AGD

1238 Monterey Street

San Luis Obispo, CA 93401

michael@andrewgoodwin.us

Point of Contact

REQUEST FOR INFORMATION

PROJECT NAME	RFI NUMBER	DATE OF REQUEST
Royal Theater	9	8/14/2025
PROJECT LOCATION	**PROJECT ID**	**DRAWING ID**
848 Guadalupe Street Guadalupe, CA	825	
RFI OVERVIEW	**SECTION(S) REFERENCED**	

CHANGE IN COST				CHANGE IN TIME	
	NO CHANGE			NO CHANGE	
	INCREASE IN COST	$ -		INCREASE IN TIME	# of Days =
	DECREASE IN COST	$ -		DECREASE IN TIME	# of Days =

REQUEST / CLARIFICATION REQUIRED

Additional abatement contractor:

MICHAEL ALPER
Senior Project Manager
Alliance Environmental Group, LLC
CALIFORNIA | WASHINGTON | NEVADA | ARIZONA
California Central Coast Office - Santa Barbara to King City
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NAME & TITLE OF REQUESTING PARTY	DATE OF REQUEST
	08/01/25

AGD

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REQUEST FOR INFORMATION

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	DECREASE IN COST	$ -	DECREASE IN TIME	# of Days =

REQUEST / CLARIFICATION REQUIRED
Updated Electrical Specificaitons to supercede the previous.

NAME & TITLE OF REQUESTING PARTY	DATE OF REQUEST
	08/01/25

Guadalupe Royal Theater

848 CA-1
Guadalupe, CA 93434

Division 26 Electrical Specifications

Project Owner
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Guadalupe, CA 93434

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Specification Index

Section 26 0500 - Common Work Results For Electrical

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic electrical materials and methods.
B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Selective Demolition of existing electrical systems.
      b. Raceways, boxes, gutters, enclosures, power wire, cable, and conductors.
      c. Distribution equipment, including panelboards, load centers, switchgear, motor controls, and transformers.
      d. Fused disconnect switches, safety switches, fuses, and circuit breakers.
      e. Grounding
      f. Interior lighting system and controls.
      g. Exterior lighting system and controls.
      h. Utility company (electric, telephone, and cable television) provisions for service.
      i. Underground system installation.
      j. Connection of equipment.
      k. Line voltage connection of mechanical and plumbing equipment.
      l. Central Lighting Inverter System, Central Battery Equipment
      m. Owner training.
      n. Electrical Acceptance.
      o. Lighting Acceptance.

1.2 RELATED SECTIONS

1. 26 56 70 LIGHTING ACCEPTANCE TESTING
2. 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS

A. Related Sections Under Other Divisions:
   1. The drawings and general provisions, including supplementary conditions, of this contract apply to this section.
   2. Grading, patching, and repairing of existing surfaces, including but not limited to: asphalt, concrete, and vegetation, as required by the Architect/Civil Engineer.
   3. Painting of exposed electrical equipment/raceways as required by the Architect.
   4. Concrete work including but not limited to: equipment pads, luminaire bases, as required by the Architect/Structural Engineer.

5. Low voltage mechanical controls including but limited to: control wiring and conduit system, as required by the Mechanical Engineer. Control wiring and conduit shall be the responsibility of DIVISION 25, Mechanical, however, shall be installed in accordance to this specification.
6. Fire smoke dampers and duct mounted smoke detectors shall be the responsibility of DIVISION 25, Mechanical, however, electrical and fire alarm system connection(s) shall be installed in accordance with this specification.

1.3 SYSTEM DESCRIPTION

A. Furnish, install, and test materials and equipment in accordance with the drawings and this specification in order to provide a complete, working installation.
   1. Lighting acceptance testing, documentations, and completion of California State required acceptance forms.
   2. Electrical system acceptance, testing, and documentation.
B. Notify the Architect/Engineer of discrepancies within the drawings, this specification, and/or actual field conditions.
C. Install equipment at locations indicated on the drawings as closely as field conditions permit. Obtain acceptance of equipment dimensions prior to installation through submittal review. California Electrical Code (CEC) minimum working clearances shall be maintained.
D. Electrical drawings are diagrammatic in nature and do not reflect minor variations in equipment alignment/installation that may be necessary. Review existing field conditions and make proper adjustments as required to avoid conflict with other trades or portions of work, satisfy the design requirements, and meet code minimums. Obtain acceptance of adjustments from the Architect/Engineer.
E. Electrical, Telephone, and Cable Television (CATV) Services:
   1. Provide work in accordance to Utility Companies requirements, specifications, and design drawings.
   2. Coordinate inspections with serving utility company, local, and state authorities having jurisdiction in order to obtain acceptance. Final adjustments and requirements pursuant to inspection(s) shall be adhered to.
   3. The owner shall be responsible for utility company charges incurred. The owner shall pay the respective serving utility company directly.
F. Permits shall be obtained for electrical work. Arrange inspections with the authority having jurisdiction and obtain acceptance.
G. Two copies of an Operating and Installation Manual shall be provided to the owner prior to final acceptance. Manuals shall reflect the installed system and include the following:
   1. Submittal documentation reflecting installed materials, equipment, and systems.
   2. Device Settings
   3. Testing Reports

4. Maintenance requirements and battery replacement recommendations per manufacturer requirements for exit signs, luminaire battery packs, emergency luminaires, UPS's etc.
5. Maintenance requirements for emergency generators.
6. Certificate of product and installation warranties
7. Lighting Acceptance Documentation
8. Electrical Acceptance Documentation

H. Owner training shall be prearranged prior to final acceptance. Instruct owner on the operation of equipment and systems including, but not limited to the following: device settings, system programming, and equipment testing, maintenance, and equipment locations. Provide manufacturer support as indicated per this specification.

1.4 REQUIREMENTS

A. PERFORMANCE
   1. Final equipment feeder or branch circuit connections shall be coordinated with manufacturer nameplate data and specifications.

B. SUBMITTALS AND SHOP DRAWINGS
   1. Shop drawings and product data (including manufacturer specification sheets) shall be submitted demonstrating compliance with the construction documents. Obtain approval from the Engineer prior to procurement.
      a. Electronic submittal packages will be accepted.
      b. Submittals shall be complete. Partial submittals will not be accepted.
      c. Identification shall be made on submittal documentation indicating compliance with contract documents and intended use. Highlighted text, notation, etc. are acceptable.
      d. Submittal documentation pertaining to Utility Company infrastructure, including but not limited to: man holes, vaults, pull boxes, and metering equipment shall be routed to the respective utility company representative (as identified on the drawings) for approval.
      e. The Engineer will review two rounds of product submittals. Should subsequent review be required beyond this to obtain acceptance, the contractor shall be responsible to compensate the engineering for time spent a at the engineer's standard hourly billing rate.
      f. Equipment, materials, and components identified in the construction documents with specific manufacturer product numbers limit their use only as to the design, workmanship, and quality, not manufacturer unless otherwise noted specifically. Alternate products will be reviewed and evaluated during the submittal review process, pursuant to conformance with the contract documents. The project team reserves the right to request product samples for evaluation at no cost. The final decision will be

made by the Architect. In the event that an alternate product is accepted, the following will be required:

1. Coordination with other trades. Costs incurred as a result of the substitution will be the responsibility of the Contractor.
2. Dimensions shall be field verified to ensure product will fit and maintain code required working clearances.
3. Approval of a substituted product does not alleviate the contractor from providing a complete, working installation compliant with the contract documents, design intent, applicable codes, standards, and local ordinances.

2. Submittals shall include the following:
    a. Manufacturer equipment specifications, including but not limited to the following: Metering Equipment, Main switchboards, multi-meter switchboards, motor control centers, distribution switchgear, distribution panels, panel boards, load centers, transformers, circuit breakers, motor controls, disconnect switches, fuses, and transient voltage surge suppression.
        1. Grounding.
        2. Conduit raceway, innerduct, fittings, and straps.
        3. Ducts and trench racks.
        4. Conductors and terminations.
        5. Junction boxes, pull boxes, gutters, and vaults.
        6. Electrical devices including, receptacles, switches and accessories.
        7. Luminaires, ballasts, and lamps.
        8. Low voltage lighting control system, including but not limited to: control panel(s), cabling, terminations, switch banks, dimmers, dimming modules, and relays.
        9. Lighting control system, including but not limited to: time clock, contactors, relays, and bypass switches.
        10. Lighting control devices, including but not limited to the following: occupancy sensors, power packs, photocells, lumen and sensors.
        11. Generator and transfer switch system and components.
        12. Uninterruptible Power Supply (UPS) system and components.
        13. Inverter system and components.
        14. Fire Penetration materials and manufacturer installation details.
        15. Finish samples and color charts.
3. Coordination with other trades to the fullest of ability is required to result in a complete, functioning, and professional installation.
4. The construction documents are based on the most accurate information available when prepared. Minor adjustments are frequently made due to changes with respect to architectural plans, construction, and equipment furnished by others. This shall be recognized when bidding and during construction. No change in contract price will be allowed for alternate work which requires approximately the same work to adjust/relocate as a

result of construction coordination work. Adequate contingency in the bid price shall allow for such coordination and adjustments.

5. Record drawings shall be provided to the owner prior to final acceptance. Record drawings shall be maintained throughout construction and reflect and illustrate job changes as they occur. Record drawings shall:
    a. Be submitted to the owner as a set of reproducible drawings. Hand drafted notation is acceptable, provided it is legible and clear unless otherwise noted per Architectural specifications.
    b. Identify locations of concealed and underground conduit 1" size and larger scaled within 12" of actual field conditions.
    c. Identify type of luminaire product installed.
    d. Identify the location of vaults and boxes.

C. QUALITY ASSURANCE

1. Manufacturers shall be regularly engaged in the manufacture of electrical construction products of types required for this project, whose products have been of satisfactory use in similar service for not less than five years.
2. Installers shall have experience in the installation of products required for this project. Installers shall be experienced with proper installation techniques and manufacturer recommendations. In the acceptance or rejection of the finished installation, no allowance will be made for the lack of skill on behalf of the personnel.
3. Installers shall be qualified by the State of California and provide documentation to the owner of the following:
    a. Valid Contractors License.
    b. Valid Business License.
    c. Individuals employed as electricians on the project shall have a valid journeyman electrician pocket card or California State Division of Apprenticeship Standards General Journeyman Electrician Certificate.
4. Electrical work shall be performed in accordance of the latest published requirements of the following codes and standards:
    a. American National Standards Institute (ANSI)
    b. American Society for Testing Materials (ASTM)
    c. Institute of Electrical and Electronic Engineers (IEEE)
    d. National Electrical Contractors Association (NECA)
    e. National Electrical Safety Code (NESC)
    f. National Electrical Manufacturers Association (NEMA)
    g. California Building Code (CBC)
    h. National Electrical Code (NEC) with California State Adoptions and Amendments.
    i. National Fire Prevention Association (NFPA).
    j. California Code of Regulations, Title 8, Section 290.1 (CAL OSHA).
5. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).
6. Prior to final acceptance, the electrical system shall be tested and determined to be free from grounds and short circuits.

D. DELIVERY, STORAGE AND HANDLING
   1. Provide for delivery, uploading, transportation and storage of equipment until installation and final acceptance by the owner.
   2. Equipment and materials shall be stored in an environment consistent with what the equipment is listed for. Pay special attention and mediate environmental conditions such as, but not limited to: temperature, moisture, water, dust, dirt, etc. Assume liability of storage facilities and equipment and materials stored therein.
   3. Electrical equipment shall be free of damage upon installation. Equipment damaged in transport or while in storage on or off the job site will be rejected and shall be replaced free of charge to the owner.
      a. The Architect, Engineer, and Owner retain the right of continuous access and inspection of stored materials and equipment.
      b. Once installed, equipment (including luminaires) shall be protected from, but not limited to: construction activities, dirt, debris, temperature, moisture, etc. until project completion and final acceptance by the owner.

1.5 Guarantees

A. Damaged equipment shall be repaired or replaced as necessary at no cost to the owner prior to final acceptance.
B. Guarantees shall be submitted to the owner, in writing, prior to final acceptance.
C. The installation, including labor, shall be warranted free of defects for a minimum of one year from date of owner final acceptance. Any defect related to the contractor's work, during the warrantee period, shall be corrected at the contractor's expense.
D. Equipment shall be warranted free of defects for a minimum of one year or as stated in this specification, whichever is a longer duration.

Part 2 – PRODUCTS

2.1 Materials

A. Materials, components, and accessories shall be new unless otherwise noted in this specification.
B. Manufacturer discontinued product shall not be acceptable. Materials, equipment, and parts comprising any unit or part thereof, shall be new and unused unless otherwise noted in this specification. Damaged materials, equipment, and parts are not considered to be new and will be rejected per this specification.

Part 3 - Execution

3.1 Installation

A. Work shall be performed by a skilled worker in a manner reflecting best, modern, construction practices and shall be consistent with acceptable means and methods of the trade and code requirements.
B. Upon completion, work shall have a neat, orderly, and finished appearance. Evidence of debris associated with the work shall be removed from the premise and disposed of legally and appropriately.
C. Clean equipment, both inside and out, upon final installation. If required, retouch equipment finishes in accordance with manufacturer instructions.
D. Maintain a safe working environment, including but not limited to:
    a. Conform to all OSHA workplace requirements.
    b. Equipment dead front covers shall be in place while equipment is energized.
    c. Barriers, trench plates, flags, tape, etc. shall be used to keep persons away from unsafe conditions.
    d. Conform with owner-imposed safety requirements and site standards.
E. Coordinate raceway systems, equipment, and materials with other trades and building construction, in order to:
    a. Avoid unnecessary project delays and conflicts.
    b. Ensure penetrations made to exterior walls, foundations, fire rated assemblies, ceilings, and floors are approved and made per structural requirements and details.
    c. Ensure ceiling systems, i.e. luminaires and ceiling mounted devices, do not conflict with, or limit fire sprinkler coverage.
    d. Schedule, sequence, move, and position large equipment into the building during construction.
    e. Coordinate sequence of work installed with other trades. Every effort shall be made to avoid unnecessary modification to work that has already been performed by other trades. Arrange for chases, slots, and openings in building components where needed during the progress of construction to allow for electrical installations.
F. Install electrical equipment to facilitate future servicing, maintenance, repair, and replacement (either complete assembly or individual components). As much as practical, connect equipment for ease of disconnecting at a later date, with minimal interference with other installations.
G. Motors shall be checked for proper rotation once permanent power has been established. Should the motor rotate in the wrong direction, it shall be reconnected for proper orientation.
H. Equipment Support and Installation
    a. Electrical equipment shall be anchored to building floors, foundations, concrete housekeeping pads, concrete bases where appropriate by bolts and anchor bolts with studs.
    b. After installation and before energizing electrical equipment, torque each bolted bus and cable connection in accordance to manufacturer recommendations. Calibrated torque wrenches shall be used.

c. Screw type conductor fasteners and other permanent (i.e. epoxy conductor adhesive) shall be used in junction boxes, pull boxes, terminal cabinets, panels, switchboards, switchgear, motor control centers, variable frequency dries, or other types of enclosures containing electrical devices and/or conductors. Glue-on type conductor fasteners shall not be allowed.
d. Support channels shall be installed as required for the support of raceways, cable trays, devices, enclosures, and other electrical equipment.
e. Iron and steel supports shall be separated from aluminum with a minimum ¼" neoprene or other non-metallic gasket.
f. When working with galvanized steel product (i.e. channel, conduit, equipment), paint any field cuts and or scratches with a cold galvanizing spray paint. Ensure manufacturer requirements are met.
g. Seismic bracing shall be provided as required per the Uniform Building Code.
h. Electrical equipment, materials, and/or luminaires shall be securely supported and mounted independently from building structure to ensure sagging or swaying. Other trade work (for example, mechanical ducting) shall not be used as a support means for electrical.
i. Support devices shall be sized appropriate to withstand four times the weight of equipment it supports. Bracing shall comply with structural engineering requirements and seismic design category "SDC" D.

