ribbed back, galvanized or cadmium plated. The use of perforated strap iron or nail type straps is prohibited.
- Q. Placement of all boxes shall be governed by applicable architectural and structural requirements.

- R. Conduit fittings: Except where otherwise noted, conduit fittings shall be Appleton. Unilets shall be malleable iron and fitted with covers and gaskets. Zinc diecast conduit fittings are not approved for use on this project.
- S. Telephone and signal conduit bends where required shall have a radius of ten times the conduit trade size.
- T. Conduit, subject to limitations noted elsewhere in the specifications, may be installed in concrete slab provided prior approval of the Architect is obtained. In such a case, locate conduit in center of slab, unless otherwise instructed. Such conduit shall have an outside diameter less than one-third the thickness of the slab.
- U. Conduits shall be capped during construction.
- V. Provide pull wires in empty conduits. Size shall be #12 TW in conduits 1" and smaller and 3/16 polypropylene rope in conduits 1-1/4" and larger.
- W. Minimum size underground conduit shall be 3/4".

3.2 INSTALLATION OF SUPPORT SYSTEMS:

- A. All conduits and fixtures shall be supported in a firm and secure manner as required by code. Materials shall be secured to the structure by means of suitable clamps and hangers specifically designed for the purpose and using machine screws or bolts on metal or wood screws on wood construction.
- B. Rigid steel conduit shall be supported at intervals not greater than 10 ft, electrical metallic tubing at intervals not greater than 5 ft.
- C. A support shall be provided not more than 3 ft. from any change in direction. Additional supports to those specified above shall be installed where required to suit job conditions and to provide a secure installation. All hangers and supports shall be the products of one manufacturer, as specified in Part 2 of this Section.

3.3 OUTLET, JUNCTION, AND PULL BOXES:

- A. All boxes shall be of sufficient size to contain, without crowding, all wires, connections, and devices which may be required in any particular location. Extra deep boxes shall be provided wherever necessary to meet these requirements.
- B. Use outlet boxes as pull boxes wherever possible.
- C. Provide raised covers as required to suit the type and thickness of wall finish in each location.
- D. When other than outlet boxes are employed, pull boxes and covers shall be galvanized steel, code gauge, sized to accommodate wiring and connections. Locate such junction boxes only in equipment rooms, wire closets, and above accessible ceilings.
- E. All junction boxes shall be fully accessible according to code.

END OF SECTION

SECTION 26 05 37 – BOXES

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide electrical materials, installation and testing.

1.02 DESCRIPTION

- A. This section describes requirements for outlet boxes.

1.03 RELATED WORK

- A.

1.04 REFERENCE STANDARDS

- A. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association;
- B. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association;
- C. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association;
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association;

1.05 SUBMITTALS

- A. Provide submittals for items listed documenting compliance with specification requirements.
- B. Product Data:
 - 1. Electrical Materials: Manufacturer's current published catalog sheets.

PART 2 - PRODUCTS

2.01 OUTLET BOXES

- A. Construction: Deep drawn or fabricated interlocked flat pieces with welded tabs, electro-galvanized sheet steel with electro-galvanized hardware. Do not use sectional boxes.
- B. Size: To accommodate the required number and sizes of conduits, wires, splices and devices but not smaller than the size indicated or specified.
- C. Device Boxes: For single switches and receptacles, provide boxes not less than 4 inches square by 1-1/2 inches deep. For 2 devices, provide boxes not less than 4-11/16 inches square by 1-1/2 inches deep.

- D. Special Mounting: In cabinets, tile, concrete block, brick, stone, wood or similar material, provide rectangular boxes with square corners and straight sides. For single devices, provide boxes 4 inches high by 2-1/2 inches wide by 3-3/8 inches deep. For 2 or more devices, provide multi-gang, non-sectional box with tile or masonry ring.

2.02 PULL AND JUNCTION BOXES

- A. General: For all pull and junction boxes over 300 cubic inches, provide code gauge, sheet steel boxes which meet NEMA 1 standards for panelboard and terminal cabinet box construction, with screw type covers.
- B. Ground Lug: Weld, before finish is applied, a grounding pad drilled for two bolted grounding lugs or two ground studs on the box interior.
- C. Finish: Apply rust inhibiting prime coat and 2 coats of baked enamel, standard factory gray.
- D. Hardware: Cadmium plated steel screws.

2.03 PRECAST CONCRETE BOXES

- A. Provide high-density reinforced concrete pull and junction boxes with end and side knockouts as manufactured by Christy, Forni, Brooks, or approved equal. Fabricated boxes with non-settling shoulders to facilitate maintaining grade during backfilling. Unless noted otherwise, provide galvanized steel checker plate covers with hold-down bolts, identified as follows:

<u>System</u>	<u>Identification</u>
Power - 600 volts or less	Electrical

PART 3 - EXECUTION

3.01 BOXES AND CABINETS

- A. Install junction boxes with covers in concealed areas accessible after installation. Do not install junction boxes flush with finish walls or ceilings unless specifically approved by the Engineer.
- B. Attach surface boxes with:
 - 1. Steel or malleable iron expansion anchors in concrete or solid masonry.
 - 2. Wood screws in wood.
 - 3. Toggle bolts in hollow walls or masonry.
 - 4. Machine screws, bolts or welded studs in steel.

END OF SECTION

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Extent of electrical identification work is as outlined by this specification.
- B. Types of electrical identification work specified in this section include the following:
 - 1. Buried cable warnings.
 - 2. Electrical power conductors.
 - 3. Operational instructions and warnings.
 - 4. Danger signs.
 - 5. Equipment/system identification signs.

1.02 QUALITY ASSURANCE

- A. California Electrical Code (CEC) Compliance: Comply with CEC as applicable to installation of identifying labels and markers for wiring and equipment.
- B. Underwriters Laboratories, Inc. (UL) Compliance: Comply with applicable requirements of UL Standard 969, "Marking and Labeling Systems", pertaining to electrical identification systems.
- C. American National Standards Institute (ANSI) Compliance: Comply with applicable requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems".
- D. National Electrical Manufacturer's Association (NEMA) Compliance: Comply with applicable requirements of NEMA Standard No's WC-1 and WC-2 pertaining to identification of power and control conductors.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's data on electrical identification materials and products.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):
 - 1. Almetek
 - 2. Brady, W.H. Company
 - 3. Calipico Inc.
 - 4. Panduit Corporation
 - 5. Or equal

