

ELECTRICAL SPECIFICATION SECTIONS INCLUDED:

26 00 00 BASIC ELECTRICAL REQUIREMENTS

26 05 00 BASIC ELECTRICAL MATERIALS AND METHODS

26 09 43 LIGHTING CONTROL SYSTEM

26 24 00 SERVICE AND DISTRIBUTION

26 05 00 LIGHTING

SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish materials, labor, equipment, fabrication, installation, tests and appurtenances for a complete and operational installation of the electrical work, whether or not they are specified on the Drawings or herein.

1.2 RELATED WORK

- A. The General Conditions, Supplementary Conditions and General Requirements (as part of Division 1) of the Contract Documents apply to the work specified in Division 26. Review especially the following Sections and/or Divisions for requirements related to the work of this Section.
 - 1. Section 01 33 00: Submittal Procedures
 - 2. Section 01 40 00: Quality Requirements
 - 3. Section 01 50 00: Temporary Facilities and Controls
 - 4. Section 01 60 00: Product Requirements
 - 5. Section 01 70 00: Execution and Closeout Requirements
 - 6. Section 01 73 29: Cutting and Patching
 - 7. Section 01 74 16: Site and Area Cleanup
 - 8. Section 01 75 16: Startup Procedures
 - 9. Section 01 78 23: Operations and Maintenance Data
 - 10. Section 01 78 39: Project Record Documents
 - 11. Division 25 00 00: Mechanical and Plumbing Systems
- B. Work specified in Division 26:
 - 1. Section 26 05 00: Basic Electrical Materials and Methods
 - 2. Section 26 09 43: Lighting Control System
 - 3. Section 26 24 00: Service and Distribution
 - 4. Section 26 50 00: Lighting
- C. Coordinate the Electrical work with work by Owner, Owner's Contractor(s) or others:
 - 1. Fire Detection and Alarm System Components and Wiring
 - 2. Controls System Integrator

3. Telephone and Data system hardware, wiring and wiring devices

1.3 CODES AND STANDARDS

- A. Equipment, materials and installation is to conform to the codes, standards, tests, guidance or recommended methods of trade effective as of the date of the Contract Documents as published by the following bodies:
 1. Americans with Disabilities Act (ADA)
 2. Authority Having Jurisdiction (AHJ)
 3. American National Standards Institute (ANSI)
 4. American Society of Testing and Materials (ASTM)
 5. California Energy Commission
 6. Certified Ballast Manufacturers (CBM)
 7. California Code of Regulations, Titles 8, 19, and 24 (CCR)
 8. California Building Code (CBC)
 9. California Electrical Code (CEC)
 10. California State Fire Marshal (CSFM)
 11. Electrical Testing Laboratories (ETL)
 12. Electric Utility Service Equipment Requirements Committee (EUSERC)
 13. Insulated Cable Engineers Association (ICEA)
 14. Institute of Electrical and Electronics Engineers (IEEE)
 15. National Electrical Manufacturer's Association (NEMA)
 16. International Electrical Testing Association (NETA)
 17. National Fire Protection Association (NFPA)
 18. Occupational Safety and Health Act (OSHA)
 19. Underwriter's Laboratories (UL)
 20. Local Building Department, where applicable.
 21. Local Fire Department, where applicable.
 22. Local power, telephone and cable television utilities, where applicable.
- B. The Contract Documents are to govern where they exceed the applicable Codes and Standards. Where governing Codes and Standards vary or conflict, the more restrictive provision is to apply.
- C. The Contract Documents are not be construed to contain permission to violate legal requirements. Immediately notify the Engineer should such conflicts arise.

- D. Provide official documentation from the California State Licensing Board (CSLB) to the General Contractor and Owner showing state certification of all electricians working on the project site in conformance with CSLB regulations (see www.cslb.org and <http://www.dir.ca.gov/DAS/ElectrialTrade.htm>). Electricians who are not certified are not allowed on the project site.

1.4 QUALITY ASSURANCE

- A. Provide materials and equipment, new and free from defect, from manufacturers regularly engaged in those products' manufacture.
- B. When available, items of a given type are to be products of the same manufacturer.

1.5 CONTRACT DOCUMENTS

A. ELECTRICAL DRAWINGS

1. The electrical drawings are generally diagrammatic for purposes of legibility and clarity. Although the size and location of equipment is drawn to scale wherever possible, the drawings may be distorted for clarity and for fit. Make use of all data in the Contract Documents and verify at the project site.
2. The electrical drawings do not show all offsets, bends, special fittings, junction and pull boxes that may be necessary in conduit runs. Install equipment, outlets, junction and pull boxes in accessible locations and in a manner to conform to structure, avoid obstruction, preserve headroom and keep passageways and openings clear.
3. The architectural, civil and structural drawings take precedence over the electrical drawings as to the locations of architectural, process, site and structural elements. Review the floorplans, reflected ceiling plans and elevations to determine the exact location of electrical devices and equipment.
4. Outlets, fixtures or equipment located on the drawings by dimension to be installed as shown. Where dimensions are not indicated, these items are to be installed symmetrical with architectural elements and as close to the location shown as practical. Notify the Engineer should any discrepancies arise.
5. Make reasonable changes to locations of outlets, fixtures or equipment as directed by the Architect, Owner and/or Engineer prior to rough in at no additional cost to the Owner.
6. Provide conduit sizes as specified on the drawings. Where conduit sizes are not specified, size conduit to satisfy code-minimum requirements for conduit fill.

B. ELECTRICAL SPECIFICATIONS

1. The electrical specifications (Division 26000), in general, establish quality and character of materials and equipment.
2. The electrical specifications may omit words or phrases such as "the Contractor shall", "furnish"; "provide"; "all"; and "shall be" to be more brief.

1.6 SITE CONDITIONS

1. Prior to submitting a bid, visit the project site and become familiar with discernible conditions which may be pertinent to or affect the electrical work. Include in the bid a sum which is sufficient to cover the cost of the electrical work in consideration of site conditions.

1.7 MATERIALS AND EQUIPMENT SUBMITTALS AND SHOP DRAWINGS

A. TIMING

1. Within 7 days of the Owner's Notice to Proceed, submit a complete schedule of submittal dates for materials, equipment and shop drawing submittals.
2. Furnish submittals and shop drawings promptly in accordance to the submitted schedule and in the proper sequence as not to cause delay in the work of this or other Divisions. When possible, furnish all submittals at the same time. Submittals should in no case be furnished more than 30 days after the Owner's Notice to Proceed.