END OF SECTION 26 0500

SECTION 26 05 01 – SELECTIVE ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic, selective, electrical demolition.

B. Electrical plans identifying the scope of demolition have been prepared pursuant to limited, visual, field observation and facility as-builts/record drawings.

C. Principal features of electrical demolition include, but are not limited to, the following:
   a. Demolition of select distribution equipment, including: service equipment, panelboards, and disconnect switches.
   b. Demolition of select receptacles and equipment connections.
   c. Demolition of concealed conduit in floors and walls.
   d. Demolition of concealed conduit, abandoned in place, with conductors removed.
   e. Demolition of surface conduit.
   f. Demolition of select luminaires.
   g. Demolition of lighting control system and components.

1.2 RELATED SECTIONS

A. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

B. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.
   2. Grading, patching, and repairing of existing surfaces damaged pursuant to the scope of demolition, including but not limited to: walls, floors, ceilings, asphalt, concrete, and vegetation, as required by the Architect/Civil Engineer.

1.3 REQUIREMENTS

A. Electrical demolition work shall be performed in accordance of the latest published requirements of the following codes and standards:
   1. National Fire Prevention Association Standard for Electrical Safety Requirements for Employee Workplaces (NFPA 70E).
   2. California Code of Regulations, Title 8, Section 290.1 (CAL OSHA).

PART 2 – PRODUCTS

2.1 MATERIALS

A. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein.

PART 3 – EXECUTION

3.1 CONDITIONS

A. Visit the site prior to bidding and observe the extent of demolition necessary pursuant to the contract documents. Should discrepancies be discovered between field conditions and the construction documents, notify the Architect/Engineer of record prior to bidding for instruction and/or clarification. Allow for proper contingency when bidding in order to account for minor variances as stated in Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL.

3.2 PREPARATION

A. Contact the serving utility companies to coordinate service outage(s) as necessary. Parties affected by scheduled outages shall be notified in writing a minimum of 72 hours in advance.

B. De-energize electrical distribution equipment, appliances, conductors, and circuit components prior to removal. Ensure equipment is electrically safe prior to beginning work by disconnecting equipment from its energized source and testing for the absence of voltage and grounding as applicable. Ensure electrical conductors scheduled for removal serve only abandoned equipment and devices.

C. When work on energized equipment is required, perform work in accordance with applicable codes and standards. Proper personnel protective equipment ("PPE") and Flame Resistant ("FR") clothing shall be worn as required corresponding to the NFPA 70E Hazard Risk appropriate for working conditions. Use barricades and signage to prevent persons on the job site, not qualified or protected with proper PPE/FR clothing, from entering an area where work is being performed on energized equipment.

D. Provide temporary power, wiring, and connections as required to maintain power to existing loads scheduled to remain operable during construction. Temporary power to such loads shall be removed upon installation of permanent power. Coordinate power outages during cut over with owner 72 hours prior. Temporary power connection(s) may be

subject to additional review and inspection by the authority having jurisdiction.

E. Flexible power cords may be used for temporary power provided they meet the following criteria:
   1. Are rated not less than the capacity of the device(s) supplied by the cord.
   2. Are free of insulation cracks, splices, damaged conductors, and damaged plug/receptacle.
   3. Inspected by the user once every 90 days.
   4. Protected from damage and do not pose a trip hazard while in use on the job site.

3.3 DEMOLITION

A. The removal of electrical infrastructure shall be done with care such to minimize damage of the existing structure or require excessive repair.

B. Field locate, disconnect, and remove existing electrical systems scheduled for removal. Equipment connections shall be removed to source of supply.

C. Field locate, disconnect, and remove existing luminaires scheduled for removal. Remove associated branch circuit conductors, conduit system, mounting accessories, etc.

D. Field locate, disconnect, and remove existing electrical distribution equipment, including feeder connections to source of supply, scheduled for removal.

E. Field locate, intercept, and relocate existing electrical systems to accommodate new construction. When electrical conduit and conductors are required to be intercepted and extended, do so with compatible materials and methods consistent with the existing installation, unless specified otherwise in the construction documents.

F. Abandoned wiring shall be removed and de-terminated from source of supply. Wiring that has been removed shall not be re-installed or re-used onsite.

G. Abandoned conduit shall be removed where exposed and in accessible locations (examples: surface mounted and or conduit mounted in accessible ceiling spaces). It shall be acceptable to abandon conduit in place provided conductors are removed, conduit ends are cut flush and sealed in a manner that will prevent moisture penetration. Where conduit has been cut flush with adjacent surfaces, patch and repair surfaces in a manor acceptable to the Architect/Owner.

H. Devices, including but not limited to: receptacles, communication devices, and switches shall be removed. Remove associated cover plate(s), junction box(s), wiring, and conduit to source of supply. Where indicated on the construction documents, it shall be acceptable to maintain the existing junction box(s) and conduit system. Provide a blank cover plate at wall surface as appropriate.

I. The existing electrical installation not scheduled for demolition shall remain accessible.

3.4 COMPLETION

A. SYSTEM CUT OVER – The existing electrical, telephone, cable television, and fire alarm services shall remain installed and active until the new system is installed. The existing systems shall only be disabled and de-energized for the amount of time required to make the final cut over and obtain acceptance from the owner and authority having jurisdiction. System cut overs shall be prearranged with the owner a minimum of 72 hours in advance. A back-up power source or interim system shall be provided at the direction of the owner. The contractor is responsible for a complete, well planned, and scheduled system cutover.

B. Existing and new materials and equipment installed shall be clean and free of dirt and debris prior to final owner acceptance.

C. Existing materials and equipment scheduled to remain shall be free if damage. Make repair where necessary. Ensure electrical connections are tight, replace damaged or missing device cover plates, etc.

D. Where new branch circuits and feeders are extended from existing load-centers, panelboards, service, and/or distribution panels update the circuit breaker directory. The circuit breaker directory shall be typewritten, identify circuit number and load served, and be installed on the inner face of the panel cover door in a plastic sleeve.

E. Install existing materials and equipment in their new location as specified in the construction documents.

F. Allow the facility owner first right to salvaged equipment removed.

END OF SECTION 26 05 01

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic wire and cable for feeder and branch circuit conductors.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.

C. Principal features of this section include, but are not limited to the following:
   1. Wire and cable
      a. Solid and stranded type
      b. Mineral-Insulated, Metal Sheathed Cable, type "MI"
      c. SE (Service Entrance Cable) type
      d. MC and HCF type
      e. SO cord and SOW cable
   2. Connectors, Lugs, and Pads
   3. Splice Kits
   4. Strain Relief Fittings

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 33 RACEWAYS & BOXES FOR ELECTRICAL SYSTEMS
   3. Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEM
   4. Related Sections Under Other Divisions:
      a. The General provisions, including supplementary conditions, of this contract apply to this section.
      b. Control, Signal, and Communications conductors shall be as required per the manufacturer of the equipment or as specified by others.

1.3 REQUIREMENTS

A. Materials and installation shall be in accordance with the latest published requirements of the following codes and standards:
   1. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).
   2. IEEE Standard 510 – 1992, Recommended Practices for Safety in High Voltage and High Voltage Power Testing.

3. IEEE Standard 400 – 2001, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
4. National Electrical Code, NFPA 70.
5. National Fire Protection Code 70B, Recommended Practice for Electrical Equipment Maintenance.
6. Federal Specification A-A-59544.
7. UL 83 – Thermoplastic-Insulated Wires and Cables
8. ASTM B1 – Hard-Drawn Copper Wire
9. UL 486 A and UL 486 B – Wire Connections for Copper and Aluminum
10. NECA/AA-104-2012 – National Electrical Contractors Association Recommendation for Installing Aluminum Building Wire and Cable

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Wire, cable, SE Cable: Southwire, Okonite, or engineer of record approved equal.
2. MC and HCF cable: Southwire, AFC, or engineer of record approved equal.
3. SO cord and SOW cable: AWC or engineer of record approved equal.
4. Connectors, Lugs, and Pads: Thomas & Betts or engineer of record approved equal.
5. Splice Kits: 3M, Ideal.
6. Strain Relief Fittings: Hubbell, or equal.

2.2 MATERIALS

A. Copper Wire and Cable, Solid and stranded type – Suitable for operation at 600 volts in all installations as specified in the National Electrical Code. Type XHHW, THHN, or THWN insulation rated for 90 deg. Celsius in wet and dry locations. Stranded or solid for sizes smaller than and including 8 AWG and stranded for larger than size 8 AWG.

B. Copper SE (Service Entrance Cable) type – Two or three wire copper conductor with bare ground wire. 90 deg. Celsius rated type XHHW, THHN, or THWN insulation. Copper conductors shall be annealed copper. Weather resistant polyvinyl chloride PVC jacketed. Suitable for operation at 600 volts in all installations as specified in the National Electrical Code.

C. Copper MC and HCF type - Suitable for operation at 600 volts in all installations as specified in the National Electrical Code. Type XHHW, THHN, or THWN insulation rated for 90 deg. Celsius in dry locations, copper grounding conductor. High strength galvanized steel or aluminum interlocking (listed and identified for grounding), flexible armor. Insulated circuit and grounding conductors shall be cabled together and contained under an overall nonmetallic tape covering.

D. SO cord and SOW cable – Maximum of six annealed copper conductors and bare ground wire. 90 deg. Celsius rated polyvinyl chloride (PVC), nylon jacketed. Suitable for operation at 600 volts in all installations as specified in the National Electrical Code.

E. Connectors, Lugs, and Pads – Connectors shall be UL listed and suitable for 600 volts in all installations and a minimum of 75 deg. Celsius rated. Strict adherence to manufacturer installation means and methods is required. Connections shall be suitable for use with conductors installed (i.e. Copper or Aluminum). Connectors shall be appropriately sized pursuant to the conductors connected (i.e. stranded or solid). Exposed wires, clamps, and connectors shall be completely insulated with vinyl plastic tape. Indenture-compression type connectors shall be used for stranded conductors. Screw-on compression type connectors shall be used for size 8 AWG and smaller.

F. Splice Kits
   1. Copper Conductors, sizes #10 AWG and smaller where spliced shall use "spring-lock" connectors.
   2. Copper Conductors, sizes #8 and larger where spliced shall utilize an approved split bolt connector. These types of non-insulated connections shall be thoroughly protected with applied insulation.
   3. Spliced conductors in exterior, damp and wet locations shall be insulated with an epoxy kit or protected with 3M #2200 or #2210 vinyl mastic insulating pads.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Follow manufacturer instructions with respect to installation in low ambient temperatures. Cables installed in cold weather shall be handled with care and pulled slower.

B. Conductors shall have the proper listing for the environment installed (i.e. wet location, plenum ceiling, high/low ambient temperature). Conductors installed exterior, underground, or below floor slab shall require a wet location listing.

3.2 PREPARATION

A. Inspect cable and reels for damage prior to installation. Ensure cable ends are sealed to prevent entrance of moisture.

B. Consult cable manufacturer for approval of proper pulling equipment (i.e. wood reels, steel reels, etc.)

C. Ensure pulling lubricant is approved by the manufacturer and compatible with the cable. Lubricant that is made of flammable product, wax, and/or grease is not approved.

3.3 INSTALLATION

A. Conductors shall be installed in a permanent raceway or cable tray. Raceways shall be as sized to meet minimum code requirements or as noted on the drawings, whichever provides a larger cross-sectional area. Conduit raceway shall be installed prior to pulling conductors through.

B. Conductor bend radii shall not exceed manufacturer recommendations during installation.

C. Do not exceed manufacturer limitations for the amount of pulling tension applied to the conductors. Avoid pulling different conductor sizes, with different tension limitations, at the same time. Pull tension calculations shall be performed prior to pulling conductors to ensure maximum pulling stress allowed by the manufacturer.

D. Do not exceed manufacturer limitations with respect to maximum side wall pressure.

E. Strain relief fittings shall be used where the installation exceed manufacturer maximum stress allowanced for cables under vertical tension. Vertical raceways shall be supported at the top (or as close as practical), with interval supports per NEC Table 300.19 (A).

F. Dedicated neutral conductors shall be provided for each single phase circuit (i.e. one neutral conductor for each phase conductor) with the exception of multiwire branch circuits where either a common handle tie, two, or three pole circuit breaker is used in accordance with NEC 210.4 (B).

G. Conductors shall be as specified on the drawings. Conductors smaller than 12 AWG shall not be used for commercial projects and 14 AWG for residential projects.

H. Copper Wire and Cable, either solid, compact stranded, or stranded type shall be color coded pursuant to voltage and phase configuration. Phase A – Black (208V, 240V), Brown (480V). Phase B – Red (208V), Orange (240V, 480V). Phase C – Blue (208V, 240V), Yellow (480V). Neutral – White (208V, 240V), Gray (480V). Ground – Green (208V, 240V, 480V). Isolated Ground – Green w/ colored strip (208V, 240V, 480V).

I. MC and HCF type cable shall be allowed with the following restrictions and criteria:
   1. For branch circuits in concealed, non-exposed, dry, areas where there are accessible ceiling spaces.

2. MC and HCF cable shall not be used for branch circuit homeruns. Homerun conductors shall be installed in conduit per 26 05 33 RACEWAYS & BOXES FOR ELECTRICAL SYSTEMS.
3. Cable runs shall be secured and supported at intervals not less than six feet unless otherwise permitted per code.
4. Cable runs shall be installed with the radius of the curve of the inner edge of any bend not less than seven times the cable diameter.
5. MC and HCF type cable shall be installed per the cable manufacturers through-penetration firestop system listed by Underwriters Laboratory, or equivalent listing agency.
6. MC and HCF cable shall not be used in exposed, underground, overhead, direct burial, or wet locations.
7. MC and HCF cable shall not be used for emergency or critical branch circuits in healthcare facilities except as permitted in NEC 517.30(C)(3)(3).

J. Service Entrance Cable, Type SE, shall be used for residential service drops from the distribution or service panel to the load center. In addition, four wire residential equipment connections size 8 AWG and greater.

K. SO Cord and SOW cable shall be used for portable tools, appliances, and equipment. SO cord and SOW cable shall also be used for temporary power connections.

L. SPLICES
1. The contractor shall be responsible to assure that all splices are completed in a secure and permanent fashion, maintaining the integrity of the connection without faults or shorts. Where applicable, and required per installed conditions, the contractor shall take extra care to tape wrap spliced conductors.
2. Splices shall be minimized. Splices below grade shall be avoided, if required, the Engineer of Record will approve prior to installation. Feeder splices below grade shall be made be fully watertight and made with conductors encapsulated in epoxy.

M. CONNECTORS
1. Electrical connections shall be inspected periodically in accordance to NFPA 70B.
2. Where set screw connectors are used, ensure screws are tightened via a torque wrench or torque screw driver. Connectors shall be tightened to the value as required by the connector manufacturer.
3. Where compression connectors are utilized, ensure the crimping tool utilizes is as per manufacturer recommendations. Remove and excess oxide inhibitor from conductors after crimping is complete.