2.02 ELECTRICAL IDENTIFICATION MATERIALS

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, provide single selection for each application.
- B. Color-Coded Plastic Tape:
 - 1. Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2 inches wide.
 - a. Colors: Unless otherwise indicated or required by governing regulations, provide white tape.
- C. Underground-Type Plastic Line Marker:
 - 1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.
- D. Cable/Conductor Identification Bands:
 - 1. Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.
- E. Plasticized Tags:
 - 1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matte finish suitable for writing, approximately 3-1/4 x 5-5/8 inches, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.
- F. Self-Adhesive Plastic Signs:
 - 1. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
- G. Colors: Unless otherwise indicated, or required by governing regulations, provide black signs with white lettering.
- H. Baked Enamel Danger Signs:
 - 1. General: Provide manufacturer's standard DANGER signs of baked enamel finish on 20-gauge steel; of standard red, black and white graphics; 14 x 10 inches size except where 10 x 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

- I. Engraved Plastic-Laminate Signs:
 1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 2. Thickness: 1/8 inch, except as otherwise indicated.
 3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.03 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

- A. General Installation Requirements:
 1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of CEC and OSHA.
 2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
 3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.
- B. Conduit Identification:
 1. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated use white as coded color for conduit.
- C. Box Identification:
 1. After completion, using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, i.e., A-1, 3, 5. Use a black marker for normal power circuits a red marker for critical circuits, an orange marker for life safety circuits, and a green marker for equipment circuits.
 2. All junction and pull boxes for wiring systems above 600V shall be identified with high voltage warning labels installed every 20 linear feet in accordance with

OSHA standards. All boxes shall also be painted red, see Section 09900 of the specifications.

3. All junction and pull boxes for the fire alarm system shall be painted red. All raceway for the fire alarm system shall be labeled "Fire Alarm" in red letters on intervals not to exceed ten feet.

D. Underground Cable Identification:

1. During back-filling/top-soiling of each exterior underground electrical, signal or Communication conduits, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16 inches, install a single line marker.
2. Install line marker for every buried conduit.

E. Cable/Conductor Identification:

1. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work. Refer to Section 16100 - Basic Materials and Methods of these specifications for color coding requirements.

F. Operational Identification and Warnings:

1. Wherever required or directed by the Architect, to ensure safe and efficient operation and maintenance of electrical systems, including prevention of misuse of electrical facilities equipment by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposed. Request a meeting with the Architect prior to substantial completion to coordinate warning requirements.

G. Danger Signs:

1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations identified by the Architect as constituting similar dangers for persons in or about project. Request a meeting with the Architect prior to substantial completion to coordinate danger sign requirements.
 - a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.
 - b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely

or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

H. Equipment/System Identification:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2 inch high lettering, on 1-1/2 inch high sign (2 inch high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
 - a. Electrical cabinets and enclosures.
 - b. Access panel/doors to electrical facilities.
 - c. Transformers.
2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate. Identification of flush mounted cabinets and panelboards shall be on the inside of the device.
3. Panelboards, individually mounted circuit breakers, and each breaker in the switchboards, secondary unit substations, and distribution panels shall be identified with an engraved plastic laminate sign. Plastic nameplates shall be multicolored laminated plastic with faceplate and core as scheduled. Lettering shall be engraved minimum 1/4 inch high letters.
 - a. Power equipment shall be identified with black faceplate with white core.
 - b. Equipment identification is to indicate the following:
 1. Equipment ID abbreviation.
 2. Voltage, phase, wires and frequency.
 3. Power source origination.

Example:

Panel HC1
480/277V, 3 phase, 4 wire
Fed by DH1

- c. Submit complete schedule with the shop drawings listing all nameplates and information contained thereon.

END OF SECTION

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section describes requirements for panelboards.

1.02 REFERENCE STANDARDS

- A. The Underwriters Laboratory, Inc. (UL).
- B. National Electrical Manufacturers Association (NEMA).

1.03 SUBMITTALS

- A. Submit manufacturers' data and shop drawings in accordance with Section 26 05 00 Paragraph 2.4
- B. Manufacturers Data:
 - 1. Panelboards.
- C. Shop Drawings.
 - 1. Panelboards.

PART 2 - PRODUCTS

2.01 ALL PANELBOARDS

- A. Distribution High Panel- Provide and show a 480/277V panel board with feeders and branch breakers sized for loads and 20% spares and spaces.
- B. Distribution Low Panel- Provide and show a 208/120V, panel board with feeders and branchbreakers sized for loads. Provide 20% spares and spaces.
- C. Provide sub panels with a minimum number of circuits per connected branch circuits with 20% spares and spaces. Provide the next standard size as manufactured.
- D. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- E. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature:
- F. Short Circuit Current Rating: As required where located within the electrical distribution system.

- G. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- H. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- I. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.
- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 3. Fronts: Door in door with piano hinges
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated. Provide master key to Owner.
- L. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions. Ensure Distribution panels have spaces for the largest feeder breaker used.

2.02 BRANCH CIRCUIT PANELBOARDS

- A. General: Provide bussed, circuit breaker type panelboards with main lugs or circuit breaker in flush or surface mounted enclosures as indicated. Provide KAIC rating per short circuit
- B. Construction:
 - 1. Cabinets: Code gauge steel cabinets, deadfront panels, and doors. Fasten deadfront panels to cabinets with concealed trim fasteners. Conceal front door hinges.
 - 2. Dimensions: 20 inches wide by 5 3/4 inches deep.
 - 3. Locks: Flush door locks, keyed alike for all panelboards.
 - 4. Standards: Provide UL label where applicable and conform to No. 67 and 50 Underwriters Laboratories, Inc., and NEMA PB-1.
- C. Bussing:
 - 1. Phase Bus: Silver-plated copper, rated 1000 amperes per square inch cross sectional area maximum, braced for 100,000 rms amperes minimum.
 - 2. Neutral Bus: Copper with lugs for connection of neutral conductors.
 - 3. Ground Bus: Copper with terminals for equipment grounding conductors.

4. Terminals: As specified in Section 26 0519 – Low Voltage Electrical Power Conductors and Cables (600V or Less).
- D. Finish: Degrease, clean, phosphatize, prime, and finish cabinets, deadfront panels, and doors with baked enamel, color ASA-61, or standard factory grey. Galvanized cabinets are acceptable for flush cabinets.
- E. Nameplates:
 1. Provide a nameplate identifying panelboard in accordance with 26 05 00 - General Requirements for Electrical Work.
 2. Provide a manufacturer's nameplate on the deadfront interior panel indicating panelboard type, voltage rating, current rating and manufacturer's name.
- F. Directory: Provide a directory card which fits into slots in the back of the panelboard. Protect directory with non-yellowing clear plastic.
- G. Manufacturer: Eaton (Pow-R-Line 2), General Electric, Square D, Siemens.
- H. KAIC Rating: Per the short circuit calculation. Provide fully rated.
- I. Circuit Breakers:
 1. Provide circuit breakers for miscellaneous branch circuits with frame sizes and ratings as shown on the plans.
 2. Bolt-on, thermal magnetic, molded case, with inverse time current overload, and instantaneous magnetic trips, trip-free and trip-indicating all poles of multi-pole device shall operate simultaneously during open, close and trip operations.
- J. Manufacturer: Eaton (Pow-R-Line 2), General Electric, Square D, Siemens.