B. CONTENT

1. Submit at least six copies of the submittals and/or shop drawings. The Engineer, the Architect and the Owner will retain individual copies of the submittals. Additional copies are for the Contractor's use for vendors and manufacturers.
2. Shop drawing submittals are to include at least one reproducible copy. The reproducible copy will be returned with any applicable review comments.
3. Shop drawings and submittals may be submitted electronically.
4. Provide cover sheet(s) which identify the submittal and include the following information:
 - a. Project name
 - b. Submittal number
 - c. Applicable Division and Section of submittal
 - d. Date of submission
 - e. Referenced addendum or change-order number as applicable
 - f. Names of Contractor, supplier and manufacturer
 - g. Stamp and signature by the Contractor certifying that the Contractor has reviewed the submittal and it is in compliance with the Contract Documents
 - h. Complete index of submittal, including schedule of electrical equipment, lighting fixtures, accessories, etc.
 - i. Complete index of submittal, including schedule of electrical equipment, lighting fixtures, accessories, etc.
 - j. Approximately a half-sheet of space on the front cover sheet for Engineer review stamp and submittal comments
5. Submittals are to include those items listed in each Section of these Specifications and any items specifically requested by the Engineer.

6. Submittals and shop drawings are to be complete and are to include cut sheets of all system components (i.e., circuit breakers in switchboards, ballasts and lamps, etc.) as well as any certificates of compliance that may be required by the Contract Documents. If cut sheets indicate more than one model number or type of product, the submitted model number or product must be marked. Incomplete or unmarked submittals will be rejected.
7. Equipment cut sheet submittals are to be bound in a binder or notebook as opposed to loose sheets. Identify the submitted product on each sheet.
8. Submittals for main switchboards, precast utility transformer pads, utility vaults and pull boxes are to bear the favorable review stamp and/or signature by the local utility representative.

C. REVIEW

1. Submittals will be reviewed by the Engineer and will be returned with review comments. Comments made to the submittals during this review do not relieve the contractor of his responsibility to comply with the requirements of the Drawings and Specifications. Contractor is responsible for dimensions to be confirmed and correlated at the project site, and quantity of items to be furnished. This review is only to check for general conformance with the design concept of the project and general compliance with the Contract Documents.
2. Explanations of the applicable review comments are listed below; note that one submittal may receive multiple review comments.
 - a. NO EXCEPTIONS TAKEN: The Engineer takes no exceptions to the submitted items.
 - b. MAKE CHANGES NOTED: Make changes to the submitted items as noted; a resubmittal is not required unless noted.
 - c. REJECT: The submitted items are rejected based on non-equivalence to the specified items, or the submittal is incomplete. Submit the noted items as specified.
 - d. REVISE AND RESUBMIT: Revise the submitted items as noted by the review comments and resubmit. Resubmit only those items specifically requested.
 - e. SUBMIT SPECIFIED ITEM: Cut sheet and/or information for an item were not included in the submittal. Submit either under separate cover or bound with resubmittal if required.
3. Resubmit items for review until no exceptions are taken or a resubmission is not required. Clearly indicate all changes that have been made since the previous submittal.
4. Should more than one resubmittal by the Contractor be required for any equipment or materials, that additional Engineer review time will be charged to the Contractor.

1.8 SUBSTITUTIONS

A. SUBMITTAL OF SUBSTITUTION REQUEST

1. Submit substitution requests to the Engineer for each proposed substitution no later than seven (7) days prior to bid time. Substitution requests which do not include the following items or which are submitted after the time specified above will be rejected:
 - a. Bound cut sheets and/or shop drawings as applicable of both the specified item and proposed substitution with all applicable data substantiating equivalency to the specified

item, compliance with the Contract Documents, and any dissimilarity between the specified item and proposed substitution.

- b. Impacts of proposed substitution to the bid sum, to construction schedule and to work in this or other Sections, Divisions or related contracts.
- c. Extent of redesign or revision of work in any Division required by this substitution. Substitutions will not be considered if substantial revision of Contract Documents is required unless such costs are borne by the Contractor.

B. SUBSTITUTION REVIEW AND APPROVAL

1. Proposed substitutions submitted in accordance with the above requirements will be reviewed in a timely manner.
2. Furnish product samples of both the specified item and proposed substitution when requested by the Engineer at no additional cost to the Owner.
3. Proposed substitutions will be reviewed with respect to their compliance with the Contract Documents, potential impact to the project and equivalency to the specified item. Equivalency includes but is not limited to quality, character, performance, features, dimensions and appearance of product, and quality, stability, service and support of the manufacturer.
4. The burden of proof of a proposed substitution's equivalence is the responsibility of the Contractor.
5. The Engineer has the sole discretion to determine acceptability of each proposed substitution and reserves the right to reject any such substitution.
6. Approval of substitutions will not relieve the Contractor from full compliance with requirements of Contract Documents.

C. INSTALLATION

1. Substituted equipment or materials are not to be ordered or installed prior to approval by the Engineer.
2. Prior to installation, notify the other trades in writing of any impacts due to the substitution.
3. Any additional costs to work in this or other Sections, Divisions or related contracts due to Contractor substitutions, whether immediately known or subsequently discovered, are to be borne by the Contractor.
4. The Contractor is to replace substituted materials or equipment found to be non-equivalent to the specified items subsequent to installation at no additional cost to the Owner.

1.9 SCHEDULE OF WORK

- A. Arrange work, order equipment and schedule deliveries to conform to the established construction schedule. Additional charges from manufacturers for special expediting and/or handling of equipment not ordered in a timely manner is to be borne by the Contractor.
- B. Schedule working hours with the Owner and/or with requirements stated elsewhere in the Contract Documents.

- C. Schedule temporary power and signal system shutdowns with the Owner no less than 48 hours in advance; submit such requests as early as possible for favorable review by the Owner.