N. The use of pulling compounds is allowed. Pulling compounds shall be applied before and/or during the pull.

O. Cable shall be installed in a neat and workmanlike manor. Cable shall be installed parallel or perpendicular to walls. Diagonal runs shall not be permitted. Cables routed in cable tray shall be organized and tie wrapped.

P. Cables installed in cabinets and panelboards shall be bundled in a neat and orderly fashion in the wireway. Conductors shall be held clear of sharp edges.

Q. Conductors in panels, cabinets, switchgear, motor control cabinets, pull boxes, etc. shall be labeled indicated branch circuit designation and source of supply.

R. Conductors shall be installed in an approved raceway. Each raceway shall also contain a grounding conductor size per NEC table 250.122.

3.4 TESTING

A. Insulation Resistance (IR) testing shall be conducted for branch circuit conductors rated 400 amps and higher in accordance with IEEE Standards . Testing shall be done with a dc potential of 500 to 1,000 volts dc. Avoid testing conditions such as humidity, moisture in conductors, and excess pulling lubricants.

B. The conductors shall be de-energized prior to resting. Remove grounds from the cable phase that will be tested only.

C. Test results shall be recorded and provided to the owner. Testing records shall include testing instrument used, feeder specifications, conductor insulation type, voltage applied, conduit specification, length of conductor, and megohm meter reading.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING AND BONDING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic grounding and bonding of electrical systems.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification for a complete grounded and bonded system.

1.2 DEFINITIONS

A. Definitions shall be consistent with Article 100 of the National Electrical Code, with California State Amendments.
   1. "Bonding Jumper" – A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.
   2. "Bonding Jumper, Equipment" – The connection between two or more portions of the equipment grounding conductor.
   3. "Bonding Jumper, Main" – The connection between the grounded circuit conductor and the equipment grounding conductor at the service.
   4. "Ground" – The earth.
   5. "Grounded" (grounding) – Connected (connecting) to ground or to a conductive body that extends the grounded connection.
   6. "Grounded, Solidly" – Connected to ground without inserting any resistive or impedance device.
   7. "Grounded Conductor" – A system or circuit conductor that is intentionally grounded.

1.3 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
   3. Section 26 05 46.13 UNDERGROUND ELECTRICAL CONSTRUCTION AND SERVICE

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.4 REQUIREMENTS

A. Grounding and bonding of the electrical system shall be performed in accordance to the latest published requirements of the following codes and standards. Note, grounding and bonding of electrical systems shall be specific to electrical equipment and conductive material, establishing an effective ground-fault current path and personal safety.
   1. National Electrical Code (NEC), with California State Amendments, Article 250 – Grounding
   2. IEEE Standard 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials for a Grounded System
   3. IEEE Standard 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
   4. ASTM B1 – Hard-Drawn Copper Wire
   5. ASTM B8 – Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   6. UL 83 – Thermoplastic-Insulated Wires and Cables
   7. UL 467 – Grounding and Bonding Equipment

1.5 GUARANTEES

A. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).

PART 2 - MATERIALS

2.1 MATERIALS

A. Ground Rods – Copper-covered steel, minimum 3/4" diameter x 10' long.

B. Grounding Conductor – Insulated green stranded (No. 8 AWG and larger) and solid (No. 10 AWG and smaller) copper. Insulated green with yellow stripe is acceptable pursuant to NEC.

C. Bonding Conductors – Shall be bare stranded copper, with the exception of solid bare copper for No. 10 AWG and smaller sizes as required per NEC.

D. Connectors, Clamps, Splices, Termination Components, & Mechanical Lugs - Industry standard type for connection grounds, bonding, splicing, tapping and similar. Shall be appropriate for the conductor size as permitted by the manufacturer.

E. Ground Bars – 10" L x 1/4" thick copper ground bar with wall mounting kit. Ground bar shall include tapped holes for grounding conductor connections. Extend a #6 AWG copper ground wire from the main electrical service to the

ground bar. Attach the ground wire to the ground bar via a cad weld connection.

PART 3 - EXECUTION

3.1 GENERAL CONDITIONS

A. Grounding shall be performed in accordance to the National Electric Code Article 250 requirements.

B. Drive ground rods and install grounding conductors prior to construction of concrete slabs, structural equipment pads, and general equipment housekeeping pads.

C. Grounding conductors shall be sized per the drawings. When a ground conductor size is not identified, the size shall be installed to meet minimum NEC requirements. Refer to NEC Table 250.66 for grounding electrode conductors and NEC Table 250.122 for equipment grounding conductors for grounding raceway and equipment.

D. Switches for controlling lighting loads shall be grounded in accordance to NEC Article 404. Switches shall not disconnect the grounding conductor unless otherwise indicated specifically on the drawings. The grounding circuit conductor for the lighting circuit shall be provided at the location where switches control lighting loads that are supplied by a grounded general-purpose branch circuit. Note exceptions as outlined specifically in NEC 404.4(C)1-7.

E. Snap switches, including dimmer and control switches, shall be connected to an equipment grounding conductor as outlined in NEC 404.9. Provide snap switches with an equipment bonding jumper connected to the equipment grounding termination of the snap switch.

F. Equipment grounding conductors, grounding electrode conductors, and bonding jumpers shall be connected by one or more of the following means as outlined in CEC 250.8: Listed pressure connectors, terminal bars, exothermic welding process, machine screw type fasteners, thread –forming machine screws, and connections part of a listed assembly. Connections made solely of solder shall not be permitted.

G. Where ground clamps and fittings are subject to physical damage, maintain protective covering by means of metal, wood, or equivalent. Coordinate in field.

H. Contact surfaces shall be thoroughly cleaned of nonconductive coatings (i.e. paint, lacquer, and enamel) before connections are made to insure good metal contact.

I. Grounding conductors shall be installed in every raceway, both metallic and non-metallic, unless specifically identified on the drawings or permitted per this specification.

J. Inaccessible Grounding Connections: Ground connections that are/will be inaccessible upon completion of construction shall be made via exothermic welds or clamp suitable for direct bury.

K. Ground Connections Requiring Periodic Testing, Not Subject to Physical Damage: Where periodic testing is required for ground connections, the grounding electrode, where the ground conductor connection is made, shall be exposed and stubbed up above grade (approx.. 3-4"), in an area not subject to physical damage.

L. Ground Connections Requiring Periodic Testing, Subject to Physical Damage: Where periodic testing is required for ground connections, the grounding electrode, where the ground conductor connection is made, shall be exposed (approx.. 3-4"), integral to a flush in grade pull box.

M. Grounding at serving electric utility company interface shall be made pursuant to utility company specifications and field inspection requirements.

N. Obtain inspector of record acceptance as required and prior to below grade and/or inaccessible connections are completed and concealed.

O. Where occurring, above ground gas piping shall be electrically continuous and bonded to an effective ground fault current path. Piping shall be considered to be bonded where it is connected to appliances that are connected to the appliance grounding conductor.

3.2 INSTALLATION

A. Ground Rods: Shall be driven into the earth. The quantity of rods shall be determined per ground resistance testing. Adequate ground rods shall be provided to maintain a minimum ground resistance defined per Section 3.3 TESTING. Where auxiliary ground rods are required, the installed shall be in accordance to NEC 250.54. Electrodes shall be installed within, and not less than, 6 feet spacing between. Ground rods shall be bonded together, and considered a single grounding electrode system. Bonding connections shall be made by either clamps, suitable for direct burial, via an exothermic weld. The ground rod and connection shall remain accessible.

B. Install bonding jumpers between sections of loosely jointed metallic raceways (i.e. expansion fittings and telescoping raceways) to ensure electrical continuity.

C. Where circuit conductors are spliced within a pull box, junction box, or terminated on equipment within or supported by a pull box, junction box, or like, the associated equipment grounding conductor shall be terminated at the box via listed grounding means in accordance to NEC Article 250.

D. Metal raceways, cable trays, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as grounding conductors shall be bonded where necessary to ensure electrical continuity per NEC Article 250.96.

E. Ground non-current-carrying metallic parts of fixed, portable, and mobile equipment and associated fences, housings, enclosures, floors, and supporting structures.

F. Bond all conductive components of the conduit system, both interior and exterior, to the building grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

G. Bond all conductive components of the communications raceways system, including but not limited to: conduit, cable trays, conduit sleeves anticipated for use with low voltage signaling or data cabling. Bonding connections shall be made via two (2) no. 10 AWG copper conductors. Maintain a minimum of 4" separation. Where exposed to physical damage, install a no. 6 AWG copper conductor in lieu of the references no. 10 AWG copper conductor.

H. System Grounding:
   1. The grounding electrode conductor shall be connected from the load side of the electrical service drop or lateral to the main electrical equipment ground terminal or bus at the service disconnecting means. The ground terminal or bus shall be secured via bolts to the equipment enclosure. A main bonding jumper shall be installed between the grounded conductor terminal bar, or bus, to the secondary service neutral bus at the main service equipment.

I. Grounding Electrodes: Grounding electrodes present at each building or structure shall be bonded together to the grounding electrode system, with exceptions as defined per the NEC. Grounding or bonding conductors shall be connected to the grounding electrode by exothermic welding, listed lugs, listed pressure connectors, listed clamps, or other listed means. Electrodes permitted per NEC Article 250, part III for grounding include:
   1. Metal underground water pipe in direct contact with the earth for 10 feet and electrically continuous.
   2. Metal building frame or structure.
   3. Concrete-encased electrodes.
   4. Ground Rings.

5. Rod and Pipe Electrodes.
6. Listed Electrodes.
7. Plate Electrodes.
8. Other Local Metal Underground Systems or Structures.

J. Secondary Equipment:
   1. Switchgear, Motor Control Centers, Panelboards, and Load centers – Ground conductors of feeders and branch circuits shall terminate at the equipment ground bar or bus. Provide ground bushings for metallic conduits connecting to the physical enclosure. Isolated ground conductors shall terminate at a dedicated/isolated ground bar or bus where indicated on the drawings.
   2. Metallic structures, enclosures, piping, ductwork, raceways, pull boxes, junction boxes, outlet boxes, etc. associated with or in close proximity to shall be bonded and grounded as part of the electrical system.
   3. Fixed Appliances fastened in place or connected by permanent, fixed, wiring methods shall be provided with a ground lug for connection of the branch circuit/feeder equipment grounding conductor.
   4. Transformers – The transformer core shall be grounded to the enclosure. Where a transformer supplying the electrical service and is located outside of the building, the transformer neutral shall be grounded at the transformer secondary. Transformer grounding shall be installed per CEC Article 250, with special attention per the following:
      a. Transformer connection to a grounding electrode and grounding electrode conductor.
      b. Connection of the grounded conductors to the nearest available point of metal water piping systems (s) and the exposed structure frame in the area that is served by the transformer.
      c. Equipment grounding conductor of the transformer primary circuit.
   5. Motors and Starters – Terminate grounding conductors at the ground lug integral to the enclosure, terminal box, etc.
   6. Receptacles – Install an equipment bonding jumper connecting the grounding terminal of the receptacle to a grounded device box/junction box. The box shall be metallic. The equipment bonding conductor shall be terminated at the box by either a listed grounding clip or grounding screw. Size the equipment bonding conductor pursuant to the overcurrent device protecting the branch circuit conductors.
   7. Floor Boxes – Shall be designed and listed to provide ground continuity between the device and the box.
   8. Luminaires – Shall be grounded through the associated conduit system. Where the luminaire manufacturer provides a green ground wire, connect it to the branch circuit grounding conductor

3.3 TESTING

A. Ground resistance testing shall be conducted per IEEE standards four-point fall – of-potential method to determine the resistance between the ground system and earth.

B. Ground resistance shall not exceed 25 ohms.

C. Ground resistance testing shall be performed in the presence of the authority having jurisdiction.

D. Ground resistance testing report shall be included in O&M documentation and provided to the owner prior to final acceptance.

E. GFI circuit breakers and GFI convenience receptacles shall be thoroughly tested during installation and at the completion of the project.

END OF SECTION 26 05 26

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Raceways and boxes for electrical systems.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Conduit and associated fittings
      b. Innerduct
      c. Wire Basket and Cable Tray
      d. Cable sleeves
      e. Outlet, device, pull, and junction boxes
      f. Floor boxes
      g. Conduit bodies
      h. Wire Gutters
      i. Handhole enclosures
      j. Concrete pull boxes and vaults
      k. Fiberglass/composite pull boxes and vaults

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 46.13 UNDERGROUND ELECTRICAL CONSTRUCION AND SERVICE
   3. Section 26 05 53 IDENTIFICATION OF ELECTRICAL SYSTEMS
   4. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
   5. Related Sections Under Other Divisions:
      a. The General provisions, including supplementary conditions, of this contract apply to this section.
      b. Painting of exposed raceways and/or boxes as required by the architect.
      c. Grading, patching, and repairing of existing surfaces, including but not limited to: asphalt, concrete, and vegetation, as required by the Architect/Civil Engineer.

1.3 REQUIREMENTS

A. Materials and installation shall be in accordance with the latest published requirements of the following codes and standards:
   1. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).
   2. National Electrical Code (NEC) with California State and local amendments.
   3. UL 1 – Flexible Metal Conduit
   4. UL 5A – Nonmetallic Surface Raceway and Fittings
   5. UL 6 – Electrical Rigid Metal Conduit - Steel
   6. UL 6A – Electrical Rigid Metal Conduit – Aluminum, Stainless Steel
   7. UL 50 – Enclosures for Electrical Equipment, Non-Environmental Considerations.
   8. UL 360 – Liquid Tight Flexible Steel Conduit
   9. UL 514A – Metallic Outlet Boxes
   10. UL 514B – Conduit, Tubing, and Cable Fittings
   11. UL 514C – Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
   12. UL 651 – Schedule 40, 80, Type EB, and A Rigid PVC Conduit and Fittings
   13. UL 651A – Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit
   14. UL 797 – Electrical Metallic Tubing – Steel
   15. UL 797A – Electrical Metallic Tubing - Aluminum
   16. UL 886 – Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
   17. UL 1660 – Liquid-Tight Flexible Non-metallic Conduit
   18. UL 1653 – Electrical Non-Metallic Tubing
   19. UL 2225 – Standard for Cables and Cable-Fittings for Use in Hazardous (Classified) Locations
   20. American National Standards Institute (ANSI) OS1 and OS2
   21. National Electrical Manufacturers Association (NEMA) FB1 and 250

PART 2 - PRODUCTS

2.1 MATERIALS

A. Raceways
   1. Raceway product shall be rated for use with 90 degree Celsius power wiring conductors.
   2. Rigid Non-Metallic Conduit
      a. Schedule 40, wall thickness of 0.113 inches, Polyvinyl Chloride (PVC) construction, Bell end feature, manufactured in accordance with NEMA standard TC-2 (conduit) and TC-3 (fittings).
      b. Schedule 80, wall thickness of 0.154 inches, Polyvinyl Chloride (PVC) construction, Bell end feature, manufactured in accordance with NEMA standard TC-2 (conduit) and TC-3 (fittings).