2.03 DISTRIBUTION PANELBOARDS

- A. Construction:
 1. Enclosure: Rigid, dead-front, metal enclosed, free standing, bussed structures, bolted together. Provide removable, 12 gauge sheet steel, minimum, screw-on access plates at front, top and rear. Door in Door, with piano hinges, both doors with locks with master key matching all other panels.
 2. Quality control: Provide each vertical section which is composed of UL listed devices with a UL Label. Provide switchboard which conforms to applicable NEMA standards. Test switchboard at factory before delivery.
 3. Dimensions: Varies depending on breakers. Typically 73-1/2" H x 24" W x 11-5/16" D.
- B. Bussing:
 1. Phase Bus: Silver-plated copper, rated 1,000 amperes per square inch cross sectional area maximum, braced for 50,000 RMS amperes minimum.
 2. Neutral Bus: Full-size, copper, with lugs for connection of neutral conductors.
 3. Ground Bus: Half-size, copper, with lugs for connection of ground conductors.
 4. Spacing: Maintain code separation between phases and between phase and ground.

- C. Finish: Degrease, clean, phosphatize, prime and finish all interior and exterior surfaces with baked enamel, color ANSI 61 or standard factory grey.
- D. Nameplates: Provide nameplates for all circuit breakers and manufacturers' nameplate indicating voltage and current rating, switchboard type and shop order number.
- E. Padlocking Devices: Provide for all breakers and switches.
- F. KAIC Rating: Per the short circuit calculation. Provide fully rated.
- G. Circuit Breakers: Provide UL listed circuit breakers in frame sizes 100 through 400 amperes with thermal-magnetic trip units. Provide 200 through 800 ampere frame circuit breakers with either thermal-magnetic interchangeable trip units or electronic interchangeable rating plugs. Provide circuit breakers with toggle-type handles which are trip-free and trip-indicating. All poles of multi-pole device shall operate simultaneously during open, close and trip operations.
- H. Manufacturer: Cutler-Hammer PRL3, 4 or 5, General Electric, Square D, Siemens.

PART 3 - EXECUTION

3.01 PANELBOARDS

- A. Mount panelboard so that the top is 6 feet-6 inches above the finished floor.
- B. Neatly terminate conductors onto breaker, ground bus and neutral bus. Train conductors in an organized grouping with conductors fanning out at the circuit terminals, bundled in the wireways and laced with plastic ties.
- C. Identify all conductors with a circuit number and phase color.
- D. Type all panelboard directories.
- E. Provide a minimum of three (3) 3/4 inch empty conduits for branch panelboards into accessible ceiling space.
- F. Provide insulated grounding bushings on all conduits which enter the cabinet and bond to ground bus.
- G. Install conduits in a vertical line, perpendicular to the cabinet.

END OF SECTION

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wiring Devices

1.2 RELATED SECTIONS

A. Section 26 05 19: Low Voltage Cables

1.3 REFERENCES

A. California Electrical Code 2019 Edition

PART 2 - PRODUCTS

2.1 WIRING DEVICES: Units shall be equal to the devices set forth herein, in standard colors (brown, white, grey, beige, red, or ivory) as selected by the Architect:

A. WIRING DEVICES	LEVITON#	HUBBELL#	P&S#
Single pole switch 15A	1201-2	HBL1201	PS15AC1
Single Pole Switch, 20A	1221-2	HBL1221	PS20AC1
Double Pole Switch 15A	1202-2	HBL1202	PS15AC2
Double Pole Switch 20A	1222-2	HBL1222	PS20AC2
Threeway Switch 15A	1203-2	HBL1203	PS15AC3
Threeway Switch 15A	1223-2	HBL1223	PS20AC3
Duplex conv out 15	5262	HBL5262	5262
Duplex conv out 20A	5362	HBL5362	5362
Isol ground outlet 15A	5262IG	IG5262	IG5262
Isol gorund outlet 20A	5362IG	IG5362	IG5362
Duplex Conv GFI Outlet 15A	6599	GF15	1595L
Duplex Conv GFI Outlet 20A	6899	GF15	2095L

B. All switches on this project shall be rated 15A, U.O.N. on plans.

C. All receptacle outlets on this project shall be 15A, U.O.N. on plans.

D. Single receptacle on an individual 120V, 20A branch circuit shall be rated 20A per CEC 210.21(B)(1).

2.2 DEVICE PLATES

A. All device plates for indoor use shall be smooth nylon or approved equal unless otherwise noted. Color shall match the color selected by Architect in paragraph 2.1 above.

- B. All device boxes which are installed in fire rated wall assembly and are provided with a fire-stopping putty pad shall have a brushed stainless steel coverplate in accordance with the requirements of the putty pad.
- C. Install multiple gang plates where devices are grouped.
- D. Device covers for surface mounted boxes shall be ½" raised steel plates.
- E. Device covers for devices located in damp locations shall comply with CEC 406.8(A).
- F. Device covers for devices located in wet locations shall comply with CEC 406.8(B).
- G. Cover for weather proof outlets and switches shall be as follows:
 - 1. While-in-use coverplates for duplex outlets - Legrand #WICUCAST1
 - 2. WP coverplate for duplex outlet, heavy cast aluminum - Legrand #4510, 4511, 4512
 - 3. WP, Toggle Switch Cover with actuating lever - Legrand #CA1GL
 - 4. WP, Self-Closing Lid over toggle switch - Legrand #CA1GL
 - 5. Dust proof stainless steel cover, not weatherproof - Legrand #WP1, WP2, WP3, #WP2GL(K.KEY)

PART 3 - EXECUTION

3.1 GENERAL

- A. See Section 26 05 00 for Basic Execution methods.

3.2 INSTALLATION OF WIRING DEVICES

- A. Boxes for light switches shall be installed at +48" to top of box. In case device falls inside the line of any change in wall finish, lower the device to be wholly within the lower wall finish.
- B. Boxes for power and communications devices shall be installed at +16" to top of box unless otherwise noted.
- C. Devices on walls above countertops shall be installed 4" above countertop surface or backsplash. Such outlets shall be installed horizontally.
- D. Verify exact location of all outlets with architectural plans, cabinetry, equipment connections, etc, prior to rough-in.
- E. Grounding type receptacles shall be installed with the grounding pin up above the hot and neutral pins.
- F. Outlets installed outdoors shall be provided with coverplates noted in Paragraph 2.2 above.
- G. Outlets installed outdoors, in bathrooms, rooftops and in Kitchen shall be GFI type, except outlets in Kitchen which are dedicated to specific appliances.