1.10 COORDINATION OF WORK

- A. Coordinate the electrical work with the other trades to avoid conflicts, delays and omissions. No additional cost will be considered for work that must be relocated due to conflicts with the work of other trades.
- B. Verify that sufficient space is available for materials and equipment installation throughout the course of construction.
- C. The maximum height of circuit breaker handles, disconnect or selector switches, pushbuttons, and similar devices is 6'-7" above finished floor or finished grade.
- D. Coordinate with the representatives of the local utility companies to obtain utility requirements, arrange inspections, schedule service installations, and finalize the service arrangements.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Protect electrical materials and equipment in original packages during transit, storage, handling and installation to prevent damage, soiling and deterioration. Replace such damaged equipment at no cost to the Owner.
- B. It is the Contractor's responsibility to check materials and equipment for compliance with the Contract Documents and/or for damage as they are delivered to the project site.
- C. Verify access routes and dimensions at the site that equipment must pass through to be installed. Ship equipment in crated sections, or dismantle, reassemble and retest equipment too large to pass through access routes to final locations in one piece.

1.12 CONNECTIONS TO EQUIPMENT

- A. Make final connections to equipment furnished under this Division, other Divisions or by the Owner. Verify the electrical requirements of the equipment nameplates with the information specified on the applicable drawings or submittal, and the designed electrical connection.

1.13 CUTTING AND PATCHING

- A. Provide core drilling, cutting and patching of existing surfaces for the installation of electrical work. Repair the surfaces to match the surrounding conditions.

1.14 EXCAVATION AND BACKFILL

- A. Provide excavation for underground electrical utilities and substructures. Backfill and patch excavated areas to the original condition and as shown on the Drawings.

- B. Locate all existing underground utilities prior to trenching. Hand-dig in locations of known utilities. Damage caused to utilities by the Contractor is to be repaired at the Contractor's expense.

1.15 SUPPORT SYSTEMS

- A. Provide support systems and seismic restraints to structure for electrical materials and equipment per applicable code and as per detailed on the drawings.
- B. Do not support conduit, wiring or equipment from piping, existing piping racks, ceiling or fixture wires or other similar elements unless specifically allowable by Code or the Authority Having Jurisdiction (AHJ).

1.16 WATERPROOFING

- A. Provide roof jacks and/or flashing wherever raceways pass through roof or outer wall structures. Assembly is to be constructed in a waterproof, permanent, neat and workmanlike manner and is subject to the approval of the Architect and Engineer.
- B. Electrical devices and equipment located outdoors, in semi-exposed areas, or interior damp areas are to be weatherproof and NEMA-rated as noted.

1.17 PAINTING

- A. Provide cleaning, prep, priming and painting of exposed work as directed by the Engineer, Architect and/or Owner. Mask manufacturer nameplates prior to painting and remove masking after paint is dry.

1.18 IDENTIFICATION

- A. Refer to Nameplates details on DRAWINGS.
- B. Provide nameplates of 1/16" black phenolic and 1/2" high white lettering attached with steel rivets or machine screws and nuts on all electrical equipment including:
 1. Switchboards
 - a. Individual switchboard sections covers identifying content (i.e. Utility Incoming Section, Meter/Main Section, PV Tap Section, Distribution Section)
 2. Branch circuit panelboards
 3. All feeder breakers and motor controllers in switchboards, distribution panelboards and motor control centers and panels (indicate load served)
 4. Transformers; include also the following on transformer nameplates: "De-energize prior to removing cover"
 5. Disconnect switches, enclosed breakers, manual motor starters, and combination motor controllers (indicate load served)
 6. Control panels

7. Main and intermediate distribution frames
 8. Telephone terminal boards
 9. Signal terminal cabinets
- C. Label all junctions and pull boxes with the upstream panel or equipment name and circuit numbers as applicable. Labeling is to be made neatly and legibly with a permanent marker using different colors for different electrical systems.
- D. Conductors in conduit are to be labeled at every junction and termination point.
1. Install tags made of pressure-sensitive plastic or engraved phenol with plastic tie-wrap on the following items:
 - a. Feeder sizes #8 and larger to electrical equipment (panels, transformers, etc.) and other equipment (HVAC, pumps, etc.). Indicate upstream panel, circuit(s), phase(s) and equipment name.
 - b. Signal distribution cables (optical fiber, telephone multipair, etc.). Indicate function and locations of upstream and downstream terminations.
 - c. Pull ropes in spare conduits. Indicate system and location of other end.
 2. Install adhesive strips with the circuit number(s) on all branch-circuit wiring.
- E. Provide typewritten or computer-generated panel directory in each new or modified panel board's cardholder frame under plastic cover. Directory is to include circuit number and description of each load.
- F. Provide permanent self-adhesive labels on each receptacle faceplate, below the lower receptacle, indicating the panel and circuit number (i.e., for circuit 11 from panel B, label is to read B-11). Labels are to be 3/16" high black text on clear background for white or similar faceplates, or on white background for other colored faceplates in non-finished (i.e., industrial) areas.
- G. In open areas and/or where light switches are ganged together, provide a permanent engraved or silk-screened label at each light switch of the load served. Obtain approvals of labels from the Engineer.

1.19 PRELIMINARY OPERATION

- A. Place into operation any portion of the system or equipment at the request of the Owner prior to the final completion and acceptance of the work. Any preliminary operation is not be construed as acceptance of any part of the electrical work.

1.20 CLEANING

- A. Throughout the course of the work, keep the project site clean and free of debris and rubbish. Remove project spoils from the site.

- B. Clean equipment and materials prior to cleaning, painting and acceptance. Remove debris from inside and outside of material and equipment with brushing or vacuuming tools. Remove unnecessary manufacturers' labels and tags from exposed conduit, boxes and similar work.

1.21 PERMITS AND REVIEW OF CONSTRUCTION

- A. Pay for and obtain all required fees, permits and licenses.
- B. Representatives of the Engineer, Architect and Owner may review the work at any time.
- C. Advise the Engineer when the work is ready for review prior to backfilling of buried work or concealment of work in floors, walls and ceilings. Work is not be concealed without Engineer's consent.
- D. Arrange for inspections by the local utility representatives and local building officials as applicable.
- E. Advise the Engineer when all requirements of the Contract Documents have been completed to arrange for the Engineer's final walkthrough and punch list.

1.22 TESTING AND ADJUSTMENT

- A. Test the entire electrical installation under full loads, and make required adjustments and correct any defects.
- B. Test wiring for continuity, short circuits, and improper grounds. Insulation resistance is to meet or exceed applicable electrical code requirements.
- C. Verify correct functional performance of installed devices and equipment with the device ratings, operating sequence and code requirements.
- D. Verify proper operation and correct rotation of all motors. Measure and record the full-load amperage of all installed motors.
- E. Balance the phase loading of branch-circuits and feeders in all panel boards.
- F. Repair or replace defective work or equipment at no cost to the Owner.