3. Galvanized Rigid Steel (GRS) Conduit – Hot-dip galvanized, zinc coated rigid steel conduit, manufactured in accordance with ANSI C80.1.
4. Electrical Metallic Tubing (EMT) – Light gauge, steel raceway with zinc galvanized coating manufactured in compliance with ANSI C80.3.
5. Electrical Non-Metallic Tubing (ENT) – Pliable corrugated raceway of circular cross section made of Polyvinyl chloride (PVC) manufactured in compliance with NEMA Standard TC-13.
6. Flexible Metal Steel Conduit (FMC) – Galvanized, corrosion resistant, high strength steel alloy. Metal strip is helically formed into continuously interlocked flexible metal conduit. Manufactured in accordance with Federal Specification WW-C-566c.
7. Liquid Tight Flexible Metallic Conduit (LFMC) – Manufactured with a spiral wound strip of heavy gauge, corrosion-resistant, hot-dipped galvanized steel. For 3/8" through 1-1/4" trade sizes, a square locked steel strip with an integral copper-bonding strip enclosed within the steel convolutions. For 1-1/2" through 4" trade sizes, the core is constructed with a fully interlocked steel strip. Flexible, rugged, flame retardant, PVC jacket extruded over the steel core. The jacket shall resist oils, mild acids and exposure to sunlight. Rated for temperature range of -30 to +80 degrees Celsius.
8. Liquid Tight Flexible Non-Metallic Conduit - Manufactured with a spiral of rigid PVC reinforcement imbedded within a flexible PVC wall, resistant to oils, mild acids and exposure to sunlight. Rated for a temperature range of -30 to +80 degrees Celsius.
9. Conduit Supports – Unistrut, Caddy or engineer approved equal. Conduit supports shall consist of; clamps, straps, brackets, clips, j-hooks trapeze hangers, "C" channel strut etc.
10. Conduit Fittings – Thomas & Betts, O-Z Gedney, or engineer approved equal. Fittings shall be appropriate for use with the conduit system installed. Fittings shall consist of connectors, rigid and flexible, adaptors, bushings, liquid tight (as required), locknuts, etc.

B. Boxes
   1. Manufacturers
      a. Outlet Boxes – Bowers, Steel City, Raco, or engineer approved equal.
      b. Weatherproof outlet boxes – Bell, Red Dot, or engineer approved equal.
      c. Weatherproof outlet box "While-in-use" locking cover – Red Dot "CK" series or engineer approved equal.
      d. Masonry Boxes - Bowers, Steel City, Raco, or engineer approved equal.
      e. Pull boxes, Junction Boxes, and Gutters – Hoffman, Circle AW, or engineer approved equal.
      f. Vaults (non-utility company use), Handhole enclosures – Christy, Oldcastle Enclosure Solutions, Brooks Products, or engineer approved equal.
      g. Floor Boxes – Wiremold/Walker, Hubbell, or engineer approved equal.

C. Accessories
   1. Manufacturers
      a. Box Extension Adaptor – Bell, Red Dot, or engineer approved equal.
      b. Putty Pads – 3M, Hilti, or engineer approved equal.

PART 3 - EXECUTION

3.1 General

A. Raceway systems shall be installed in accordance to uses permitted per code.

B. Raceways and boxes penetrating a listed fire rated assembles (i.e. walls, floors, and ceilings) shall be installed with use of an UL approved classified through-penetration fire stop systems. Fire Stop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

C. Trenching and backfilling for underground raceway systems is the responsibility of the contractor. Refer to trench requirements detailed on the drawings and Section 26 05 46.13 UNDERGROUND ELECTRICAL CONSTRUCION AND SERVICE requirements. The contractor is required to implement traffic control and provide barriers as required to protect excavated areas.

D. Seismic Support shall consist of approved channel (either in combination or pierced), heavy/standard duty concrete inserts, hangers, nuts, hardware, general support fittings (i.e. Angle supports, beam clamps, pivot fittings, retrofit fittings, brace-anchor fittings, and hinge fittings). Electrical equipment shall be anchored and braced to meet the horizontal and vertical forces identified in the California Building Code.

3.2 CONDUIT SYSTEM

A. Minimum conduit size shall be 1/2", with the following exceptions:
   1. When a larger size is required to meet Code.
   2. Underground and/or under slab conduit shall be a minimum ¾".

B. Systems (i.e. power, control, communications, etc.) shall be installed in dedicated raceways. Systems shall not be combined within a raceway unless specifically identified in the construction documents.

C. Install conduit runs in accordance to the schematic representation as indicated on the drawings and as specified. Modify conduit runs to suite field conditions as accepted by the engineer of record.

D. Install conduit runs for branch circuits and or feeders where only circuit numbers are identified on the plans, without schematic conduit routing shown.

E. Install conduit runs in straight lines, parallel to planes of walls and/or ceilings, with uniform and symmetric elbows, offsets, and bends. Conduit shall not be run diagonally.

F. Be conscious of the elevation by which underground conduits are installed. The open conduit end at the building and/or where it transitions into distribution equipment shall be at a higher elevation such to prevent the infiltration of water through the conduit raceway.

G. Conduit shall be installed such that it does not interfere or block equipment, ingress/egress, or access hatches.

H. Conduit shall be securely fastened by means of clamps and/or straps as required per the NEC. Type 316 stainless steel straps and/or clamps shall be used with exposed PVC-coated rigid steel conduit. Provide appropriate conduit hangars, supports, fasteners, and seismic restraints.

I. Liquid-tight, flexible conduit shall be used in short lengths as required for final motor connections and/or vibrating equipment.

J. Conduit bends shall be made such that the conduit will not be damaged and the internal diameter of the conduit will not be effectively reduced. Form or field bend conduit with appropriate tools. Conduit shall be routed such that it does not exceed a cumulative angular sum of 360 degrees in bends between junction boxes, pull boxes, conduit bodies, handholes, and vaults

K. When re-using existing raceway(s) and/or installing new raceways, verify raceway(s) are free of internal debris and are not crushed or creased prior to installing conductors or cables. The use of a mandrel may be required. The contractor shall replace conduit sections that are determined to be damaged and/or obstructed.

L. Spare and empty conduits shall be properly plugged with the appropriate cap and/or insert. The use of tape, “duct” tape or like, will not be acceptable. Spare conduit identified on the drawings shall be retained as spare and shall not be used during construction unless prior authorization is given from the engineer of record.

M. Special attention shall be paid to atmospheric conditions (i.e. Corrosion, sunlight, chemicals, abrasion, moisture) and occupancies pursuant to the NEC. Raceway systems shall be suitable for the environment in which they are installed.

N. Use of dissimilar metals shall not be allowed. Boxes, fittings, enclosures, and conduit supports shall be of the same metal, with or without coatings, as the conduit type.

O. Galvanized Rigid Steel (GRS) risers shall be used where conduit runs are installed equal or in excess of 150 LF. GRS elbows shall be used where the top of the

elbow is installed less than 18 in. below finished grade, with conduit rising up from below grade to terminate at an equipment enclosure, disconnect switch, device, machinery, etc. above grade. GRS risers and elbows shall either be PVC coated, as identified in this specification, or tape wrapped to a minimum of 3" above finished grade or the top of the equipment pad or slab, whichever is applicable to the installation condition.

3.3 RACEWAYS

A. Rigid Non-Metallic Conduit – Rigid Polyvinyl Chloride (PVC) schedule 40 and/or 80. Utilize below grade, in/under slab or foundation, not where subject to physical damage or at operating temperatures outside of product listing. Cut ends shall be trimmed inside and outside to remove rough edges.

B. Galvanized Rigid Steel (GRS) Conduit - Utilize where exposed between +18" below grade and +8' above finished grade where exposed to physical damage. Cut ends shall be reamed or otherwise finished to remove rough edges. Tape wrap where located below grade.

C. Electrical Metallic Tubing (EMT) – Utilize exposed or concealed, where not subject to physical damage, underground, and in/under slab. Couplings and connectors used with shall be made up tight and of die cast, insulated/non-insulated, set screw type. Stainless steel fittings shall be used in high corrosive areas. Compression type, weatherproof fittings shall be used in damp and wet locations.

D. Electrical Non-Metallic Tubing (ENT) – Shall be used in concealed, dry locations within walls, floors, and ceilings. Special attention shall be paid to buildings exceeding three floors above grade. Do not use where subject to physical damage, in direct bury applications, in hazardous (classified) locations, in theaters, where exposed to direct sunlight, or at operating temperatures outside of product listing. Fittings, outlet boxes, and cement shall be designed and listed for use with ENT. ENT shall be color coated as follows: BLUE for branch circuiting, YELLOW for communications, and RED for fire alarm and emergency systems. Where nails and/or screws are likely to penetrate installed ENT, a steel sleeve, plate or clip not less than 1.6mm in thickness shall be used to protect the tubing.

E. Flexible Metallic Tubing (FMT) - May be used in interior exposed/concealed locations. Do not use in wet locations, hoistways, hazardous (classified) locations, underground or embedded in concrete/aggregate, and where subject to physical damage. All cut ends shall be trimmed or otherwise finished to remove rough edges, except where fittings that thread into the convolutions are used. Flexible metal conduit shall not be used in cumulative lengths exceeding 30 linear feet. Liquid Tight Flexible Conduit shall be installed in damp and wet locations. Fittings shall be set screw, squeeze type, use for appropriate damp, wet, or dry location. Fittings shall be of grounding type.

3.4 Conduit Supports – Provide a conduit supports system consisting of; clamps, straps, brackets, clips, j-hooks trapeze hangers, "C" channel strut etc. The use of J-hook style supports shall be restricted to not exceeding 1" conduit and wood frame construction. Ensure support is provided with isolation material or cushion as required for shock absorption, sound and vibration isolation, protection from corrosion and abrasion, and allowance for expansion and contraction. Conduit supports shall be selected for use given the conduit size and weight. Follow manufacturer recommendations for pipe spacing when supported, bolt torque. Conduit supports are subject to the approval of the AHJ. Corrections required to obtain approval shall be the sole responsibility of the contractor.

3.5 Conduit Fittings – Fittings shall be appropriate for use with the conduit system installed. Fittings shall consist of connectors, rigid and flexible, adaptors, bushings, liquid tight (as required), locknuts, etc. Connection devices and or fittings that depend solely on solder shall not be used for grounding and bonding. Protect fittings from physical damage. Fittings shall be tight using suitable tools. Fittings shall be insulated when used with raceways that contain 4 AWG or larger conductors per NEC 300.4.

3.6 BOXES

A. Junction boxes, pull boxes, and conduit bodies shall be sized a minimum per NEC Article 314. Adhere to volume and fill calculations as identified in the code.

B. Metallic boxes shall be bonded and grounded in accordance to NEC Article 250.

C. Listed weatherproof boxes, conduit bodies, and fittings are required for use in damp and wet locations.

D. Terminal blocks shall be installed in junction/terminal boxes as required.

E. Pursuant to NEC Article 314, boxes installed in walls or ceilings with a surface of concrete, tile, gypsum, plaster, or other noncombustible material, using a flush-type cover or faceplate shall be installed so that the front edge of the box, plaster ring, extension ring, or listed extender will not be set back of the finished surface more than a ¼ in. In walls and ceilings constructed of wood or other combustible surface material, boxes, plaster rings, extension rings, or listed extenders shall be flush with the finished surface or project therefrom. In addition, there shall be no gaps around a flush-type cover or faceplate greater than 3/8 in. at the edge of the box.

F. Junction and pull boxes shall be installed such that access is not restricted by obstructions such as, but not limited to: piping, ladders, and equipment.

G. Outlet boxes and junction boxes installed in fire rated construction shall be installed Metallic and nonmetallic boxes that are classified for fire resistance by

Underwriters Laboratories (UL) Inc. The spacing between boxes cannot be less than 24 inches, however closer spacing shall be permitted where wall opening protective materials are installed according to the requirements of their classification. These materials shall be found under CLIV in the Fire Resistance Directory published by UL. Boxes shall be installed so that the surface area of individual boxes does not exceed 16 square inches, and the aggregate surface area of the boxes does not exceed 100 square inches per 100 square feet of surface area.

H. Outlet Boxes
   1. Non-metallic outlet boxes are permitted for residential applications only where used with type NM-B "Romex" cable.
   2. Galvanized Steel outlet boxes shall be used throughout unless otherwise noted in this specification. Metallic boxes shall be grounded and bonded in accordance to NEC requirements.
   3. Luminaire boxes and lampholders shall be listed for such purpose and shall have threaded entries or hubs. Outlet boxes supporting luminaires shall be rated for 50 lbs. or less. Luminaires weighing over 50 lbs. shall not be supported from the outlet box and shall be supported independently from the building structure.
   4. Paddle Fan outlet boxes shall be metallic and listed to support fans up to 70 lbs. Paddle fans weighing over 70lbs. shall be supported independently from the building structure. Utilize bracing/bar hangers between ceiling framing.

I. Weatherproof outlet boxes and covers shall be die-cast metal, powder-coated silver finish, corrosion resistant, provided with threaded conduit ends, and NEMA 3R rating.

J. Outlet boxes for receptacles installed outdoors in a damp and/or wet locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is in use (i.e. "While-in-use" over). "While-in-use" covers shall be metallic and the appropriate gang construction (i.e. Single, double) as required for the device indicated on the drawings.

K. Masonry Boxes shall be suitable for use imbedded in concrete or masonry and shall be protected from corrosion.

L. Floor Boxes
   1. Shall be cast iron when installed in floor slabs at grade level. Stamped steel construction is acceptable when installed in floors not at grade. Non-metallic floor boxes are not approved for installation on this project.
   2. Floor boxes shall be fully adjustable before and after floor slab pour, accommodating a minimum floor slab pour depth of 3.75". Provide floor boxes with quantity, configuration, and type of device(s) as indicated on the drawings. Floor box gang construction (ie. Single, double) as required per the quantity of devices noted on the drawings. Floor boxes shall be flush in the floor and provided with appropriate covers, plates, and

flanges. Flanges shall be suitable for the type of flooring installed (ie. Carpet, wood, or tile). Floor boxes shall accommodate threaded hub sizes of 3/4" and 1" conduits or as identified on the drawings.

3.7 ACCESSORIES

A. Box Extension Adaptors shall be provided with either die cast aluminum or cast iron, with gasket construction appropriate for use with the outlet box intended. Extensions and adaptors shall be of appropriate gang construction (i.e. Single, double) as required and shall be either round, square, or flanged as required.

B. Putty Pads shall be moldable and listed for the appropriate use (i.e. Fire stop or sound). Prior to application excess water, dirt, oil, or debris shall be removed. Ensure the pad size is selected appropriately to ensure the entire surface of the box is covered with a smooth and even thickness. Trim excess putty pad material to allow for the application of conduit fittings. Conduits shall be sealed as they enter/leave the box. Follow manufacturer application instructions.

C. Provide outlet box mounting brackets, hangars, extension, plaster rings, studs, clamps, and straps as required.

END OF SECTION 26 05 33

SECTION 26 05 46.13 – UNDERGROUND ELECTRICAL CONSTRUCTION AND SERVICE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Complete underground electrical raceway system.

B. Furnish labor, materials, equipment, components, and necessary services to support design requirements as show on the drawings and specified herein in this specification.
   1. Principal features of acceptance include:
      a. Trenching
      b. Pull boxes
      c. Conduit
      d. Ducts

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
   3. Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
   4. Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
   5. Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.
   2. Grading, patching/repair of existing surfaces (asphalt, concrete, vegetation, etc.).
   3. Concrete work including but not limited to: equipment pads, luminaire bases, as required by the Architect / Civil / Structural Engineer.