END OF SECTION

SECTION 26 28 00 – LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 THIS SECTION INCLUDES

- A. Enclosed Switches/Disconnects.
- B. Circuit Breakers.

1.2 RELATED SECTIONS

- A. Section 26 05 00: Common Work Results for Electrical
- B. Section 26 05 26: Grounding and Bonding System
- C. Section 26 24 16: Panel Boards
- D. Section 26 24 13: Switchboards

1.3 REFERENCES

- A. California Electrical Code 2019 Edition

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES:

- A. Heavy duty, Eaton, Square D, Siemens or General Electric to match manufacturer of the new Panelboards.
- B. Disconnect switches for motor loads shall be horsepower rated.
- C. Disconnect switches installed outdoors or in wet or damp locations shall be weatherproof type and shall comply with NEMA standards for the service conditions.
- D. Disconnect switches shall be fused, rating as required for the service conditions and as required by Code. Fuse rating shall match the highest nameplate rating of the equipment served.
- E. Disconnect switches shall be located within sight of the load served as required by Code.

2.2 FUSES:

- A. Fuses shall be current limiting Buss fuses as manufactured by Bussman Manufacturing Division, McGraw-Edison Co., Class L or T or equal.
- B. Furnish fuses for all fused switches as required.

2.3 CIRCUIT BREAKERS:

- A. Circuit breakers shall be molded case, equipped with arc quenchers, and shall be of the indicating type, providing "On," "Off," and middle "Tripped" positions of the operating handle. Circuit breakers shall be front-connected and shall be removable without disturbing adjacent units or without removing the main bus of the circuit branch connectors. Circuit breakers shall be of the quick-make, quick-break type on manual operation, trip-free with inverse time characteristics secured by the use of bimetallic tripping elements supplemented by a magnetic

trip. All circuit breakers serving multi-wire circuits where two or more poles are required shall have all poles automatically and simultaneously disconnected. Single-pole breakers with handle ties will not be acceptable.

- B. Circuit breakers shall be of the same manufacture as the panelboards and switchboards.
- C. Feeder circuit breakers interrupting capacity shall be coordinated with main circuit breaker rating for the available short circuit current at each switchboard.
- D. Circuit breakers in panelboards shall be bolt-on type as noted, full size, with a minimum interrupting rating of 10,000 amps symmetrical.
- E. The use of tandem or half-size breaker is not permitted.
- F. Circuit breaker feeding power to Fire Alarm Control Panel and Booster Power Supplies shall be red handles, with lock-on device.

PART 3 EXECUTION

3.1 INSTALLATION DISCONNECT SWITCHES:

- A. Provide disconnect switches where shown on the Drawings or where required by code even if not shown on the Drawings. Locate all disconnects as required by code, ensuring full access and working clearances.
- B. Outlets shall not be mounted on disconnects.
- C. Disconnects shall not be used as through raceways.
- D. Provide enclosure, NEMA 1 or NEMA 3R depending on location, for standalone circuit breaker.

END OF SECTION

SECTION 26 28 18 – ENCLOSED SWITCHES

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide electrical materials, installation and testing.

1.02 DESCRIPTION

- A. This section describes requirements for fused and non-fused disconnects.

1.03 RELATED WORK

- A.

1.04 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002.
- B. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2001.
- C. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

1.05 SUBMITTALS

- A. Submit manufacturers' data and shop drawings in accordance with Section 26 05 00 Paragraph 2.4.
- B. Provide submittals for items listed documenting compliance with specification requirements.
- C. Product Data:
- D. Electrical Materials: Manufacturer's current published catalog sheets.

PART 2 - PRODUCTS

2.01 DISCONNECTS, FUSED AND NON-FUSED

- A. Where indicated, provide horsepower rated disconnect switches, pad-lockable in the open position.
- B. Three Phase Switches (over 10 horsepower):
 - 1. Fused or non-fused, as indicated, 600 VAC, heavy duty type safety switches, mounted in NEMA 1 general purpose enclosures in dry locations and NEMA 3R

rain-tight enclosures in damp or wet locations, Eaton "H600", General Electric "Type TH", Square D "Heavy Duty" or equal.

2. Clearly indicate on the switch enclosure the "on" and "off" positions.
3. Mechanisms, quick-make, quick-break.
4. Door interlock, defeatable to facilitate access into the switch enclosure with the switch in the closed position. Equip fusible switches with Class R fuse rejection clips.

C. Single Phase Switches (non-fused):

1. 120/240 VAC, general duty type safety switches, mounted in NEMA 1 general purpose enclosures in dry locations and NEMA 3R rain-tight enclosures in damp or wet locations, Eaton "DG", General Electric "Spec-Setter TG", Square D "Class 3130" or equal.
2. Clearly indicate on the switch enclosure the "on" and "off" positions.
3. Mechanisms, quick make, quick break
4. Door interlock, defeatable to facilitate access into the switch enclosure with the switch in the closed position.

PART 3 - EXECUTION

3.01 DISCONNECT SWITCHES

- A. Install disconnect switches where indicated. Provide all mounting hardware and accessories.
- B. Provide a flexible connection from the disconnect switch to the motor unless otherwise indicated.
- C. Attach disconnect switches with specified anchors.
- D. Apply phase tape and identify circuit numbers as specified.
- E. Install fuses where indicated or when required by UL listing of equipment.

END OF SECTION

26 33 53 - UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification describes a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, batteries, or other DC storage systems, and accessory cabinet(s) for transformers, maintenance bypass, and distribution applications, and other features as described in this specification.

1.02 UPS SYSTEM DESCRIPTION

- A. UPS System Components: The UPS system shall consist of the following main components:
 - 1. UPS module containing Rectifier(s), Inverter(s), Battery Charger(s), Static Bypass, and associated Control and Monitor Panel.
 - 2. Battery string(s) in Line-and-Match Battery Cabinets provided by UPS manufacturer.
 - 3. Non-matching wall mounted or floor standing maintenance bypass cabinets or multi-module parallel tie cabinets. Maintenance bypass cabinet must include a keyed interlock with solenoid key release unit (SKRU) and indicator lamp.
- B. UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:
 - 1. Normal: Utilizing commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
 - 2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source. The 93PM UPS shall be capable of operating with 480VDC battery systems.
 - 3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
 - 4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break

transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.