1.23 RECORD DOCUMENTS

- A. Maintain Record Documents which clearly and accurately indicate actual installed locations of equipment, devices, underground and otherwise concealed conduit and wiring routing, modifications to panel schedule circuits, installation details, and other items that vary from the Contract Documents, including change orders and addenda.
- B. Submit one reproducible set of Record Documents to the Engineer for review prior to project closeout. The Record Documents are to contain neat and legible markings of the variances from the Contract Documents as described above. Make changes or clarifications to the Record Documents as requested by the Architect and/or Engineer, and submit a final reproducible copy to the Owner.

1.24 OPERATING INSTRUCTIONS

- A. Provide and post operating instructions at the electrical equipment as directed in other Sections of these specifications. Instructions are to be typewritten or computer-generated and are to include wiring diagrams as noted. Install under UV-rated laminated plastic or in weatherproof enclosure.

1.25 OPERATIONS AND MAINTENANCE MANUALS

- A. Prior to requesting acceptance of work, submit one bound copy of the operations and maintenance manual of major electrical equipment to the Engineer for review. Manuals are to include the following:
 - 1. Manufacturer's name, model number, service manual, spare-parts list, and descriptive literature for all components.
 - 2. Maintenance instructions.
 - 3. Instruction for starting, operation and programming.
 - 4. Detailed one-line and/or wiring diagrams.
 - 5. Field test report.
 - 6. Contact information of contractors, equipment suppliers and service agencies.
- B. Incorporate review comments by the Engineer into two final copies. Manuals are to be assembled in order by specification section in three-ring binders clearly titled on the spine and front cover, and be submitted to the Owner prior to project completion.

1.26 GUARANTEE

- A. Guarantee all electrical work to be free from defects of materials and workmanship for a period of one (1) year from the date of the final acceptance. Materials and equipment having longer manufacturer warranty periods are to be guaranteed for those time periods. Should any materials and/or workmanship be found to be defective during this term, replace and/or repair such defective work and any other work damaged by such defects at no cost to the Owner. Such replacement or repairs is to be guaranteed for a period of one (1) year from the date of the replacement or repairs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 26 00 00

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Raceways, fittings, junction and outlet boxes
- B. Pullboxes and terminal cabinets
- C. Conductors, splices and connectors
- D. Wiring devices and cover plates
- E. Manual motor controllers
- F. Disconnect switches
- G. Grounding and bonding

1.2 RELATED WORK

- A. Section 26 00 00: Basic Electrical Requirements

1.3 SUBMITTALS

- A. Provide submittals for the following materials and equipment in accordance with Section 26 00 00: Basic Electrical Requirements.
 - 1. Wiring devices and cover plates
 - 2. Manual motor controllers
 - 3. Pullboxes and terminal cabinets
 - 4. Disconnect switches
- B. Submittals for conduit, fittings, junction, outlet boxes and similar materials that are not requested are not required and will be returned un-reviewed. Provide these items as specified.

PART 2 - PRODUCTS

2.1 RACEWAYS, FITTINGS AND BOXES

- A. METALLIC CONDUIT

1. Exterior conduit and exposed risers in non-process areas: Hot-dipped galvanized rigid steel (GRS) conduit with watertight galvanized threaded fittings.
 2. Exposed conduit in process, corrosive and high humidity areas including crush, production, bottling, water treatment, tank farm, and barrel building areas: Rigid aluminum conduit with watertight threaded aluminum fittings.
 3. Underground conduit less than 18" below grade, and conduit risers through grade or concrete slabs/assemblies: appropriate metallic conduit as specified above. To prevent contact between conduit and soil or concrete, wrap with half-lapped 3M Scotch #50 protection tape to 4" above grade. The intent is to have a continuous metallic conduit through A/C paving.
 4. Conduit across concrete expansion joints: appropriate metallic conduit as specified above with watertight threaded fittings and expansion couplings, bonding jumpers and corrosion protection as specified above.
 5. Interior concealed conduit, exposed conduit in interior unfinished spaces, and exposed conduit in other interior spaces where approved: electrical metallic tubing (EMT) with steel compression fittings in damp areas and steel set-screw fittings in dry areas.
 6. Interior concealed connections for lay-in lighting fixtures in ceiling grids: Galvanized flexible steel conduit not exceeding six-foot lengths with approved grounding bushings.
 7. Flexible connections below raised floors, in damp areas, kitchens, exterior areas, to transformers, motors and other vibrating equipment, and connections across seismic or expansion joints: Liquid-tight flexible galvanized steel conduit not exceeding six-foot lengths with approved grounding bushings.
 8. Provide plastic conduit bushings except where metallic grounding bushings are required.
 9. Conduit bodies shall be OZ Gedney type EW or equivalent, unless otherwise noted.
 10. Provide materials as manufactured by Allied, Thomas & Betts or equivalent.
- B. NON-METALLIC CONDUIT
1. Underground, underslab, in slab, and in concrete and CMU walls: Schedule 40 PVC with cemented fittings. Conduit shall be listed for direct burial and use with 90-degree Celsius wiring. Restrictions: see metallic conduit requirements above for risers and conduit less than 18" below grade.
 2. Provide non-metallic underground conduit for utility cables that comply with the requirements of the respective utility (i.e., DB120 conduit for power).
 3. Provide materials as manufactured by Carlon or equivalent.
- C. JUNCTION AND OUTLET BOXES
1. Provide galvanized steel boxes with tapped ears approved for the purpose and location of each installation. Boxes shall be flush-mounted unless they are located in unfinished areas. Where boxes are approved by the Architect and Engineer to be surface-mounted in finished areas, provide surface-mounted boxes as specified in this or other Sections.

2. Surface-mounted junction and outlet boxes in process, damp or wet locations shall be Crouse-Hinds cast aluminum type FS or FD with proper quantity and size hubs, device plates, covers, adapters and accessories.
3. Metallic boxes shall be Code-sized at not less than 4" square by 2-1/8" deep. Provide proper galvanized trim rings for flush boxes and flat steel cover plates for surface boxes, color to match neighboring cover plates. The trim ring shall provide a minimum 1/4" clearance between any device and the back of the box. All boxes shall have connectors with integral insulated throats.
4. Boxes shall be rigidly supported with prefabricated brackets and/or blocking.
5. Provide materials as manufactured by Raco or equivalent, unless otherwise noted.