1.3 QUALITY ASSURANCE

A. Electrical work shall be performed in accordance of the latest published requirements of the following codes and standards:
   1. National Electrical Code (NEC) with California State Adoptions and Amendments.

B. Electrical work for site power / communication utilities shall adhere to the respective utility company design drawings (i.e. "handout package") and standard specifications. Work done prior or in advance of shall be done at risk.

PART 2 - EXECUTION

2.1 CONDUIT

A. Direct buried cable shall not be allowed.

B. Conduit installed underground shall maintain minimum cover requirements as defined in the NEC / CEC Table 300.5, "Minimum Cover Requirements, 0 to 600Volts, Nominal". Consistent with the NEC / CEC cover shall be defined as the shortest distance measured between a point on the top surface of any direct buried conduit or other raceway and the top surface of finished grade, concrete, asphalt, or other surface. Lower cover shall only be allowed where specified with concrete encasement.

C. Where subject to physical damage conduit shall be rigid metal conduit or schedule 80 PVC.

2.2 TRENCHING

A. Backfill material shall not contain large rocks, paving material, cinders, large sharp angular materials / substances, or corrosive materials and like.

B. Actual trench depth shall be adequate to maintain required cover as indicated per NEC / CEC Table 300.5, "Minimum Cover Requirements, 0 to 600Volts, Nominal".

C. "Joint Trenching" by means of combining different dry utilities in a common trench shall be utilized where practical, within utility company allowances / restrictions.

D. Electric and / or communication conduit systems shall not share a common trench with wet utility systems (i.e. water, sewer, sanitary drains, propane, storm drain, or the like). Adequate separation clearance shall be maintained between wet and dry conduit systems defined by the civil engineer. Warning ribbon or tape shall be installed in conduit trenches as identified on the drawings.

E. Warning ribbon or tape shall be installed in trenches at not more than 12" above the underground installation, for direct buried conduit installed 18" below grade.

F. Conform to inspection requirements set forth by the AHJ and / or Utility Company. If applicable, ensure trenches are inspected prior to backfill.

G. Coordinate trench routing with actual field conditions. Every effort shall be made to reduce / eliminate the need for sharp turns / bends.

2.3 PULL BOXES

A. Pull boxes shall be adequately protected / suitable for the environment in which they are installed. For example, traffic rated covers / acceptable installation practice as defined per the manufacturer shall be utilized where pull boxes are installed in a location subject to vehicular traffic (non-incidental).

B. Excavate approximately 6" deeper than the overall height and 4-6" wider (all four sides) that the pull box enclosure. Pull boxes shall be installed on a 3-6" bed of compacted material (i.e. sand or gravel is acceptable). The compacted material shall be level such that the pull box is installed flush with the adjacent finished grade.

C. In the event a pull box is installed in concrete / pavement where subject to occasional, non-deliberate vehicular traffic, an 8" wide section of concrete shall be installed on all four sides of the pull box, extending from grade to 8" below grade.

2.4 TEMPORARY CONSTRUCTION POWER

A. As required, the contractor shall be responsible to coordinate with the local utility company for the installation of temporary construction power. Costs associated with temporary construction power installation, including associated utility company fees, shall be included in the contractors bid.

2.5 UTILITY COORDINATION FOR NEW SERVICE

A. Utility service requirements as shown on the drawings are provided for reference only and are subject to the approval of the Utility Company and final issuance of the Utility Company design drawing, or "hand out" package. The contractor shall be fully responsible to coordinate with the Utility Company and install utility systems as directed by the Utility company.

END OF SECTION 26 05 46.13

SECTION 26 05 53 – IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Identification of electrical systems.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include identification of electrical systems by means of:
      a. Warning Signs
      b. Warning ribbon
      c. Arc Flash Signage
      d. Name Plates
      e. Device Labels and tags

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
   3. Section 26 24 13 SWITCHBOARDS
   4. Section 26 24 16 PANELBOARDS AND LOAD CENTERS
   5. Section 26 27 26 WIRING DEVICES
   6. Section 26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.3 REQUIREMENTS

A. Identification of electrical systems shall be performed and installed in accordance with the latest publication of the following codes and standards:
   1. National Electrical Code (NEC) with California State Amendments.
   2. ANSI Z535.4 Guidelines – Product Safety Signs and Labels
   3. National Fire Prevention Association Standard for Electrical Safety Requirements for Employee Workplaces (NFPA 70E).

1.4 PERFORMANCE

A. Labels shall be suitable for the environment where they are installed with consideration given to exposure to chemicals, sunlight, and abrasion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates
   1. Normal Power: Black lamicoid with white letters fastened with round head, stainless steel screws.
   2. Emergency Power: Red lamicoid with white letters fastened with round head, stainless steel screws.

B. Warning Ribbon – Min. 6" wide made of polyethylene film or detectable laminated aluminum designed for direct burial. Warning ribbon shall not be made of materials that will biodegrade.

C. Warning Signs – Printed adhesive polyester protected by clear polyester laminate for general use. Provide rigid polyethylene signage where abrasion is of concern or where adhesive signage is not appropriate.

PART 3 - EXECUTION

3.1 INSTALATION

A. Warning Signs
   1. Rooms and other guarded locations that contain exposed, live parts shall have conspicuous warning signs posted at the entrance forbidding unqualified persons to enter.
   2. Rooms where the operating voltage exceeds 600V, nominal, shall be kept locked and shall be provided with a conspicuous warning sign that reads the following: "DANGER – HIGH VOLTAGE – KEEP OUT".
   3. Are required where electric energy is provided to equipment from more than one source.
   4. Warning signs shall be provided on utilization equipment that has 120VAC control voltage source used for interlocking. The panel, circuit number, and conductor tag of the control voltage source disconnect shall be identified.

B. Warning Ribbon
   1. Warning ribbon or tape shall be installed in conduit trenches as identified on the drawings. Pursuant to the NEC, warning tape shall be required for

conductors that are not concrete encased and buried 18" below grade or more.

2. Warning ribbon or tape shall be installed in trenches at not more than 12" above the underground installation.

C. Arc Flash Signage

1. Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling occupancies, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric are flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment pursuant to NEC 110.16.
2. Arc Flash labels shall meet the requirements of NFPA 70E and contain the following information:
    a. At least *one* of the following:
        1) Calculated available incident energy and corresponding working distance
        2) Minimum arc rating of clothing
        3) Required PPE (Personal Protective Equipment)
        4) Highest Risk Category (HRC) for the equipment
    b. Nominal system voltage
    c. Arc flash boundary

D. Name Plates

1. Nameplates shall be provided for electrical equipment enclosures such as, but not limited to: service and/or distribution switchgear, motor controls, transformers, panels, load centers, lighting control panels, fire alarm control panels, cabinets, motors, generators, inverters, uninterruptible power supplies (UPS), and transfer switches.
2. Nameplates shall be provided for separately enclosed devices such as, but not limited to: circuit breakers, disconnect switches, contactors, time clocks, and relays.
3. The following, minimum, information shall be included on equipment and enclosed device identification:
    a. Voltage Rating
    b. Source
    c. Load Served
    d. Circuit/Feeder designation
    e. Primary and secondary voltages and load served (transformers only).

E. Available Fault Current

1. Service equipment, excluding dwelling units shall be marked with the available fault current and date of calculation / equipment installation in accordance with CEC 110.24(A).

F. Device Labels

1. Switches not within sight from the load controlled.
2. Junction boxes shall be labeled with the branch circuit and/or feeder conductors passing through the box. Hand-written labeling via permanent marker is acceptable provided it is in a visible location and is legible.

G. Raceway Identification (Tags)
   1. Identify conductors at each termination. Tag conductors with sleeve type labels.
   2. The following, minimum, information shall be included on wire and cable identification:
      a. Circuit number or load identification tag number,
      b. Origin from source.
      c. Destination to load.

H. Grounding Conductors larger than 6 AWG
   1. Grounding conductors larger than 6AWG shall have the insulation or covering marked with green tape or green adhesive labels at the termination pursuant to NEC 250.119.

END OF SECTION 26 05 53

SECTION 26 09 23 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic lighting control devices, including but not limited to lighting control devices.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Lighting control sensors shall be mounted, ie. Wall mount, ceiling mount, corner mount, integral to luminaire, interior, exterior, etc. as indicated on the drawings or specified herein.
      b. Lighting control sensors shall be provided either passive infrared ("PIR"), Passive Dual Technology ("PDT"), Line voltage, low voltage, standard coverage, extended coverage, as indicated on the drawings or specified herein.

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 03 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
   3. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
   4. Section 26 27 26 WIRING DEVICES

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.3 SYSTEM DESCRIPTION

A. SUBMITTALS AND SHOP DRAWINGS
   1. Provide manufacturer data sheet, settings, installation requirements, wiring diagrams, etc.
   2. The engineer may request a sensor layout with coverage zones indicated.

1.4 GUARANTEES

A. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).

1.5 PERFORMANCE

A. Occupancy Sensor Technology Requirements.
   1. Occupancy sensors shall sense the presence of human activity within the desired space, pursuant to device technology selected, and enable or disable manual lighting control function. Sensors shall be programmed manual or automatic on as identified on the drawings or specified herein.
   2. Sensors shall utilize passive infrared ("PIR") technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
   3. Sensors shall utilize passive dual technology ("PDT") for applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions). Acceptable dual technology shall include PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
   4. All sensing technologies shall be acoustically passive, such that they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

B. Occupancy Sensor Operational Requirements.
   1. Sensors shall have a minimum time setting range between 0 - 15 minutes. The minimum time setting shall be set to 15 min. in order to prevent the cycling of lamps before they have burned for the lamp manufacturers minimum recommended time period. This timer shall be in addition to the regular occupancy time delay that keeps lights on after last detected occupancy. User shall be able to disable/enable and change the value of this timer.
   2. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Set the default setting of the occupancy time delay to 5 minutes. Make adjustments in the field with the owner as may be required. However, sensors with a time delay setting exceeding 10 minutes shall not be acceptable.
   3. Sensors shall be installed in accordance with manufacturer's recommendation, including final sensor location. All sensors shall be factory calibrated for optimum performance for its installed PIR lens, and

shall not require initial or subsequent field adjustment of detection sensitivity.

4. All sensor setting adjustments shall be digital and made using a push-button. Dip switches, analog dials, and/or the need for tools of any kind shall not be accepted.
5. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Lighting control sensors shall be as manufactured by Sensor Switch, Leviton, Wattstopper, or engineer approved equal.

2.2 PRODUCT DESCRIPTION

A. Line Voltage Wall Mounted Sensors.
   1. Wall mounted occupancy sensors shall be stylish and low profile with soft-click buttons with motion detection up to 20 feet for small areas and up to 40 feet for larger areas.
   2. For applications which require independent control of two loads (i.e. restroom lighting and restroom exhaust fans), the wall mounted sensor shall be provided with dual relays and dual override switches. Each relay shall have independent programmable occupancy time delays. Where exhaust fans are interlocked with room lighting (i.e. restroom), the exhaust fan shall be time delay controlled and turn off 5 minutes after the room lighting.
   3. Sensors shall be capable of switching both 120 VAC / 277 VAC, 60 Hz. The sensor shall be appropriate for the associated load.
   4. Sensor shall recess into single gang switch box and fit a standard receptacle device opening.
   5. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
   6. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
   7. Sensor shall have optional features for photocell/daylight override, vandal resistant lens, low temperature/high humidity operation as may be required per the application and as noted on the drawings.
   8. Wall Switch sensors shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point as applicable.
   9. All models shall be capable of both Auto-On and Manual On operation.

B. Low Voltage Occupancy Sensors
   1. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.
   2. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used.
   3. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.
   4. Sensors shall interconnect with other sensors and power/relay packs with class 2, three-conductor wire.
   5. Upon initial power up, sensors must immediately turn on. Power packs may be wired on the line or load side of local switching and must not exhibit any delays when switch is energized.
   6. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.
   7. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based as indicated on the drawings.

C. Power Packs
   1. Power packs shall be compatible with the lighting controls specified as well as the luminaries it will control.
   2. Power packs shall be installed in accessible areas within the ceiling or concealed spaces.

2.3 WIRING CONFIGURATIONS

A. Lighting control sensors shall be installed per manufacturer wringing diagrams. Should wiring diagrams be included on the drawings, they are for reference only.

2.4 FINISHES

A. Wall mounted sensors and associated cover plates shall match wiring device specifications.

B. Ceiling and corner mount sensors shall be white.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sensors shall be installed and programmed as per manufacturer's instructions.

B. Sensors shall be installed with complete electrical connections.

C. Verify with manufacturer's representative that the sensors are laid out in compliance to manufacturer's published sensing distribution. At no cost to the owner, provide additional sensors for complete coverage as may be required.

3.2 COMPLETION

A. Use manufacturer's published testing and adjusting procedures to adjust sensors time delay, daylight sensitivity, and passive infrared sensitivity to satisfaction of the Owner.

END OF SECTION 26 09 23

SECTION 26 22 13 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic low voltage transformers, dry-type, general purpose, rated for application 1500kva (and below) at 600 volts (and below)

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Single-phase and three-phase general purpose, individually mounted, dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
   3. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
   4. Section 26 05 26, GROUNDING AND BONDING OF ELECTRICAL SYSTEMS
   5. Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEM

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.
   2. National Fire Protection Association (NEPA): 70-2007 California Electrical Code (CEC)
   3. National Electrical Manufacturers Association (NEMA): ST 20-1992 Dry-Type Transformers for General Applications
   4. National Electrical Manufacturers Association (NEMA): TP-1-1996 Energy Efficient Transformers

1.3 SYSTEM DESCRIPTION

A. SUBMITTALS AND SHOP DRAWINGS
   1. Outline dimensions and weights.
   2. Transformer ratings including: kVA, primary and secondary voltage, taps, basic impulse level (BIL) for equipment over 600 volts, design impedance, insulation class and temperature rise, and sound level.
   3. The following information shall be submitted for record purposes.

a. Final as-built drawings and information, incorporating all changes made during the manufacturing process.
b. Connection diagrams.
c. Installation information.
d. Seismic certification and equipment anchorage details as specified.
e. Product data sheets.

1.4 QUALIFICATIONS

A. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

B. The manufacturer shall be a participant in the UL Data Acceptance Program (DAP) under the Client Test Data Program (CTDP) certification to ensure UL test methodologies and record traceability complies with the requirements of ISO 17025.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

D. Provide Seismic tested equipment as follows:
1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
3. The IP rating of the equipment shall be 1.5
4. The Structural Engineer for the Site will evaluate the SDS values published on the [Manufacturer's] website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
6. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
    a. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
    b. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

E. DELIVERY, STORAGE AND HANDLING

1. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

F. OPERATION AND MAINTENANCE MANUALS
1. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

1.5 GUARANTES

A. Independent testing laboratory listing is required. Note Underwriters Laboratories, "UL", is referenced throughout this specification. However, equivalent listing agencies will be accepted.

1.6 PERFORMANCE

A. Transformers shall meet the requirements of the most current version of federal law CFR Title 10 Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

PART 2 - PRODUCTS

2.1 MATERIALS

A. The listing of specific manufacturers below does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer of record ten (10) days prior to bid date.
1. Eaton Cutler Hammer
2. Square-D
3. ACME

2.2 DRY TYPE TRANSFORMERS

A. CONSTRUCTION AND RATINGS
1. Self-cooled by natural convection, isolating windings, indoor, dry type.
2. The kVA and voltage ratings shall be as indicated on the drawings. Ratings shown on the drawings are for continuous-duty without the use of cooling fans.