5. Energy Saver: The UPS shall continuously monitor the voltage and frequency of the bypass source. When the source parameters are within acceptable limits, the UPS will utilize a minimal/optimal combination of its internal subsystems to ensure acceptable power is always delivered to the critical load, at a system efficiency of up to 98.5%. The Energy Saver System shall be enabled by the user and shall be adjustable. It shall incorporate a "High Alert Mode" to automatically (without user intervention) provide maximum power conditioning any time bypass source variation levels exceed preset, adjustable limits. When Energy Saver System is utilized, the UPS shall attenuate ANSI C62.41-type line transients to within IEC and ITIC limits. The Energy Saver System shall be able to distinguish between upstream (utility) faults and downstream (load) faults and react appropriately to protect and support the critical load, without interruption.

1.03 REFERENCES

- A. UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment. Product safety requirements for the United States, 5th Edition.
- B. C-ULus CSA C22.2 No 107.3-14(Canadian Standards Association) – Commercial and Industrial Power Supplies. Product safety requirements for Canada.
- C. NEMA PE-1 – (National Electrical Manufacturers Association) – Uninterruptible Power Systems standard.
- D. IEC 62040-2 C2
- E. IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.
- F. IEEE 587 (ANSI C62.41) Category A & B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.
- G. FCC Rules and Regulations 47, Part 15, Class A (Federal Communications Commission) – Radio Frequency Devices.

1.04 SUBMITTALS

- A. The UPS shall be supplied with sufficient documentation, including the following manuals:
 1. Installation and Operation Manual: One copy of the installation and operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the UPS equipment and accessories. The manual shall include the following major items:
 - a) UPS description
 - b) UPS site planning and unpacking
 - c) UPS installation
 - d) Optional accessory installation

- e) UPS theory of operation
- f) Operating procedures
- g) System events
- h) UPS maintenance

- i) Performance and technical specifications
- j) Wiring requirements and recommendations
- k) Physical features and requirements
- l) Cabinet dimensions

1.05 QUALIFICATIONS

- A. The UPS manufacturer shall have a minimum of fifty years of experience in the design, manufacture and testing of solid-state UPS systems. A list of installed UPS systems of the same type as the manufacturer proposes to furnish for this application shall be supplied upon request.
- B. The UPS manufacturer shall have ISO 9001 and ISO 14001 certification for engineering/R&D, manufacturing facilities and service organization.
- C. The UPS manufacturer shall maintain a staffed 7x24x365 call center for technical and emergency support.
- D. Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours. A map of the United States showing the location of all field service offices shall be submitted with the proposal. Third-party service or maintenance will not be accepted.
- E. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. Parts are stocked in regional logistics centers, ensuring a 95% First Time Fix rate and maximizing system availability.
- F. Product Enhancement Program: The UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These upgrades shall be available as optional field-installable kits.
- G. Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal. Under these contracts, the manufacturer shall maintain the user's equipment to the latest factory revisions.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. The UPS shall withstand any combination of the following external environmental conditions without operational degradation.
 - 1. Operating Temperature: +5° C to +40° C (41° F to 104° F) without de-rating (excluding batteries).

2. Storage Temperature: - 25° C to + 55° C (-13° F to 131° F). Prolonged storage above + 40° C (104° F) will cause rapid self-discharge and permanent damage to the battery.
3. Relative Humidity (operating and storage): 5-95% non-condensing.

4. There shall be at least a 1.8°F (1.0°C) difference between the dry bulb temperature and the wet bulb temperature, at all times, to maintain a non-condensing environment
5. The maximum rate of temperature change shall be limited to 3°F over 5 minutes (36°F/hour), based on the ASHRAE Standard 90.1-2013
6. Elevation:
 - a) Operational: 5000 ft. (1500 m) maximum without de-rating. Above this rating, altitude percent load de-rating as per IEC 62040-3
 - b) Transportation: Capable of air transport, up to 15,000m.

1.07 SAFETY

- A. The UPS shall be certified by Underwriters Laboratories in accordance with UL 1778, 5th Edition.
- B. The UPS shall be certified by the Canadian Standards Association in accordance with cULus CSA C22.2 NO.107.3-14.
- C. Cabinets are NEMA 1 and IP20 rated.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers: Eaton, APL.

2.02 UPS MODULE STANDARD FEATURES

The UPS module shall consist of the following standard components, housed in a 60 kW frame:

- A. Either (1) 30kW module or two identical 20kW UPM Uninterruptible Power Modules, each containing:
 1. Rectifier/Charger: The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bi-polar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger module shall also provide the following:

2. The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.
 3. The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
 4. Inverter: The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall also have the following features:
 5. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
 6. The modular design of the UPS shall permit safe and fast removal and replacement of the power module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode.
 7. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
- B. Static Bypass: The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. Each bypass circuit for 60kW frame shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. The bypass shall feature the following transfer and operational characteristics.
1. Transfers to bypass (for stand alone, and parallel capacity systems) shall be automatically initiated for the following conditions:
 - a) Output overload period expired.
 - b) Critical bus voltage out of limits.
 - c) Internal over temperature period expired.
 - d) Total battery discharge.
 - e) UPS failure.
 2. Uninterrupted automatic re-transfer shall take place whenever the inverter(s) is capable of assuming the critical load.
 3. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:
 - a) When transfer to bypass is activated manually or remotely.
 - b) In the event of multiple transfers/re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten-minute period. The third transfer shall lock the critical load on the bypass source, for 60 minutes.
 - c) UPS failure.
 4. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter

must verify proper bypass operations before transferring the critical load to the bypass.

5. All transfers to bypass shall be inhibited for the following conditions:
 - a) Bypass voltage out of limits (+15%, to -15% of nominal 208V and +10% to -15% nominal 220V)
 - b) Bypass frequency out of limits (+/- 4 Hz, adjustable, factory set)
 - c) Bypass out of synchronization
 - d) Bypass phase rotation / installation error
 6. Static transfer time: No break, complete in less than 4ms.
 7. The bypass shall be manually energized using the control panel or remotely through a building alarm input.
- C. Monitoring and control components: The following components shall provide monitor and control capability:
1. Control panel: color LCD, touch sensitive, with LED status indicators.
 2. Alarm and metering display.
 3. Building alarm monitoring.
 4. Communication ports: RS-232 and USB.
- D. Battery management system: The UPS shall contain a battery management system which has the following features when used with lead acid batteries:
1. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Upon commissioning, battery runtime information shall be available.
 2. The battery management system shall automatically test the battery system to ensure that the battery is capable of providing greater than 80% of its rated capacity. Testing the batteries shall not jeopardize the operation of the critical load. Upon detection of the battery string(s) not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement. The battery test shall be able to detect the following:
 - a) Open battery string
 - b) Shorted battery string (current limit)
 - c) Battery capacity (runtime) less than 80% of "new" battery capacity
- E. Wiring Terminals: The UPS 60kW frame modules shall contain through-hole busbar landings (adequately sized to accommodate 75-degree C wiring), for securing user wiring, using compression lugs, to the following locations:
1. Rectifier/charger input connections 3-wire plus ground
 2. Bypass input connections, (for dual source configurations): 4-wire plus ground.
 3. DC connections for battery cabinets (positive and negative plus ground).