2.2 PULLBOXES AND TERMINAL CABINETS

A. CONCRETE UNDERGROUND PULLBOXES

1. Provide Christy, Brooks, or Quikset precast concrete underground pullboxes for power and signal systems in sizes and quantities as shown on the Drawings and as required by Code.
 - a. In areas not subject to vehicular traffic, provide Christy N-series boxes with extensions as required and concrete lids.
 - b. In areas subject to vehicular traffic, provide Christy B-series boxes with extensions as required and bolt-down galvanized steel checkered lids.
 - c. Lids shall be properly labeled with the following acceptable captions for the separate systems: "POWER" or "ELECTRICAL", "TELCOM" or "SIGNAL" or "COMMUNICATIONS", or as specially noted on the Drawings.
2. Provide precast utility pullboxes and vaults for utility systems that comply with the requirements of the respective utility company.

B. ABOVE-GRADE PULLBOXES AND TERMINAL CABINETS

1. Provide pullboxes and terminal cabinets as shown on the Drawings and where required. Boxes shall be 14 gauge galvanized steel (exterior) or 16 gauge (interior) steel in non-process areas and aluminum in process areas and shall have continuous welded seams and stainless steel hardware (hinges, screws, etc.). Boxes shall be UL labeled, finished with an ANSI 61 light gray or equivalent powder coat finish (steel), shall be approved for the purpose and location of each installation and shall be equivalent to Square D, B-Line or Hoffman.
2. Pullboxes shall have non-hinged covers attached with machine screws; terminal cabinets shall have hinged pad-lockable covers with stainless-steel hinge pin.
3. Weatherproof boxes shall be fully gasketed. Penetrations into weatherproof boxes shall be made with Square D interchangeable hubs, gaskets and adapter nuts.

2.3 600 VOLT CONDUCTORS, SPLICES AND CONNECTORS

- A. Conductors shall be copper with THHN/THWN insulation, and shall have clear markings on the jacket of UL listing, gauge, voltage, insulation type, insulation temperature rating, trade name and

manufacturer. #10 AWG conductors and smaller shall have color-coded insulation and shall be stranded with compression spade connectors at all device terminations, or may be solid without compression connectors. Conductors #8 AWG and larger shall be stranded. Provide materials as manufactured by General Wire and Cable or equivalent.

- B. Prefabricated wiring and raceway assemblies, including types AC (armored cable), MC (metal-clad cable), are permitted in framed areas where the wiring can be concealed in walls and ceilings. Type AC and MC are not permitted for feeders and exterior circuits. NM (non-metallic sheathed "Romex"), is not permitted in this project.
- C. Branch-circuit conductor connectors for #10 AWG and smaller: 3M Scotchlok connectors or equivalent.
- D. Conductor connectors for #8 AWG and larger: T & B Lock-Tite connectors or equivalent.
- E. Feeder splices above-grade in dry locations: Lug connectors with half-lapped Scotch #23 rubber tape covered with an equal number of turns of half-lapped Scotch #50 PVC tape, or equivalent.
- F. Below-grade feeder splices: butt splice with heat-shrink sleeve covering, 3M or equivalent.
- G. Below grade branch-circuit conductor splices: Totally encapsulated insulated splices in 3M #3570 resin "Sealing Packs" or equivalent.

2.4 WIRING DEVICES AND WALL-PLATES

- A. Provide wiring devices that are Specification Grade or better as specified below, colors shall be white unless otherwise as-directed by the Architect. Refer to the Lighting Controls specifications for additional device specifications.
 - 1. Light switches, 20A 120V/277V , paddle type, back and side wired:
 - a. SPST: Legrand #2621W
 - b. DPS: Legrand #2622W
 - c. Three-way: Legrand #2623W
 - d. Four-way: Legrand #2624W
 - e. Illuminated SPST: Legrand #2625W
 - f. Illuminated three-way: Legrand #2626W
 - g. Illuminated four-way: Legrand #2628W
 - 2. 125V 2P 3W convenience receptacles; 15A for multi-outlet branch-circuits, 20A for dedicated 20 amp branch circuits, nylon face, back and side wired, heavy duty specification grade for front of house, including public areas, and hospitality:
 - a. 15A Duplex receptacles: Legrand #26252W
 - b. 20A Duplex receptacles: Legrand #26652W

3. 125V 2P 3W convenience receptacles; 15A for multi-outlet branch-circuits, 20A for dedicated 20 amp branch circuits, nylon face, back and side wired, heavy duty at 'back of house' locations including equipment rooms, janitor closets, storage rooms and other unfinished spaces:
 - a. 15A Duplex receptacles: Legrand #PS5262W
 - b. 20A Duplex receptacles: Legrand #PS5362W
 4. 125V 2P 3W hard use receptacles; 15A for multi-outlet branch-circuits, 20A for dedicated 20 amp branch circuits, nylon face, back and side wired, hard use specification grade at pump stanchions, fermentation and barrel storage areas:
 - a. 15A Duplex receptacles: Legrand #5262W
 - b. 20A Duplex receptacles: Legrand #5362W
 6. 125V 2P 3W USB chargers compatible with USB 2.0 and 3.0 devices, comply with battery charging specification USB BC1.2, two USB ports 3.1 amps 5 volt DC, 15 amp for multi-outlet branch-circuits, nylon face, back and side wired, specification grade:
 - a. 15A Duplex receptacles: Legrand #TM8USBW
- B. Cover plates: color to match the respective device. Single and multigang plates
1. 'Back of house locations' including equipment rooms, janitor closets, storage rooms and other unfinished spaces:
 - a. Flush-mounted devices in interior locations: Brushed 302 stainless steel.
 - b. Surface-mounted devices in interior locations: Galvanized steel.
 - c. GFI receptacles in process and/or exterior locations: Wet location while-in-use, Hubbell #WP26M or equivalent.
 2. Finished locations including offices, hallways: thermoset plastic, color-matched screws.
 3. Public areas including hospitality spaces: screwless polycarbonate, .065" thick, matte finish, 2-piece plastic polycarbonate subplate, automatic alignment pins.
- C. Pump Stanchion Interlock Receptacles:
- a. Devices shall be as manufactured by Mennekes as noted on the drawings (Mennekes type disconnect devices are installed throughout the existing winery).
 - b. Unfused pin and sleeve mechanical interlocks shall be CEC listed as "Suitable as Motor Disconnect that has a visual means of verifying equipment has been disconnected.
 - c. Refer to the construction drawings for the exact amperage and voltage required.
 - d. The switch cannot be turned ON until the plug is completely engaged, and the plug cannot be removed until the switch is turned OFF.
 - e. The interlocks shall be watertight, non-metallic heavy duty housing, nonconductive and corrosion resistant. Housing shall accept conduit entry from the rear. Tabs or drill holes shall be provide wall mounting
 - f. The pin and sleeve receptacle shall be IEO color coded by voltage

- g. Lockable handle with Lockout/Tagout to meet OSHA regulations
 - h. Provide permanent nameplate on the interlock identifying the respective panelboard and branch circuit number.
- D. Manual motor controllers
- a. Provide manual motor controllers with thermal overload elements in each phase and pilot light in enclosures as noted.
 - b. Maximum ½HP, 2-pole, 115/230V, FVNR: Square D 2510 Type F (toggle switch) with pilot light.
 - c. ¾HP and above, FVNR: Square D 2510 Type M (pushbutton) with pilot light.