3. Transformer sound levels shall not exceed ANSI and NEMA levels for self-cooled ratings.
4. Insulation systems:
   a. Transformer insulation system shall be as follows:15 kVA and above: minimum of 200 degree C insulation system with [80] degree C rise, ventilated design
   b. -- OR—
   c. 50 kVA and above three-phase: minimum of 220 degrees C insulation system with [150] degree C rise, ventilated design.
5. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C.
6. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

B. CORE AND COIL ASSEMBLIES
1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade Aluminum or copper with continuous wound construction.
2. On three-phase units rated 75 kVA and below: the core and coil assembly shall be completely encapsulated in a proportioned mixture of epoxy or resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.
3. On three-phase units rated 75 kVA and above the coils assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads.
4. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance, and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.

C. TAPS
1. Three-phase transformers rated 15 through 225 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 225 kVA shall be provided with manufacturer's standard taps for that rating.

D. ELECTROSTATIC SHIELDING
1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed

between the primary and secondary winding and grounded to the housing of the transformer.

2. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.
3. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique: Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz; minus 55 dBA minimum at 1.51 kHz to 100 kHz. Normal mode (Transverse mode) noise attenuation: Minus 35dBA minimum at 1.5 kHz to 10 kHz.

E. WIRING / TERMINATIONS

1. Recommended external cable shall be rated 90 degrees C (sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.3 ENCLOSURES

A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C per UL requirement. The core of the transformer shall be grounded to the enclosure.

B. On three-phase units rated 75 kVA and below the enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 3R, with lifting provisions.

C. On three-phase units rated 75 kVA and above the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weather shields over ventilated openings.

D. Ventilated type transformers that meet 10 CFR Part 431 efficiency requirements, with a core size of 150 kVA or less, shall be suitable for installation with 2-inch clearance from a wall or other obstruction behind the transformer enclosure.

2.4 FINISH

A. Steel enclosures shall be finished with ANSI 61 color, weather-resistant enamel. Stainless steel enclosures shall not be painted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

B. Install the transformers with adequate clearance at a minimum 6 inches or more from the wall and adjacent equipment for air circulation to remove the heat produced by transformers and as recommended by the manufacturer to achieve U.L. listing.

C. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

D. Use flexible metal seal tight conduit to contain the conductors from the transformer to the raceway system.

3.2 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.3 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION 26 22 13

SECTION 26 24 13 – DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic distribution switchboards, were applicable to commercial metering equipment or distribution only.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Free-standing, dead-front-type low voltage distribution switchboard(s) utilizing individually mounted tenant metering and group mounted circuit protective devices as specified herein and as shown on the contract drawings.

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1.3 RELATED SECTIONS UNDER OTHER DIVISIONS
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.4 RELATED STANDARDS

A. The low voltage metering switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:
   1. NEMA PB-2, Dead-front Distribution Switchboards
   2. UL Standard 891, Switchboards.
   3. UL Standard 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.
   4. UL Standard 489, Molded-case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.
   5. UL Standard 1449, 4th addition, Standard for Surge Protective Devices.

1.5 SYSTEM DESCRIPTION

A. SUBMITTALS AND SHOP DRAWINGS

1. The following information shall be submitted to the Engineer:
    a. Master drawing index
    b. Front view elevation
    c. Floor plan
    d. Top view
    e. Single line
    f. Schematic diagram
    g. Nameplate schedule
    h. Component list
    i. Conduit entry/exit locations
    j. Assembly ratings including:
        1) Short-circuit rating
        2) Voltage
        3) Continuous current
    k. Major component ratings including:
        1) Voltage
        2) Continuous current
        3) Interrupting ratings
        4) Cable terminal sizes
        5) Product data sheets
    l. Where applicable, the following additional information shall be submitted to the Engineer:
        1) Busway connection
        2) Connection details between close-coupled assemblies
        3) Composite floor plan of close-coupled assemblies
        4) Key interlock scheme drawing and sequence of operations
        5) Shunt trip circuit breaker assemblies

B. SUBMITTAL DOCUMENTATION REQUIRED FOR CONSTRUCTION
1. The following information shall be submitted for record purposes:
    a. Final as-built drawings and information for items listed herein, and shall incorporate all changes made during the manufacturing process.
    b. Wiring diagrams
    c. Certified production test reports
    d. Installation information
    e. Seismic certification and equipment anchorage details as specified
    f. Scaled drawing of the electrical distribution equipment in the electrical room identifying all clearance, both NEC working clearances and serving electric utility clearances are maintained.

C. SEISMIC DATA
1. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
    a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based

upon the above criteria to verify the seismic design of the equipment.

b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified per applicable codes and standards as identified on the drawings.

c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

D. DELIVERY, STORAGE AND HANDLING

1. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
2. Switchboards shall be protected during construction, and before final acceptance from the owner, in a manor to prevent paint, dust, and construction debris from defacing the finish of the equipment. Prior to final acceptance the contractor shall clean switchboards and remove construction debris and packaging material.

E. OPERATION AND MAINTENANCE MANUALS

1. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.6 GUARANTEES

A. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).

B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

C. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

D. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.
   1. Eaton
   2. Siemens
   3. Square-D

2.2 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current amperes symmetrical at rated voltage as shown on the drawings.

B. Bus voltage and current ratings as indicated on the contract documents.

2.3 CONSTRUCTION

A. Switchboards shall consist of the required number of vertical sections, bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of the front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

B. All sections of the switchboard shall be front and rear aligned with depth as shown on the drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.

C. The assembly shall be provided with adequate lifting means.

D. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

E. The entire assembly shall be front accessible and shall consist of main lugs or main device as shown on the plans.

F. All metering shall be in accordance with the serving utility requirements. The contractor shall obtain the utility company pre-approval of switchboard product prior to installation.

G. The meter sockets and associated branch protective devices shall be completely pre-wired and shipped ready for installation of the meters. Meter sockets shall include covers with sealing provisions.

H. Feeder devices 150-ampere frame through 1200-ampere frame shall be panel-mounted-type construction. Devices over 1200-ampere frame or main devices shall be individually mounted when required.

2.4 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. A copper ground bus (minimum 1/4 x 2 inch), shall be furnished firmly secured to each vertical section structure, and shall extend the entire length of the switchboard.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.5 WIRING AND TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.

C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle-type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks

with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.6 MAIN PROTECTIVE DEVICES

A. Protective devices shall be fixed mounted insulated case low-voltage power circuit breakers, Eaton type Magnum SB or approved equal. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.

B. Main and tie breakers shall be true two-step stored energy devices and shall be manually operated unless otherwise indicated on contract documents.

C. Main circuit breaker shall have a minimum symmetrical interrupting capacity of not less than the available fault current as not on drawings or as required per the utility, whichever is greater. Main circuit breakers shall have 30-cycle short-time withstand ratings equal to 18 times their frame ratings.

D. All main insulated case circuit breakers shall be UL1066 listed.

E. All insulated case circuit breakers shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

F. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a "Positive On" feature. The breaker flag will read "Closed" if the contacts are welded and the breaker is attempted to be tripped or opened.

G. Each main insulated case circuit breaker shall be equipped with a tripping system consisting of three current sensors, true RMS microprocessor-based trip unit and flux-transfer shunt trip. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall be equal in all aspects to Eaton type Digitrip RMS 520MC.

H. The trip unit shall be provided with an Arcflash Reduction Maintenance System. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode using a 5 position switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode. The use of zone selective interlocking to emulate this feature does not meet the intent of these specifications and will not be accepted.

I. The trip unit shall have LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip. Provide battery backup for LEDs.

J. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

K. Trip unit shall have selectable thermal memory for enhanced circuit protection.

L. The trip unit shall have provisions for a single test kit to test each of the trip functions.

M. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination where indicated on contract documents. If provided, factory shall wire the zone interlocking system.

N. The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be +/- 2% of full scale.

O. The trip unit shall have provisions for connection to client's remote monitoring and control network. All monitored parameters and breaker status shall be transmitted in industry standard protocol.

2.7 FEEDER PROTECTIVE DEVICES

A. All feeder protective devices shall be molded case circuit breakers with inverse time tripping characteristics.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the contract documents.

D. All molded case circuit breakers shall be equipped with true RMS sensing electronic trip units and inverse time-current characteristics.

E. Provide trip units with integral arc flash reduction mode for 400A frame and above. The use of zone selective interlocking to emulate this feature does not meet the intent of these specifications and will not be allowed.

F. Ground fault protection shall be provided where indicated.

G. Where indicated provide 100% rated UL listed circuit breakers.

2.8 ACCESSORIES

A. Provide shunt trips, bell alarms and auxiliary switches as shown on the contract drawings.

2.9 MISCELLANEOUS DEVICES

A. Key interlocks shall be provided as indicated on the drawings.

B. Control power transformers with primary and secondary protection shall be provided, as indicated on the drawings, or as required for proper operation of the equipment.

C. For outdoor (NEMA 3R) installations, each section of the switchboard shall be provided with a thermostatically controlled space heater. Power for the space heaters shall be obtained from a source as indicated on the drawings.

2.10 UTILITY METERING

A. Where indicated on the drawings, furnish a barrier to separate the utility metering compartment complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers or potential taps as required by the utility company. Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements.

2.11 SURGE PROTECTIVE DEVICE

A. SPD shall comply with ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL).

B. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

C. The SPD shall be of the same manufacturer as the switchboard.

D. The SPD shall be factory installed integral to the switchboard by the original equipment manufacturer.

E. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

F. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD.

G. All monitoring and diagnostic features shall be visible from the front of the equipment.

H. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

I. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

J. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

K. Type 2 units with filtering shall conform to UL 1283 5th Edition

L. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.

M. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

N. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
   1. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
   2. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
   3. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

4. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
5. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
6. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

O. Electrical Requirements:
1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
4. Unit shall operate without the need for an external overcurrent protection device (OCPD), and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
5. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

6. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1

and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

7. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

2.12 ENCLOSURES

A. NEMA 1 Enclosures shall be provided for switchboard mounted in interior areas not subject to moisture and / or extreme temperatures.

B. Outdoor NEMA 3R Enclosures shall be provided for switchboard mounted in exterior locations and / or areas subject to moisture. Outdoor enclosure shall be non-walk-in and meet applicable NEMA 3R requirements of UL.

C. Switchboard Enclosure shall have flat roof.

D. Doors shall have provisions for padlocking.

E. Ventilating openings shall be provided.

2.13 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

2.14 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

B. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.

C. The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 MANUFACTURER CERTIFICATION

A. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.3 TRAINING

A. A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on the operation of the assembly, circuit breakers, fused switches, meters, and major components within the assembly.

3.4 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

B. Switchboards shall be securely bolted to the flooring structure. Final attachment means shall be in compliance with seismic requirements of the authority having jurisdiction. Shop drawings with bolt down requirements shall be provided by the manufacturer along with all necessary calculations.

C. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to contractor supplied floor sills to be set level in concrete per manufacturer's recommendations. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

END OF SECTION 26 24 13

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Panelboards

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification. Panelboards shall be furnished and installed with the quantity, rating, and type of circuit breakers as shown on the contract documents.

1.2 RELATED SECTIONS

1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
2. Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEM
3. Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
4. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
5. Section 26 05 26 GROUNDING FOR ELECTRICAL SYSTEMS

A. Related Sections Under Other Divisions:

1. The General provisions, including supplementary conditions, of this contract apply to this section.
2. Painting of panelboards as required.

1.3 SYSTEM DESCRIPTION

A. SUBMITTALS AND SHOP DRAWINGS

1. In addition to Section 26 05 00 COMMON RESULTS FOR ELECTRICAL requirements, the following shall be submitted to the Engineer of Record prior to procurement:
   a. Dimensioned outline drawing.
   b. Component list.
   c. Knockout configurations.
   d. Cable terminal sizes, including maximum conductor rating that can be terminated.
   e. Enclosure and door assembly.
   f. Panelboard load center ratings, including:
      1) Continuous Current (i.e. “Ampacity”)
      2) Voltage and phase
      3) Short Circuit Rating in “kAIC”.
   g. Circuit Breaker ratings, including:
      1) Breaker type (i.e. plug-in, bolt on)

2) Continuous Current (i.e. "Ampacity")
3) Voltage and phase
4) Interrupting Rating in "kAIC".

2. The following shall be included in the O&M manual and provided to the facility owner prior to final acceptance:
   a. Final as-built conditions documenting changes made during construction.
   b. Wiring Diagrams
   c. Certified production test reports
   d. Installation information, including equipment anchorage provisions.
   e. Seismic certification as specified.

1.4 GUARANTEES

A. Independent testing laboratory listing is required. Note Underwriters Laboratories, "UL", is referenced throughout this specification. However, equivalent listing agencies will be accepted.

B. Independent testing shall be conducted for all GFI circuit breakers installed in main panelboards. Results shall be included in O&M documentation and provided to the owner prior to final acceptance.

C. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

D. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

E. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.5 REQUIREMENTS

1. Panelboards, load centers, and associated components and circuit breakers shall be manufactured, tested, and installed in accordance to the latest published requirements of the following codes and standards:

1. National Electrical Code (NEC) with California State and local jurisdiction amendments.
2. UL 67 – Standards for Panelboards
3. UL 50 – Standards for Cabinets and Boxes
4. UL 489 – Standards for Molded Case Circuit Breakers

5. UL 1699 – Arc-Fault Circuit Interrupters
6. UL 869 – Standards for Service Equipment
7. UL 486B - Requirements for Wire Connectors and Soldering Lugs
8. Federal Specification W-C 375 A and B – Circuit Breakers
9. Federal Specification W-P-115c – Panel, Power Distribution
10. NEMA Standard PB1 – Panelboards
11. NEMA Standard AB3 – Molded Case Circuit Breakers

PART 2 - PRODUCTS

2.1 MATERIALS

A. The listing of specific manufacturers below does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer of record ten (10) days prior to bid date.
   1. Eaton Cutler Hammer / Eaton Corporation
   2. Square-D
   3. Siemens

2.2 PANELBOARDS

A. RATINGS
   1. Panelboards shall be rated for AC voltage and short-circuit as indicated on the drawings. The short-circuit rating shall not be less than 10,000 amperes rms symmetrical.
   2. Panelboards shall be labeled with the UL short-circuit rating from the manufacturer.

B. CONSTRUCTION
   1. Dead-front construction shall be utilized.
   2. Interiors, with the exception of the branch circuit breakers, shall be completely factory assembled with a main breaker, main lugs only, or double lugs as specified on the drawings.
   3. Where double lugs are not permitted by the authority having jurisdiction, provide a pull box or gutter, sized per NEC code as required for connections. The pull box or gutter shall be located adjacent to the panelboard enclosure.
   4. Interiors shall be designed so that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors. In addition, interiors shall be designed so that circuits may be changed without machining, drilling, or tapping.

5. Physical means must be provided to prevent the installation of more over-current devices than that number for which the enclosure was designed. Full size breakers are required.
6. Dust filters shall be installed for vented openings.

C. BUS
1. Bus bars for the main and cross connectors shall be of copper construction in accordance with UL (or equivalent) standards. Busing shall be braced throughout to conform to industry standard practice governing short-circuit stresses in load centers. All connection points shall be tin-plated copper. Bus bars shall be mounted to a rigid metal backpan.
2. Neutral bus shall have a suitable lug for each outgoing feeder requiring a neutral connection that is the same of same ampacity as the branch circuit.