4. AC output connections 3-wire or 4-wire plus ground.

2.03 UPS MODULE OPTIONS AND ACCESSORIES

The UPS system may include the following options and accessories as required:

- A. Maintenance Bypass Cabinet: Cabinet shall be provided that includes:
 1. Maintenance Bypass Panelboard: Wall-mount or floor-standing three manual maintenance bypass system to isolate UPS module from commercial AC input.
- B. Network Adapter and UPS Power Monitoring Software: PX Gateway card adapter shall provide a communications interface between the UPS module and the following network management systems.
 1. SNMP v.1, v.3
 2. Modbus TCP
 3. BACnet/WS or /IP
 4. IPv6 SMTP report generator for usage and Alarms.

This capability shall allow the unit to be monitored remotely over an Ethernet network using a standard web browser.
- C. UPS Power Monitoring Software: This system shall continuously monitor critical power elements associated with the UPS, using the communications port on each module and a customer furnished PC. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition via email, page, or text message.
- D. Relay Card: Serial dry contact card providing 5 isolated dry output contacts, 1 isolated input. The relays are programmable.
- E. External Battery Cabinet: The battery cabinet shall feature either lithium ion batteries or valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinet shall have the following features:
 1. The battery cabinet shall be the same depth and height as the UPS module. A "Slim" (16.7" width) battery cabinet is optional for 10 to 200 models.
 2. The battery cabinet shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters for easy installation. Each battery cabinet shall require front access only for installation, service and maintenance.
 3. Power wiring internal to line and match battery cabinet shall be factory provided. Battery cabinet shall feature up to 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
 4. Battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string(s) within that battery cabinet. For battery configurations involving multiple battery

cabinets, the batteries in one battery cabinet may be isolated from the DC link via its circuit breaker without disconnecting other battery cabinets from the DC link and the UPS module.

5. The circuit breaker in battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.
6. The circuit breaker in battery cabinet shall feature a 48VDC shunt trip device. The shunt trip shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.
7. Power and Control wiring between the co-located battery cabinet and the UPS shall be factory provided. Remote installation is available, with cabling provided by the installer.
8. The batteries shall be optionally configured with a ¼" spade type connector for attaching sense leads to each jar to facilitate the future addition of a battery monitoring system.
9. Expected battery life: for VRLA batteries, 200 complete full load discharge cycles when operated and maintained within specifications.

2.05 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS*

A. UPS Continuous Ratings. The UPS shall be rated:

Units may be upgraded to their maximum UPS frame rating when sufficient UPMS are installed and appropriate firmware settings are implemented.

UPS output power factor rating is unity with the ability to support 0.8 leading to 0.8 lagging without de-rating.

The UPS may be ordered with any of the optional ratings, and later upgraded to its corresponding maximum frame rating (60kW). It is recommended that premises wiring should be sized for the maximum possible rating of the UPS (i.e. to match the UPS frame rating).

B. Acceptable UPS input sources:

1. UPS shall support 4-wire grounded Wye sources. A neutral conductor from the source is required to be terminated on the neutral bus in the UPS, and is then passed through to the load, if 120 or 127 Vac output is required.

- a) Single source, single or dual feed: 4-wire grounded neutral wye
- b) Dual source*, dual feed: 4-wire grounded neutral wye

*TT sources for the UPS must all share the same ground plane.

C. Rectifier/charger input:

1. Nominal three phase input voltage: 208/120Vac three wire plus ground
2. Operating input voltage range: +15%, -15% for 208V of average nominal input voltage without battery discharge. Note the UPS shall "power share" with the battery to -30% of nominal voltage, at full rated load.
3. Operating input frequency range shall be 40 to 72Hz.

4. Input power factor 0.99 lagging at rated load.
 5. Normal input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode:
 6. Rectifier/charger input current limit shall be adjustable from 100 to 115% of UPS kW rating.
 7. On generator input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode on generator:
 8. Rectifier/charger input current limit shall be adjustable from 100% to 115% of UPS full load kW rating.
 9. Battery recharge input current limit shall be adjustable from 0 to 7A per 20kW UPM module. This limit may be less, depending on size of input service and UPS input current limit setting.

 10. Input current total harmonic distortion (THD) shall be less than 3.5% at nominal line voltage and 5% nominal source impedance.
 11. Power walk-in: Ramp-up to full utility load adjustable from 14 amps per second to 0.7 amp per second, per each UPM in the system.
- D. Bypass input:
1. Synchronizing bypass voltage range shall be +15, -15% of average nominal (208V) input voltage.
 2. Synchronizing bypass frequency range is +/- 0.5 Hz to +/-4 Hz, user adjustable, and is centered on the nominal frequency. Default setting is +/- 4 Hz.
 3. Slew rate: 0.5 Hz per second, maximum.
 4. Bypass and rectifier inputs can be supplied from out of phase sources if required.
 5. Input surge withstand capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), category A & B (6kV).
- E. Rectifier/charger output:
1. Nominal DC voltage shall be 480 VDC (open circuit battery voltage).
 2. Capacity: The rectifier/charger shall support a fully loaded inverter and recharge the VRLA battery to 90% of its full capacity within 10 times the discharge when input current limit is set at maximum.
 3. Low line operation: The rectifier/charger shall be capable of sharing the DC load with the battery when the input voltage falls below the specified operation input voltage range, the "on battery" indicator shall annunciate operation in this mode.
 4. DC sensing: DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.

5. Battery charger characteristics: The UPS battery charging system shall have the following characteristics:
 - a) The charger shall be capable of being configured for several charge modes including:
 - (1) A charging mode that increases battery life by allowing the battery to rest periodically, reducing positive plate corrosion
 - (2) A charging mode floating the battery at a set level, which can be adjusted via firmware.
 - b) UPS module will automatically adjust battery shutdown based upon loading and battery capacity.
 - (1) The UPS module shall automatically adjust the final discharge voltage between 1.67 and 1.75 Volts per cell based on the existing load and the rate and length of discharge.
 - (2) The absolute minimum operational voltage is 1.67 V per cell (adjustable upward).