2.5 DISCONNECT SWITCHES

- A. Electric loads greater than 30amps: Heavy-duty, padlockable, 600-volt or 250-volt and number of poles as required, NEMA 1 unless indicated otherwise on the Construction Documents (NEMA 3R for exterior), quick-make, quick-break operating mechanism, dual cover interlock, Lock-out/Tagout ability, as manufactured by Square D Class 3100 or equivalent.
- B. Electric loads 30amps or less: Switched disconnects suitable for motor disconnects with 600-volt or 250-volt and number of poles as required, NEMA 1 enclosure unless indicated otherwise on drawings, handle interlock preventing cover removal when switch is in the ON position, as manufactured by Square D #MD3304X, Hubbell #HBL78XXX series or equivalent.

2.6 GROUNDING AND BONDING

- A. Ground rods: Copper-clad steel, 5/8" x 8'-0" and 0.01" copper jacket thickness minimum, vertically driven at a 6'-0" minimum spacing from other rods and other grounding electrodes. Rods may be diagonally driven or buried 30": below grade when the soil prevents rods from being vertically driven. Eritech 615880 or Calpico CP588, manufacturer and length shall be visible on the exposed end of the rod.
- B. Underground boxes for ground rods: Christy #FL8BOX with FL8 lid, install in non-traffic areas.
- C. Ground clamps, fittings and connectors:
 - 1. Utility-grade at utility transformers: Eritech #HDC58H or Dossert or AMP equivalent, and as required by the utility company.
 - 2. Non-utility locations: Bronze pressure clamps equivalent to OZ-Gedney ABGO series.
- D. Non-integral Ground buses:
 - 1. At terminal boards and in MPOE termination cabinets: Eritech #EGBA14112EE ¼" x 1" x 12" predrilled bus on brackets, exposed on terminal board or in termination cabinet.

PART 3 - EXECUTION

3.1 RACEWAYS, FITTINGS AND BOXES

A. GENERAL

1. Thoroughly clean, de-burr and mandrel conduit prior to installation of conductors.
2. Install a ¼" polyethylene pull rope in all empty conduits and identify per Section 26 00 00: Basic Electrical Requirements.
3. Seal all conduit penetrations through non-rated assemblies with clear silicone caulking. Provide chrome escutcheon plates over seals at exposed conduit penetrations in interior finished locations.
4. Seal conduit penetrations through fire rated assemblies with sealant that is equal to or greater than the fire rating of the assembly. Use U.L. approved fire rated material by 3M or equivalent.
5. Use UL-approved pulling lubricants as recommended by the cable manufacturer when installing conductors into conduit. Do not exceed Code conduit fill requirements.
6. Conduit bends and offsets shall not exceed 270 degrees for power and control wiring and 180 degrees for telcom wiring between pull points. Provide junction or pullboxes to maintain these maximum bends sum total.
7. Maintain 6" minimum separation between power/control and telcom conduit runs. Intersections between power/control and telcom conduits should be at a 90-degree angle.

B. ABOVE-GRADE CONDUIT

1. Install conduit concealed within building structure wherever possible. Exposed conduit shall be installed to follow structural elements.
2. Group conduit runs wherever possible on steel or aluminum channel, as appropriate, attached to structure with anchors, beam clamps, lag bolts or threaded rod as appropriate. Install individual conduit runs with steel one-hole straps. Supports shall be no more than 10 feet on center and within 3 feet of each junction box or termination point.
3. Grouped conduit runs shall be neat, properly spaced and aligned parallel.
4. Make conduit bends without reducing the cross-sectional area of the conduit.
5. Securely fasten conduit fittings to ensure good electrical continuity along entire conduit path.
6. Provide fire stopping of conduit through fire-rated assemblies with UL listed materials methods per California Building Code.

C. UNDERGROUND CONDUIT

1. Install conduit runs a minimum of 24" below grade with sand bedding as detailed on the Drawings. Backfill and compact trenches to compaction as noted in the civil drawings, specifications, and/or geotechnical report (minimum 90% density) and remove trench soils from the project site.
2. Slope underground conduit to facilitate drainage to exterior locations.
3. Do not install conduit near or through grade beams, building footings or pads without approval from the Engineer. Install underslab conduit beneath the slab's sand and gravel base.

4. Horizontal bending radii for underground conduit shall be 24" for conduit sizes up to 2½" and 48" for larger conduit sizes. Vertical bending radii shall not be less than six times the conduit diameter.
5. Clean and seal conduit joints with approved compounds to be watertight.

D. JUNCTION AND OUTLET BOXES

1. Provide UL listed fire stopping materials and methods for installation of boxes greater than 16 square inches, or multiple boxes installed in more than 100 square feet of fire-rated assemblies.
2. Do not install back-to-back flush junction and outlet boxes in the same stud cavity. Where this is not practical, provide UL listed fire stopping materials and methods for fire-rated assemblies and sound-proofing outlet box pads for non fire-rated assemblies.

E. FLOORBOXES

1. Seal joints and openings and grease all adjustable parts prior to concrete pour. Thoroughly clean boxes after concrete curing.
2. Install floor boxes level and flush with finish floor. Install carpet or tile section into floor box flip-covers.

F. PULLBOXES

1. Install pullboxes wherever the maximum number of conduit bends has been exceeded and at locations shown on the drawings.
2. Provide poured in place concrete bottoms sloped to the middle with a 2" diameter hole for drainage. Install 24" of drain rock beneath the pullbox.
3. Terminate conduit in the pullbox a minimum of 3" above the bottom of the box. Install conduit bells on the ends of the conduits.
4. Do not install conduits where site water drainage will enter the pullbox. Do not install pullboxes adjacent to direct inverts (DI's). Coordinate pullbox locations with the civil and landscape drawings.