D. WIRING/TERMINATION
1. Wire, connectors, and terminals shall be of the anti-turn solderless type and suitable for copper or aluminum wire of the sizes indicated in the construction documents. Connectors shall meet UL 486B.
2. Load centers shall be suitable for use with 60/75 degrees Celsius rated wire.

E. CIRCUIT BREAKERS
1. Molded case type circuit breakers shall be 3/4-inch wide per pole. Multi-pole circuit breakers shall be of a stack pole design to provide electrical phase isolation and have an internal common trip.
2. Circuit breaker operating handles shall indicate "ON" and "OFF" breaker positions.
3. Panelboards breakers shall be a minimum of 125-ampere frame. Breakers 10- through 125-ampere trip size shall take up the same pole spacing.
4. Each pole of the circuit breaker will have inverse time delay overload and instantaneous short-circuit protection by means of both thermal and magnetic sensors.
5. The circuit breaker calibration shall not be affected by environmental changes in relative humidity. Breakers shall be calibrated after assembly.
6. Circuit breakers shall be operated by a toggle-type handle and multi-pole circuit breakers shall have an internal common trip mechanism. The circuit breakers shall incorporate trip mechanisms that are mechanically trip-free from the handle. The handle position shall provide good visual trip indication.
7. Contacts shall be of non-welding silver alloy.
8. Each pole shall contain phase barriers and arc quenching.
9. Circuit breakers shall be molded case thermal-magnetic quick-make/quick-break, over toggle type suitable for use in systems having a short-circuit capacity as indicated on the drawings.

10. Instantaneous, thermal magnetic, long-time delay trip elements shall be provided per each pole.
11. Panelboard branch circuit breakers shall be full-size, with a minimum rating of 20 amperes.
12. Ground fault breakers for personnel (5 ma) and equipment (30 ma) protection shall be available through 60 amperes.
13. All terminals shall be listed for use with copper or aluminum conductors. Terminals shall be of the box lug design. The terminals shall meet UL 486B requirements and shall be suitable for use with either 60 degree or 75 degree Celsius wire, unless otherwise specified.
14. Where indicated on drawings, supply arc fault circuit interrupters (AFCI) or arc fault circuit interrupters with ground fault circuit interruption (AFCI w/GFCI). The breaker shall provide parallel arc detection and protection in addition to overload and short-circuit protection.
15. Main Circuit Breakers greater than 125 amperes shall be a molded case design. Main breakers utilizing 4-pole bundled mains are not permitted. Single-phase main breakers 200 amperes and less shall have a side-to-side toggle mechanism allowing for top or bottom mounting.

F. ENCLOSURES
1. Enclosures shall be mounted, either surface or flush, and have the appropriate NEMA listing (1, 3R, or 4X) as indicated on the drawings.
2. Boxes shall be made from cold rolled code gauge sheet steel having multiple knockouts, except where noted. Rain tight boxes shall use galvanized steel or an approved coating system which meets or exceeds NEMA standards for outdoor type 3R enclosures. Boxes shall be of sufficient size to provide at least a minimum code gutter space on all sides.
3. The cover shall have an easy adjustment feature for flush applications.
4. Covers shall be provided with a lock, and keyed to operate from one key.
5. Boxes shall be factory assembled into a single rigid structure.

G. FINISH
1. Boxes and trims shall be finished with a high scratch resistant aesthetically pleasing finish. The finish paint shall be of a type to which field applied paint will adhere.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Panelboards/Load centers shall be installed in locations indicated on the drawings.

B. Provisions shall be made for future conduit/branch circuit installations. In flush mount panels, install one ¾" conduit from the enclosure to an accessible ceiling space location for every four spare circuit breakers or spaces.

C. Maximum circuit breaker height installation shall not exceed +6'7" above finished floor or platform pursuant to the requirements of NEC 404.8(A).

D. The depth of structure shall be adequate to accommodate flush mounted enclosures.

3.2 FINISHING

A. Protect panelboards/load centers pursuant to Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL until final acceptance by owner.

B. Provide circuit breaker marking labels and directories. Directories shall be typewritten and included in a plastic sleeve. Mount directories on the interior face of the equipment cover. Marking labels and directories shall reflect as-built conditions and final room names.

C. The key to the panelboard shall be left inside the plastic circuit breaker directory sleeve or provided to the owner upon final acceptance.

3.3 COMPLETION

A. Demonstrate operation of equipment to owner prior to acceptance.

END OF SECTION 26 24 16

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic wiring devices

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Receptacles
      b. Switches
      c. Dimmers

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
   3. Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
   4. Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
   5. Section 26 05 53 IDENTIFICATION OF ELECTRICAL SYSTEMS
      Section 26 24 16 PANELBOARDS

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.3 GUARANTEES

A. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).

1.4 REQUIREMENTS

A. Wiring devices and associated components shall be manufactured, tested, and installed in accordance to the latest published requirements of the following codes and standards:
   1. National Electrical Code (NEC) with California State and local amendments.
   2. Department of Justice ADA Standards for Accessible Design
   3. UL 20 – General-Use Snap Switches

4. UL 231 – Power Outlets
5. UL 498 – Attachment Plug and Receptacles
6. UL 514D – Cover Plates for Flush-Mounted Wiring Devices
7. UL 943 – Ground Fault Circuit-Interrupters
8. UL V0 – Flame Rating for Flat Panel Connection Enclosure Trim Ring
9. National Electrical Contractors Association NECA 130 Standard for Installing and Maintaining Wiring Devices
10. NEMA WD1 – General Color Requirements for Wiring Devices

PART 2 - PRODUCTS

2.1 MATERIALS

A. Receptacles
   1. General
      a. 120V volts, 20 ampere minimum rating for commercial projects and 15 ampere minimum for residential projects. Refer to plans for specific ratings of higher ampacity.
      b. 240V receptacles, ampacity as indicated per plans, shall be provided with appropriate cord and plug.
   2. Single, Duplex, and/or Double Duplex as indicated per the drawings.
   3. Full or half switched as shown on the drawings. Half switched double duplex receptacles shall have the top receptacle switched and the bottom receptacle un-switched.
   4. Ground Fault Circuit Interrupter (GFCI) – Shall be used for the protection of personnel, in accordance to UL 943 and located as defined in NEC Article 210.8.
   5. Isolated Ground shall be provided per the drawings. Receptacles shall feature full size ground contacts with a minimum 3/16" thick minimum nylon isolation insulator.
   6. Arc-Fault Circuit Interrupter (AFCI) type receptacles shall be provided for receptacles connected to 120V, 1-phase, 15 and 20 ampere branch circuits supplying outlets installed in dwelling units, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms. AFCI type receptacles shall be protected by a listed arc-fault circuit interrupter, combination-type, installed to provide protection for the branch circuit.
   7. Listed tamper-resistant type receptacles shall be installed in dwelling unit areas as defined per NEC Article 210.52 as well as pediatric patient care areas in healthcare facilities per NEC Article 517, for receptacles 15 and 20 ampere rated.
   8. Damp Locations – Receptacles shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed). Receptacles 15 and 20 ampere, 120 and 240V non-locking receptacles shall be listed weather-resistant type.

9. Wet locations - Receptacles 15 and 20 ampere, 120 and 240V, installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. Receptacles 15 and 20 ampere, 120 and 240V, non-locking, shall be listed weather-resistant type. All other receptacles installed in a wet location shall be in accordance to the NEC.
10. Flat Panel (television) Connection Enclosure – 2-gang in-wall enclosure, 18 ga. Cold rolled steel base, white powder coat finish, high impact ABS trim ring with power, surge protector, A/V, communication, HDMI devices as indicated per plans.
    a. Manufacturer: Hubbell Wiring System "Net Select" or engineer approved equal.

B. Switches
1. 120V volts, 20 ampere minimum rating. Refer to plans for specific ratings of higher ampacity.
2. Shall be Decora Rocker/Toggle, Pilot, and/or key locking type.
3. Commercial specification grade, self-grounding, 30-degree max. temperature rise, 1HP max rating, steel strap, thermoplastic actuator and body, and side wired.

C. Dimmers
1. Residential/Commercial grade as specified on the drawings. Dimmers shall precisely adjust lighting levels, with a "one-touch" ON or OFF at a preset level, touch and hold for bright to dim lighting control.
2. Dimmers shall be compatible for the lamp source served.
3. Dimmers shall be provided with memory during temporary power failures to ensure lighting level retain the last setting prior to power outage.
4. Provide dimmers in the capacity (wattage) needed, corresponding to the luminaires served. Power extenders shall be provided as required to serve additional load.
5. Dimmer "switch" shall be compatible with the Decora aesthetic and standard wallplates.

D. Fan Speed Controllers
1. Residential/Commercial grade as specified on the drawings. 1.5-5 ampere, 120V AC, 60Hz, Single Pole rating. Fan speed controllers shall be provided with a load rating adequate to handle fan load(s).
2. Single-pole (control from one location) or three-way (control from two locations) as indicated on the drawings.
3. Fan speed controller shall be compatible with the fan light kit lamping.

2.2 ACCESSORIES

A. Wall plates - Shall be approx. 1/8" larger than the rough-in box opening and have curved corners. Captive screws shall be utilized. Finish shall be smooth and easy to clean.

1. Standard or ganged together where appropriate or as shown per plans.
2. Material Type:
   a. Non-conductive, high-impact nylon.
3. Waterproof faceplate assemblies shall provide a watertight connection between the plate and finished surface.

2.3 FINISHES

A. Devices
   1. Isolated Ground
      a. Hospital grade, isolated ground receptacles shall be identified by an orange color or an orange triangle located on the face of the receptacle.
   2. Emergency Branch Circuit
      a. Receptacle bodies shall be red, with the branch circuit designation labeled on the device.
   3. Other Receptacles
      a. Device finishes shall be Almond, black, brown, gray, ivory, light almond, red, or white.
      b. Device finish shall be as specified by the Architect. Verify with architect prior to procurement.

B. Wall Plates
   1. Wall plate finish shall match device color.
   2. Nylon wall plates shall be as per Architect/Owner.
   3. Metallic wall plates shall have natural metal finishes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installation, outlet boxes shall be free of debris.

B. Extension rings shall be sued to bring outlet boxes flush with the finished surface as required.

3.2 INSTALLATION

A. Wiring devices shall be installed per the NECA "Standard for Installing and Maintaining Wiring Devices".

B. Outlet boxes shall be installed flush in building construction unless specifically identified as surface mounted per the plans.

C. Switches shall be installed with the "OFF" position orientated down.

D. When ganging dimmers together, consult manufacturer requirements and allow for proper derating.

E. Junction boxes less a wiring device (i.e. provision made for future) shall have a blank wall plate installed. In finished areas, blank plates shall match material and finish type of adjacent receptacles and switches.

F. Install cast iron plates on surface mounted outlet boxes and junction boxes in unfinished areas.

G. Wiring devices shall be installed at as defined per the drawings and in compliance with ADA standards.

H. Coordinate device mounting heights prior to rough in. In no instance shall a device be roughed in mid-span between finish types. For example, if wainscot is installed along the walls, switches shall be installed completely in or completely above wainscot material.

I. Switches shall be installed on the "strike" side of door frames unless specifically noted otherwise on the drawing due to architectural conflicts (i.e. full height windows). Verify door swings with architectural plans prior to rough in.

J. A bonding jumper shall be installed between the receptacle ground terminal and outlet box, in addition connected to the equipment grounding conductor. The bonding jumper shall be sized per NEC requirements.

K. Feed-thru wiring is not acceptable.

L. Receptacles shall be tested to ensure proper polarity. If polarity is reversed, corrections shall be made at no cost to the building owner or appropriate party.

3.3 FINISHING

A. Adjust wall plates to be flush and level with surface. Devices and plates shall be installed square and plumb with building lines.

B. Clean exposed surfaces and remove construction debris.

END OF SECTION 26 27 26

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Enclosed switches and circuit breakers.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Molded case circuit breakers
      b. Low voltage power circuit breakers
      c. General duty disconnect switches
      d. Heavy duty disconnect switches

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 53 IDENTIFICATION OF ELECTRICAL SYSTEMS
   3. Section 26 24 13 SWITCHBOARDS
   4. Section 26 24 16 PANELBOARDS

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.3 REQUIREMENTS

A. Materials and installation shall be in accordance with the latest published requirements of the following codes and standards:
   1. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).
   2. National Electrical Code (NEC) with California State and local amendments.
   3. ASTM E 329 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
   4. Federal Specification FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service.
   5. NEMA KS 1 - Enclosed Switches
   6. NEMA 250 - Enclosures for Electrical Equipment
   7. UL 98 - Enclosed and Dead Front Switches

8. UL 489 - Standard for Molded-Case Circuit Breakers and Circuit-Breaker Enclosures.
9. UL 508 - Standard for Industrial Control Equipment.
10. UL 1053 - Standard for Ground Fault Sensing and Relaying Equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square D, Eaton-Cutler Hammer, Siemens or engineer approved equal.

2.2 MOLDED CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle, and the accessory mounting area.

B. Circuit breakers shall have an over center, trip free, toggle operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.

C. The circuit breaker handle shall reside in a tripped position between on and off to provide local trip indication. Circuit breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings.

D. The maximum ampere rating and UL, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.

E. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.

F. Circuit breakers shall be factory-sealed with a hologram quality mark and shall have date code on face of circuit breaker.

G. Series rated combinations shall not be allowed.

H. Lugs shall be suitable for 167 °F (75 °C) rated wire and/or 194 °F (90 °C) rated wire, sized according to the 167 °F (75 °C) temperature rating in the NEC. Refer to the copper feeder schedule on the drawings.

I. Circuit breakers shall be capable of accepting bus connections.

J. Circuit breakers with ratings up to 400 amperes shall be equipped with thermal magnetic trip units. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 °F (40 °C) ambient temperature. Circuit breaker frame sizes above 150 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker

K. Circuit breakers with ratings over 400 amperes shall be equipped with electronic trip units.

L. Circuit breakers with permanent trip units shall be UL-listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.

M. The trip units shall not augment overall circuit breaker volume.

2.3 DISCONNECT SWITCHES

A. GENERAL
1. Switches identified for use as service equipment shall be labeled for this application pursuant to NEC requirements.
2. Disconnect switches shall be fused or non-fused as indicated on the drawings.
3. NEMA type 1 enclosures shall be utilized indoors and NEMA Type 3R utilized outdoor unless otherwise noted on the drawings.
4. Lugs shall be listed for a minimum of 75 degrees Celsius.
5. Verify fuse sizes with the manufacturer of the equipment served.

B. ENCLOSURES
1. Enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel for NEMA Type 1 and 3R. For NEMA Type 4 and 4X the enclosure shall have a brush finish on type 304 stainless steel finish.
2. Enclosures shall have ON and OFF markings stamped into the cover.
3. Operating handles shall be provided with a dual colored, red/black position indication.
4. Switches shall have provisions to accept up to three 3/8 in hasp padlocks to lock the operating handle in the OFF position.
5. Tangential knockouts shall be provided to facilitate ease of conduit entry (NEMA Types 1 and 3R) for switches rated 30-200A.
6. NEMA Type 4 and 4X shall have a stainless steel enclosure and shall contain no knockouts. Supply watertight hubs as required for conduit entry/exit.
7. NEMA Type 4X polyester enclosures shall be provided with polyester conduit hubs for field installation.