- F. UPS output in normal mode
 1. Nominal output voltage 208V, 3-phase, 3-wire or 4-wire plus ground at the UPS output terminals.
 2. Steady-state voltage regulation (in inverter) shall be within +/- <1% average from nominal output voltage.
 3. Transient voltage response shall be per EN62040-3, Class 1, VFI-SS-111.
 4. Transient voltage recovery shall be compliant to EN62040-3, Class 1, VFI-SS-111.
 5. Linear load harmonic distortion capability: Output voltage THD of less than 1.6% for 100% linear load.
 6. Non-linear load harmonic distortion capability: Output voltage THD of less than 2% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3.
 7. Line synchronization range shall be +/- 4Hz, adjustable to +/-0.5 Hz.
 8. Frequency regulation shall be +/- 0.1Hz free running.
 9. Frequency slew rate shall be 0.5 Hz/second maximum.
 10. Phase angle control:
 - a) Balanced linear load shall be <1 degree from nominal 120 degrees
 11. Phase voltage control:
 - a) Balanced linear loads shall be +/- 1% from average phase voltage
 - b) Unbalanced linear loads shall be less than <2% (@208V) and <3% (@220V) from average phase voltage for 100% load unbalanced
 12. Overload current capability (with nominal line and fully charged battery, non-paralleled systems):

- a) Double Conversion mode: The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and 126% to 150% for 10 seconds, >151% for 300ms.
 - b) Stored energy mode (typically on battery): The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and >126% for 300ms.
 - c) Energy Saver System operation: Continuous = 110%. Transient = 1000% peak current for 10ms.
 - d) On bypass (single UPS systems): Continuous = 125%. Transient = 1000% peak current for 10ms.
13. Fault clearing current capability: See section 12 above.
 14. Static transfer time, inverter to bypass: No break, completed in less than 4ms.
 15. Static transfer time, Energy Saver to inverter: No break, completed in less than 4ms maximum, typically <2ms.
 16. Common mode noise attenuation:
 - a) -65dB up to 20kHz, -40db up to 100kHz
 - b) > 100dB with isolation transformer
 17. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices, and IEC62040-2 C2 and C3.
 18. Electrostatic discharge (ESD): The UPS shall meet IEC61000-4-2 level 3; 4kV contact/8kV air discharge.
 19. Efficiency: The UPS incorporate 3-level power converter design for highest possible efficiency. Full load efficiency for non-derated hardware shall be up to 95%, 50% load efficiency shall be 95%, and the UPS shall achieve >94.0% efficiency at 25% load.
- G. UPS Output with Energy Saver System option
1. The Energy Saver System acts to optimize the internal components of the UPS power train to maximize system efficiency when the bypass source is within the following (adjustable) limits: Voltage: +/-10%, and Frequency: +/-3Hz.
 2. Nominal output voltage 208V, 3-phase, 4-wire plus ground at UPS output terminals. Steady-state voltage regulation shall be within +/- 10% from nominal output voltage.
 3. Line synchronization range shall be +/- 4 Hz, adjustable.
 4. Frequency regulation shall be +/-4 Hz when bypass source is within the limits in (1) above, and +/- 0.1Hz free running,
 5. Overload current capability (with bypass source within the limits of (1) above) Continuous: 110%, Transient: 1000% for 10msec.
 6. Static transfer time: No break, typically completed in less than 2ms, including detection time.

7. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed 65dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
8. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices, and IEC62040-2 C2 and C3.
9. Electrostatic discharge (ESD): The UPS shall meet IEC61000-4-2 level 3; 4kV contact/8kV air discharge.
10. Efficiency: The UPS efficiency shall be up to 98.5%, over the range of 25% to 100% load; for N+0 configurations only.

*Unless otherwise specified, performance data in Sec 2.05 above is measured under conditions of 100% resistive load for fully rated UPS sizes, 25 degrees C ambient temperature, nominal rectifier and bypass input voltages, and battery system floating.

2.06 MECHANICAL DESIGN

- A. Enclosures: The UPS shall be housed in free-standing double front enclosures (safety shields behind doors) equipped with casters and leveling feet. The enclosures shall be designed for computer room applications. Front doors shall have locks to prevent unauthorized entry.
- B. Modular construction: The UPS shall be comprised of Universal Power Modules (UPMs), each hardware-rated for 20kW, and each including the rectifier, inverter, and battery converter power and control circuitry. These UPMs shall be draw-out assemblies that can be quickly exchanged or replaced by authorized service personnel, with proper personal protective equipment; [PPE], , without transferring the UPS output load to bypass.
- C. Ventilation: The UPS and shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlet configuration for the UPS, and its accessory cabinet(s) shall be user selectable at time of order to exhaust warm air at the top of the cabinet (row or wall installations), or exhaust at the rear of the cabinet for "hot aisle" configurations. Eighteen inches of clearance over the UPS outlets shall be required for proper air circulation (top exhaust) or working space (rear exhaust). An air filter shall be mounted in the front door of the UPS module.
- D. No rear or side clearance or access shall be required for the system. The back and side enclosure covers shall be capable of being located directly adjacent to a wall.
- E. Cable entry: Standard cable entry for the 60 frame UPS cabinet shall be through the enclosure bottom. Top cable entry shall be facilitated by a sidecar which can be mounted on either side of the UPS. Standard.
- F. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). Side or rear access for installation, service, repair or maintenance of the UPS system shall not be required.
- G. Service area requirements: The system shall require no more than thirty-six (36) inches of front service access room and shall not require side or rear access for service or installation.

2.07 CONTROLS AND INDICATORS

- A. Microprocessor controlled circuitry: The UPS controls shall have the following design and operating characteristics:
1. Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled Digital Signal Processing. Start-up and transfers shall be automatic functions and will not require operator intervention.
- B. Digital Front Panel Display: The UPS control panel shall be a 7" touch sensitive, backlit LCD front panel display that includes LED indicators for basic UPS status. Large, luminous, color coded LED pillars (vertical bars) shall show the UPS status (green, amber, red), and be visible up to 30m from the UPS. The LCD shall display:
1. UPS status (home screen): the LCD screen shall have a color-coded border (header) that turns red on alarm, and shows basic UPS status in the header of the display, visible at all times. The header shall alternately show UPS status output voltage and battery time remaining and be visible constantly in all display screens. The home screen shall show load level, average efficiency, and power consumption in kWh. The home screen shall show a system mimic diagram with a color-highlighted power path, operating mode, and active events.
 2. Controls tab: Shall provide touch sensitive button controls, with a confirm prompt, for turning the UPS on and off, transfer to/from bypass, and enabling or disabling the battery charger, initiating a battery test, and enabling or disabling Energy Saver System (ESS).
 3. Metering tab: The metering screen shall show voltages currents, temperatures, kW, kVA, and power factor (as applicable) for the UPS input, output, bypass source, and battery. Color coded (green, amber, red) bar graph indicators will accompany power and temperature measurements
 4. Logs tab: alarm/event queue, active alarms and alarm history, events, status changes and commands, all timed to the 1/1000th second for tracking and analysis.
 5. Statistics tab: Numerically and graphically displays the estimated savings afforded by ESS operation over time.
 6. Settings tab: shall provide button access to user adjustable settings such as, but not limited to: date/time, building alarm designations, communications parameter setup, UPS name, user passwords, and display language.
- C. Control Panel Lamp Indicators: The UPS control panel shall provide the following monitoring functions with indicator (icon) LED's:
1. NORMAL: This green LED shall indicate that the commercial AC utility or generator source is supplying power to the rectifier and the inverter is supporting the critical load.
 2. BYPASS: This amber LED shall indicate that the UPS has transferred the load to the bypass circuit.
 3. BATTERY: This amber LED shall indicate that the commercial AC utility or generator source has failed, and the battery is supplying power to the inverter, which is supporting the load.