G. 600 VOLT CONDUCTORS, SPLICES AND CONNECTORS

1. All feeders shall be installed in conduit, unless noted otherwise on the drawings.
2. Pull conductors using only approved grips, maximum pulling tensions and bending radii as recommended by the cable and conduit manufacturer. Use nylon or equivalent pulling grips in non-metallic conduit.
3. Make connections such that all conductor strands are contained within the splice or connection and such that no strain is put on the conductors.
4. Provide color-coding of phase, neutral and ground conductors with conductor insulation color or colored Scotch #35 vinyl tape at each termination and junction point per the following table:

	480V 3PH 3W 480Y/277V 3PH 4W	240/120V 1PH 3W 208Y/120V 3PH 4W 208V 3PH 3W	240/120V 3PH 4W * stinger leg
Phase A	brown	black	black
Phase B	orange	red	orange*
Phase C	yellow	blue	blue
Neutral	white or gray		
Ground	green		
Isolated Ground	green with yellow stripes		

5. Neatly train and arrange wiring in panels, switchboards and terminal cabinets with approved tie-wraps.

H. GROUNDING AND BONDING

1. Provide grounding and bonding per the CEC and Titles 8 and 14 of the CCR. Permanently ground non-current-carrying metallic parts: raceway systems, supports, cabinets, switchboards, panel boards, transformers, lighting fixtures, and metal equipment housings.
2. Provide an insulated equipment grounding conductor sized per Article 250 of the CEC in all branch-circuit runs. Where isolated ground receptacles or connections are shown, install and terminate an isolated ground conductor along with the circuit conductors and equipment ground conductor.
3. Measure the resistance of the grounding electrode system to true ground using approved testing methods. Where the resistance exceeds 25 ohms, install additional properly spaced ground rods until the resistance is measured to be below 25 ohms.
4. Install bond conductors and provide bonding to the following items:
 - a. Utility pad-mounted transformers – provide and bond to ground rod(s)
 - b. All distribution equipment enclosures including switchboards, distribution boards, panel boards, motor control centers and motor control panels
 - c. Structural steel columns
 - d. Metallic cold water and fire protection mains and entrances of each system into each building
 - e. Above-ground portion of metallic natural gas piping
 - f. Telephone terminal boards and termination cabinets - provide equipment ground buses at these locations with a #6 copper equipment bonding conductor to the nearest electrical grounding system common with convenience receptacle(s) at the terminal board or cabinet.
 - g. Metallic telcom racks and equipment

5. All bonding and grounding connections shall accessible for testing, unless otherwise noted.

I. WIRING DEVICES

1. Terminate conductors onto device screw-terminals; do not "back-wire" devices.
2. Install all duplex receptacles with the ground terminal "down", in order to match industry preferences and pre-manufactured angled plugs.

J. DISCONNECT SWITCHES

1. Install disconnect switches in locations to maintain Code-required clearances and access to equipment. Install switches on building construction or onto galvanized steel support channels. Switches may be installed onto the served equipment where acceptable to the equipment manufacturer and where the switches do not cover removable access panels, air vents, or other important features of the equipment.

3.2 INSTALLATION OF RACEWAY AND CONDUCTORS

A. GENERAL

1. The electrical drawings indicate locations and quantities of lighting fixtures, electrical distribution equipment, wiring devices, mechanical and other special equipment, signal and telecommunications equipment and devices.
2. The electrical drawings do not indicate all sizes, quantities and routing of raceways and conductors. Prior to installation, sizes and routings shall be carefully planned and coordinated with other trades according to the Drawings, the California Electrical Code and the following criteria:
 - a. POWER SYSTEM CONDUCTORS
 - 1) All power conductors shall be fully enclosed in raceways as described in this Section and separated from all signal and telecommunications wiring.
 - 2) Power feeders consisting of conductors #8 and larger shall be installed in their own dedicated conduit raceway.
 - 3) Branch-circuits originating from the same panel board consisting of #12 and/or #10 conductors may be installed together in common raceways. Up to four circuits from a single panel board with Code-sized ground and neutral conductors may be installed in the same Code-sized raceway.
 - b. LOW-VOLTAGE CONDUCTORS AND CABLING
 - 1) All low-voltage cabling shall be installed in raceways as described in this Section and separated from all power wiring.
 - 2) All low-voltage cabling other than fire alarm may be installed together in common conduit raceways that terminate in a single outlet box (i.e., data and telephone, data/telephone and cable TV).
 - c. RACEWAYS

- 1) Raceways shall be completely concealed in new finished areas (i.e., offices, restrooms).
- 2) Conduit raceways for cables transitioning to cable trays or cable rungs shall be stubbed to within 6" laterally of the tray, and within 6" of the top of the tray. Install plastic bushings at all conduit stubouts.
3. As-built drawings of the project required in other Sections of these Specifications shall include all installed conduit and conductor sizes, quantities and routings.

END OF SECTION 26 05 00

SECTION 26 09 43

LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Network lighting control dimming system.

B. Related Sections:

1. Section 26 05 00 – Basic Electrical Materials and Methods

1.2 REFERENCES

A. Federal Communications Commission:

1. Standard for Radio Frequency Equipment.

B. Government Electronics and Information Technology Association:

1. EIA 709.1 - Control Network Protocol Specification.

C. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.
2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

E. Underwriters Laboratories Inc.:

1. UL 50 - Enclosures for Electrical Equipment.
2. UL 67 - Panelboards.
3. UL 508 - Industrial Control Equipment.
4. UL 916 - Energy Management Equipment.

1.3 SYSTEM DESCRIPTIONS

A. Provide network lighting control dimming system consisting of components manufactured by single source.

1. Dimming and switching panels, and or distribution dimming modules, with an integral astronomical timeswitch and programmable switches connected together by networked wiring

system extending from panel locations with single communications bus to allow switches to communicate with panels.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall controls with actual installed door swings.
3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
4. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Preinstallation Meeting: Conduct on-site meeting with System Provider prior to commencing work to review:

1. Low voltage wiring requirements.
2. Separation of power and low voltage/data wiring.
3. Wire labeling.
4. Processor/controls locations and installation.
5. Control locations.
6. Load circuit wiring.
7. Network wiring requirements.
8. Connections to other equipment.
9. Installer responsibilities.
10. Power panelboard locations.