8. Enclosures for Type 3R switches through 200 ampere shall have provisions for interchangeable bolt-on hubs in the top endwall.
9. Type 4 and 4X stainless steel enclosures shall be dual rated as Type 3R to facilitate their use in outdoor applications.
10. Cover viewing window shall be incorporated on 30-200A NEMA 4 and 4X, stainless steel, two or three pole switches.

C. SWITCH RATINGS
1. Switches shall be horsepower rated for the AC voltage as indicated on the plans.
2. The UL Listed short circuit current rating of the switches shall be:
   a. 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere).
   b. 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).
   c. 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

D. GENERAL DUTY DISCONNECT SWITCHES
1. Applicable to disconnect switches 240 volt and below.

E. DISCONNECT SWITCH INTERIOR
1. Switches shall have switch blades which are visible when the switch is OFF and the cover is open.
2. Lugs shall be front removable
3. Switches required for Type 4and 4X stainless steel applications shall have all copper current carrying parts.
4. All current carrying parts shall be plated to resist corrosion.
5. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
6. Switches shall have provisions for a field installable electrical interlock.

F. DISCONNECT SWITCH MECHANISM
1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
2. The operating handle shall be an integral part of the box, not the cover.
3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
4. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle position.
5. Switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock

mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.

B. Disconnect switches shall be installed where identified on the drawings. Switches shall be secured to building structure or supported via "C" channel strut as required. Field coordinate and adhere to manufacturer requirements.

3.2 ADJUSTING

A. Mold case circuit breaker pickup level and time delay settings shall be adjusted to values indicated as per manufacturer recommendations.

END OF SECTION 26 28 16

SECTION 26 56 00 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Basic exterior lighting.

B. Furnish labor, materials, equipment, components, and necessary services to support the electrical work show on the drawings and specified herein in this specification.
   1. Principal features of this installation include:
      a. Exterior luminaire product.
      b. Exterior lighting poles.
      c. Exterior lighting mounting attachments and supports.
      d. Exterior lighting controls.
      e. Exterior LED drivers.

1.2 RELATED SECTIONS
   1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
   2. Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
   3. Section 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
   4. Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
   5. Section 26 05 46.13 UNDERGROUND ELECTRICAL CONSTRUCTION AND SERVICE
   6. Section 26 56 70 LIGHTING ACCEPTANCE TESTING

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.3 REQUIREMENTS

A. Materials and installation shall be in accordance with the latest published requirements of the following codes and standards:
   1. Materials and equipment shall be listed by an independent testing laboratory for the class of service intended (Underwriters Laboratories or equivalent).
   2. American Society for Testing and Materials (ASTM).
   3. American Concrete Institute (ACI).
   4. American National Standards Institute (ANSI).
   5. Aluminum Association Inc. (AA).

6. Illuminating Engineering Society of North America (IESNA).
7. National Electrical Manufacturers Association (NEMA).
8. National Fire Protection Association (NFPA).
9. UL 1598, "Luminaires", Non-hazardous locations intended for installation on branch circuits 600V and below.

1.4 DEFINITIONS

A. Lighting terminology used herein is defined in IES
   1. Exception: The term "driver" is used herein to cover both drivers and power supplies, where applicable.

B. Clarification: The term "LED light source(s)" is used herein per IES to cover LED package(s), module(s), and array(s).

1.5 SYSTEM DESCRIPTION

A. SUBMITTALS AND SHOP DRAWINGS
   1. Luminaire product submittal shall be inclusive of the following information and shall be clearly presented and identified on submittal documentation.
      a. Manufacturer specification sheets, installation instructions, and any other pertinent manufacturer requirements.
      b. Luminaire electrical rating specifications, including: lamp data, lamp color temperature, lamp color rendering index (CRI), voltage, ballast / driver type, overall system wattage, and luminaire overall efficiency etc.
      c. Luminaire aesthetic, dimensions, loads (i.e. EPA data), termination requirements, wiring and connection diagrams.
      d. Luminaire mounting requirements, including: poles, arms, brackets, yoke mounting assemblies, etc.
      e. Luminaire photometric data including, optic configuration, lumen output, isofootcandle plots in accordance to project specified mounting height, and lumen maintenance. In the event a product substitution is being proposed, the electrical engineer of record may request a photometric site plan indicating the following:
         1) Photometric calculation plane at grade level, minimum 10' x 10' calculation plot spacing. Calculation planes shall be designated per the scope of the project and may include the general parking area and pedestrian walkways. All photometric plans shall be prepared to scale.
         2) Maintained light level calculation results considering luminaire product lumen maintenance.
         3) Calculation statistics for minimum, maximum, and average photometric values in footcandles (fc). In addition uniformity ratios for maximum:minimum and average:minimum.

4) Photometric values in a parking application, exterior uncovered, shall be a minimum of 0.2fc. and 15:1 maximum:minimum uniformity.

f. Finish color charts. Actual finish samples (i.e. color charts) demonstrating actual color and texture shall be required upon request of the electrical engineer of record or project architect.

B. DELIVERY, STORAGE AND HANDLING

1. Luminaire product shall be stored in a cool dry place, above grade and protected from the elements. Luminaire poles shall be stored in a horizontal placement, above grade. Maintain all factory packaging and wrapping until luminaire product is ready for installation.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Luminaires

1. Shall be in accordance to the drawings and as specified. Luminaires shall have been certified to the California Energy Commission by its manufacturer to comply with the efficiency standards as per California Code of Regulations Title 24, Part 6, and Section 111 referencing the Appliance Efficiency Regulations in Title 20 post certification with building permit.
2. Luminaires shall be listed for the application where installed (i.e. weather proof, damp location, heavy duty). Luminaires shall be designed adequate dissipation of heat and safe and simple cleaning and re-lamping.
3. Luminaire drivers and ballasts shall be fully incorporated into the luminaire housing unless otherwise specified on the drawings.
4. Material shall be constructed of a non-ferrous metal or powder coated to eliminate the potential of rust.
5. Luminaires shall be provided with a means for grounding metallic wireways and housings to an equipment grounding conductor.

B. Lamps / LED Arrays

1. Lamps and / or LED arrays shall be installed for every luminaire as specified and shall be listed for exterior, outdoor lighting product.
2. LED Light Sources
   a. Minimum Color Rendering Index (CRI): 60.
   b. Correlated Color Temperature (CCT)
      1) CCT shall be as listed in Table 1 below:

Table 1. Allowable CCT

Manufacturer-Rated Nominal	Allowable LM-79 Chromaticity

CCT (K)	Values
	Measured CCT (K)
2700	2580 to 2870
3000	2870 to 3220
3500	3220 to 3710
4000	3710 to 4260
4500	4260 to 4746
5000	4745 to 5311
5700	5310 to 6020
6500	6020 to 7040

C. LED Drivers
   1. Drivers shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
   2. Rated case temperature shall be suitable for operation in the luminaire operating in the ambient temperatures as indicated.
   3. Shall accept the voltage or voltage range indicated, and shall operate normally for input voltage fluctuations of plus or minus 10 percent. Consistent with NEMA SSL 1.
   4. Shall have a minimum Power Factor (PF) of 0.90 at full input power and across specified voltage range.
   5. Shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
   6. Shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
   7. The following shall be in accordance with corresponding sections of ANSI C136.37
      a. Wiring and grounding
      b. All internal components shall be assembled and pre-wired using modular electrical connections.
      c. Mounting provisions
      d. Terminal blocks for incoming AC lines
      e. Latching and hinging
      f. Ingress protection

D. LED Luminaires
   1. Luminaire shall have an external label per ANSI C136.15
   2. Luminaire shall have an internal label per ANSI C136.22.
   3. Luminaires shall start and operate in -20°C to +40°C ambient.
   4. LED light source(s) and driver(s) shall be RoHS compliant.

E. Luminaire Poles - Poles shall be as specified on the project drawings and provided as required to accommodate the overall mounting height of the luminaire.
   1. The pole assembly shall have an anchor bolt type designation which allows for the supply the luminaire via underground conduits. Anchor bolt

patterns, specifications, and requirements shall be as determined by the luminaire manufacturer.

2. Provide each pole with a hand hole with a minimum clear opening of 2-1/2" x 5". Hand holes shall be provided with a cover secured to the pole housing with steel captive screws. A grounding stud shall be provided opposite the hand hole opening.
3. Pole base covers shall be provided, either standard or decorative as specified, and shall match the finish specification of the pole and luminaire assembly. Pole base covers shall conceal mounting hardware, pole base welds, and anchor bolts. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.
4. Pole material type (i.e. Aluminum or Steel) shall be as specified on the drawings.
    a. Aluminum Poles - Manufactured of corrosion resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys, and Alloy 356-T4 (3,5) for ASTM B108-01 cast alloys. Poles shall be seamless extruded or spun seamless type.
    b. Steel Poles - Minimum 11-gauge steel, minimum strength of 48,000 psi, and iron-oxide primed factory finish.

F. Hardware shall be tamper proof, stainless steel.

G. Concrete Foundations shall be cast in place concrete and designed to support the specified luminaire assembly and effective projected area (EPA), including the pole, arm / yoke attachment, and luminaire head for wind loading as appropriate for the project site. When wind loading is not known, assume as 100 miles / hour with additional 30% gust factor. The concrete foundation shall be as designed by the project civil or structural engineer. Refer to additional division requirements.

H. Pole base grounding shall include a min. 5/8" diameter x 10' long copperclad, steel ground rod installed below each concrete luminaire base foundation. The rod shall be driven vertically with not less than 6' of the rod in contact with the earth (remainder of the rod may be encapsulated within the concrete. The ground rod shall be bonded to the pole with not less than a #6 AWG CU bare copper wire. The method of bonding shall be listed and approved for the installation.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

1. Remove existing conduit, branch circuit conductors, poles, mounting attachments, and concrete bases for luminaires scheduled for removal.

3.2 EXCAVATION AND BACKFILL

A. Excavate and maintain trenches in accordance to applicable safety code requirements. Protect existing features in place.

B. Trench and backfill requirements shall be in accordance to the project documents, including details on plans. Refer to project earthwork specifications as appropriate. Mechanically compact trenches after backfill to 98% compaction.

C. Backfill and mechanically compact holes left by demolished luminaire pole bases with to a depth of 6" below grade and fill in the remaining 6" with top soil. Re-seed holes in lawn areas where appropriate.

3.3 SLEEVE INSTALLATION

A. Conduit sleeves or spare "conduits" shall be installed in accordance to the project documents, including details on the plans. At a minimum conduit sleeves shall be buried 24" below finished grade or 18" below pavement.

B. Conduit sleeves shall be properly plugged with conduit caps. Duct tape shall not be acceptable. Mark conduit sleeves in the field with either a steel stake, pipe, or conduit a minimum of 3' in length and driven into the ground approx. 6" below grade.

3.4 INSTALLATION

A. Install luminaire assemblies in accordance to the construction documents as well as the California Electrical Code and manufacturer recommendations. Adhere to any project site standards that may be required.

B. POLES
   1. Erect pole and install "plumb" via level and leveling nuts and washers.
   2. Install anchor bolt assemblies to secure the pole to the concrete foundation as per the manufacturer and civil / structural engineer of record supplementary instructions. Upon installation of a level pole torque wrench tighten the anchor bolts to the torque values as listed in the pole instruction sheets.
   3. Where a base plate is not used, ensure the void space between the base mounting plate and leveled concrete pole base is grouted with a non-shrink cement grout product to minimize the effect of vibration at the pole assembly.
   4. Inspect the pole one week, one month, and 6 months after installation. Advise the owner on inspection requirements on a yearly basis. Inspections shall address the following:
      a. Visual inspection for any cracks in the pole, base weld, or any other area.

b. Recheck the torque of the anchor bolt assembly to manufacturer installation requirements.
c. Visual inspection for missing base covers, pole caps, etc. Replacement specifications for such shall be included in owner O&M manual upon completion of the project.
d. Cleanliness pf pole base and area underneath base cover.
e. Pole corrosion and finish deterioration.

END OF SECTION 26 56 00

SECTION 26 56 70 – LIGHTING ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes: Non-residential, interior and exterior, lighting acceptance testing.

B. Furnish labor, materials, equipment, components, and necessary services to support acceptance testing of the lighting system as show on the drawings and specified herein in this specification. Acceptance requirements ensure the equipment, controls, and systems operate as required by the State of California, Title 24, Non-residential standards.
   1. Principal features of acceptance include:
      a. Visual Inspection of the Equipment and Installation.
      b. Review of the certification Requirements
      c. Functional Testing of the system and controls.

C. Acceptance testing shall not take the place of commissioning.

D. Individual acceptance testing shall be performed by field technicians under the responsible charge of a licensed contractor or design professional ("Responsible Person") eligible under Division 3 of the Business Professions Code.

E. Pre-arrange testing with owner a minimum of 72 hours prior.

F. The acceptance requirement process shall include:
   1. Review of the construction documents to ensure sensor locations, devices, and control sequences are properly documented.
   2. Review the installation and complete the acceptance testing.
   3. Complete the Acceptance testing documentation.
   4. Certify the acceptance test results on the Certificate of Acceptance, and submit the certificate to the enforcement agency prior to receiving the final occupancy permit.
   5. Implement final settings and make adjustments to control equipment as required to complete the system as designed.

1.2 RELATED SECTIONS

1. Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
2. Section 26 09 23 LIGHTING CONTROL DEVICES
3. Section 26 09 26 LIGHTING CONTROL PANELBOARDS
4. Section 26 56 13 INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS
5. Section 25 56 00 EXTERIOR LIGHTING

A. Related Sections Under Other Divisions:
   1. The General provisions, including supplementary conditions, of this contract apply to this section.

1.3 GUARANTEES

A. Acceptance testing shall be conducted and documented in accordance to the California State Energy Code Title 24 2016 Non Residential Compliance Manual, Acceptance Requirements.

PART 2 - EXECUTION

2.1 INTERIOR LIGHTING TEST ACCEPTANCE PROCEDURES

A. Interior lighting acceptance testing procedures apply to new equipment and controls installed on new or existing lighting systems:
   1. NRCA-LTI-02A: Lighting Control Acceptance Document
      a. New construction and retrofit projects. Applicable to occupancy sensors, manual day lighting controls, automatic time switch controls. Functional testing and verification is required.
   2. NRCA-LTI-03A: Automatic Daylight Control Acceptance Document
      a. New construction and retrofit projects. Applicable to properly located controls, field calibrated and set appropriate lighting levels.
   3. NRCA-LTI-04A: Demand Responsive Lighting Controls Acceptance
      a. For new construction projects greater than 10,000sf. Applies to demand response lighting control provisions made for a future system interface.

2.2 OUTDOOR LIGHTING ACCEPTANCE TEST PROCEDURES

A. NRCA-OLT-02-A: Outdoor Lighting Acceptance Tests
   1. New construction and retrofit projects. Applicable to functional testing and verification of motion sensor location and ensure the sensor coverage is not blocked by obstruction. Verify the sensor signal sensitivity is adequate. Applies to verification of the outdoor lighting shut-off control and turning off during daytime hours. Verify the astronomical and standard shutoff controls are programmed for weekdays, weekends and holiday schedules.

2.3 COMPLETION

A. Lighting acceptance forms shall be completed and submitted to the authority having jurisdiction pursuant to the requirements of this section. Lighting

Certificate of Acceptance forms can be downloaded from California Energy Commission website at the following address:

https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency

END OF SECTION 26 56 70