4. ALARM: This red LED and the accompanying audible alarm horn, shall indicate that the UPS detects an alarm condition, outlined in detail in the Logs tab from the home screen and in the operator's manual.
- D. Interface panel: The UPS shall be equipped with an interface panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:
1. Alarm contact: A dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be Form "C" capable of supplying both N/O and N/C contacts. Contact ratings shall be 5A max at a voltage not to exceed 28VDC or 277VAC.
 2. RS232 (EIA / TIA-232) and USB communications interfaces: Circuitry shall be provided for one "host", and one "device" USB connector, and one RS232 (EIA / TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple ("dumb") terminals to gain remote access to all unit operation information.
 3. Building alarms: Five inputs shall be provided for monitoring the status of external dry contacts. Building alarms shall be set up through the UPS configuration mode function on the UPS front panel display or via the RS232 (EIA / TIA-232) port.
 4. External REPO contacts: Shall be provided to connect an external remote emergency power off switch to shut down the UPS and de-energize the critical load. Normally open or normally closed contacts shall be acceptable.
 5. Battery control contacts: Contacts shall be provided to connect the battery shunt trip and auxiliary contact signals from a battery breaker or battery disconnect switch.
 6. External bypass indicator connection: A connection point shall be provided to acknowledge that an external maintenance bypass has been closed around the UPS, placing the critical load on utility power.
 7. SELV 24V: this provides stable power for communication between the UPS and optional accessories.

2.08 COMMUNICATIONS

- A. Communications Bay: The UPS shall be equipped with field configurable communications bays that will accommodate four (4) plug-in communication devices
- B. Remote Monitoring:
 1. Optional WEB/SNMP communication capabilities will be available for all systems.
 2. The UPS shall be able to be monitored remotely via communications devices. UPS manufacturer shall provide optional communications devices capable of communicating via various industry standard protocols such as RS232, SNMP, BACnet and ModBus. Monitoring of UPS status may also be performed through isolated dry contact Form C relays.

The UPS communication capability should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System (NMS). The UPS must also be able to be monitored via any standard Internet browser.

All optional hardware interfaces shall be "Hot-swappable" (UPS maintains power to critical applications while changing interfaces).

C. Shutdown:

1. There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. The order of shutdown shall be user-defined, allowing the maximization of runtime on battery for more critical systems.
2. The UPS shall also be capable of interfacing with an operating system's built-in shutdown routine. This shall be done through a cable connection to the communication interface card.

D. Notification:

1. There shall be a mechanism to send alerts to key personnel via email or SNMP traps. An alarm notification may also be sent by a network message.

2.08 UPS MODULE PROTECTION

- A. Rectifier/Charger and Bypass protection shall be provided through individual fusing of each phase.
- B. Bypass backfeed protection shall be included with sidecar and wall mount maintenance bypass options. The UPS shall provide backfeed detection. If no maintenance bypass is used, backfeed protection shall be provided via a shunt trip (48VDC) signal available to an external bypass input breaker
- C. Battery protection shall be provided by thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery.
- D. Electronic current limiting circuitry and fuses in the Inverter circuit shall provide output protection.
- E. To comply with agency safety requirements, the UPS module shall not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide and secure all seismic restraints.

3.02 COMMISSIONING

- A. Factory start-up shall be provided on a 7 x 24 basis. Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures and tests specified within UPS Installation and Operation manual. UPS manufacturer shall also offer the following optional services:
1. Pre-energize visit to inspect installation and provide guidance to installers as required.
 2. Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.
- B. The following procedures and tests shall be performed by Field Service personnel during the UPS startup:
1. Visual Inspection:
 - a) Visually inspect all equipment for signs of damage or foreign materials.
 - b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
 2. Mechanical Inspection:
 - a) Check all the power connections for tightness.
 - b) Check all the control wiring terminations and plugs for tightness or proper seating.
 3. Electrical Pre-check:
 - a) Check the DC bus for a possible short circuit.
 - b) Check input and Bypass power for proper voltages and phase rotation.
 - c) Check all lamp test functions.
 4. Initial UPS Startup:
 - a) Verify that all the alarms are in a "go" condition.
 - b) Energize the UPS module and verify the proper DC, walkup, and AC phase on.
 - c) Check the DC link holding voltage, AC output voltages, and output waveforms.
 - d) Check the final DC link voltage and Inverter AC output. Adjust if required.
 - e) Check for the proper synchronization.
 - f) Check for the voltage difference between the Inverter output and the Bypass source.
 - g) Optional on site full-load, step-load, and battery discharge tests using supplier furnished load bank, shall also be offered.

5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

3.03 WARRANTY

All components of the UPS system shall be covered by a standard one-year limited factory warranty and service protection package.

One-year limited factory warranty shall include replacement coverage for the UPS parts for a period of 18 months from shipment or 12 months from start-up, whichever occurs sooner. Labor coverage is for 1 year after product startup.

One-year service protection package shall include 7x24 on-site repair/replacement labor for UPS parts and batteries; 7x24 technical support coverage; and 7x24 PredictPulse predictive analytics and remote monitoring service (with monthly reports for UPS and battery performance). Connectivity kit for PredictPulse is provided upon customer signup. Standard service response time shall be 8 hours from receipt of call. Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times of 4, or 2 hours in certain major metropolitan areas. Additional preventive maintenance visits shall be available as an option for both UPS and battery components.

Manufacturer shall also include Start-up services consisting of: 7x 24 Start-up service of UPS and batteries. On-site user training, Site Audit, installation and commissioning of monitoring service, and validation of one-year limited factory warranty will be performed during the start-up.

Manufacturer shall also offer an optional service plan to provide 7x24 on-site coverage (preventive and corrective) for UPS and batteries, guaranteed response time, remote monitoring, Web access to service site history, annual Site Audit, UPS and battery preventive maintenance visit, and discounts on upgrade and modification kits. Manufacturer shall also provide an optional battery service plan to provide parts-and-labor coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

End of Section