C. Sequencing:

1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. A factory authorized representative of the network lighting control system shall provide the following design and submittal based on the reviewed and approved Light Fixture Submittal. A control system submittal based on a non-approved light fixture submittal will be rejected.

1. Bill of Materials.
2. Product specification sheets of all components

3. One Line diagram indicating the equipment with model number and location, wiring interconnections, switching, and power requirements.
 4. Equipment wiring details.
 5. Load Schedules that include the Panel Identification, quantity/part number/module descriptions, and location where the panel is mounted.
- B. Shop Drawings: Indicate dimensioned drawings of lighting control systems components and accessories.
1. One Line diagram indicating the equipment with model number and location, wiring interconnections, switching, and power requirements.
 2. Drawings for each panel showing hardware configuration and numbering.
 3. Panel wiring schedules.
- C. Product Data: Submit manufacturer's standard product data for each system component.
- D. Manufacturer's Installation Instructions: Submit for each system component.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record the following information:
1. Wiring diagrams reflecting field installed conditions with identified and numbered system components and devices.
 2. Drawings for each panel showing hardware configuration and numbering.
- C. Operation and Maintenance Data:
1. Submit manufacturer's published installation instructions, operating instructions, programming instructions, and operator's guide.
 2. System user's guide and programmer's guide.
 3. Instruction books and manufacturer's printed materials.
 4. Recommended renewal parts list.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70 as applicable to electrical wiring work.
- B. Comply with NEMA 250 for type of electrical equipment enclosures.
- C. Provide equipment complying with FCC emissions' standards in part 15 subpart J for Class A application.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing lighting control system listed in this section, with minimum three years' experience.
- B. Installer: Company specializing in performing work of this section shall be certified by the lighting control system manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept system components on site in manufacturer's packaging. Inspect for damage.
- C. Protect components by storing in manufacturer's containers indoor protected from weather.

1.10 WARRANTY

- A. Furnish five year manufacturer's warranty for each system component.

1.11 MAINTENANCE SERVICE

- A. Furnish service and maintenance of system for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including checkout and adjustments.
- B. Furnish service during working hours on breakdowns and malfunctions for this maintenance period.
- C. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, with maximum 4 hour response time.
- D. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.
- E. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.12 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish 10 percent of each type of dimmer and non-dim relay of total number of relays.
- C. Furnish two of each switch type.

PART 2 - PRODUCTS

2.1 NETWORK LIGHTING CONTROL SYSTEM

- A. Manufacturers:
1. Lutron – Grafik Eye QS (Lutron model numbers are specified)
 2. Leviton – Dimensions Architectural Lighting Control System
 3. Crestron - iLux
- B. Provide microprocessor-based, fully programmable dimming systems, consisting of flush wall mounted control unit, low-voltage wall stations, and remote power boosters. Refer to the Lighting Control System diagrams on the Drawings for specific equipment and model numbers.
- C. The control unit shall be capable of controlling the following lighting sources with a continuous square law dimming curve: incandescent, tungsten, magnetic low voltage transformer, Lutron Tu-wire electronic fluorescent dimming ballast, electronic low voltage transformer,
- D. The control unit shall include programmable presets scenes, adjustable light level fades, IR receiver for remote control, and astronomical timeswitch that meet CA Title 24 requirements.
- E. The system shall be completely factory-tested, field-programmed, and shall include engraved or silkscreened labeling on all controls per the Architect's direction.
- F. Provide additional lighting control devices including occupancy sensors and daylight sensors for a complete system. Refer to the drawings for device locations.
- G. Low Voltage Control Wall Stations (Keypads):
1. Provide 'seeTouch' style keypads. Refer to the Drawings for quantity of switches. Initially install 6 button switch stations at every switch location. See 'Start up and Programming' below.
 2. Install outlet boxes for wall stations with 2½" minimum depth.
 3. Electronics: Use manufacturer's recommended wiring and connectors for low voltage communication.
 4. Provide faceplates with concealed mounting hardware. Colors to be selected by Architect.
 5. Engrave wall stations with appropriate button, zone, and scene engraving descriptions furnished prior to fabrication.
 6. Functionality: Upon button press, LEDs to immediately illuminate.
 - a. LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.
 - b. Allow for easy reprogramming without replacing unit. Replacement of units does not require reprogramming.
 7. Software Configuration: Customizable control station device button functionality:
 - a. Buttons can be programmed to perform single defined action.
 - b. Buttons can be programmed to perform defined action on press and defined action on release.

- c. Buttons can be programmed to perform automatic sequence of defined actions.
 - d. Buttons can be programmed using conditional logic statements. Conditional logic to allow nested or sequential IF-THEN-ELSE commands to allow wall station and control inputs to execute customized programming scripts; this may affect any of spaces or zones on processor to which control input device or wall station is wired.
 - e. Capable of deactivating select wall stations to prevent accidental changes to light levels.
8. Control station device LEDs to support logic that defines when it is illuminated:
- a. Scene logic (logic is true when all zones are at defined levels).
 - b. Room logic (logic is true when at least one zone is on).
 - c. Pathway (logic is true when at least one zone is on).
 - d. Last scene (logic is true when spaces are in defined scenes).

PART 3 - EXECUTION

2.0 SUPPORT SERVICES

- A. Pre-installation meeting: Manufacturer shall provide a factory authorized representative to provide a functional overview of the lighting control system prior to products being installed.
- B. System Startup: Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all system components.
- C. Training: Manufacturer shall provide factory authorized technician to train owner personnel in the operation, programming and maintenance of the lighting control system including all occupancy sensors, daylighting controls and lighting control panels. User training shall consist of four hours of on-site training of Owner-designated personnel.

2.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's installation instructions.
- B. Mount equipment including panels and switches] [occupancy sensors] [and] [photocells] as indicated on Drawings. Provide any additional equipment required to provide control intent.
- C. Install a dedicated neutral conductor on each phase of the branch circuits that serve the dimmed lighting loads to avoid cross talk between dimmers.
- D. Label each low voltage wire clearly indicating connecting panel. Refer to Section 26 05 53.

2.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Test relays and switches after installation to confirm proper operation and confirm correct loads are recorded on directory card in each panel.

2.3 LIGHTING CONTROL DIMMING SYSTEM START UP AND PROGRAMMING

- A. Provide factory-certified field service engineer to make minimum of four site visits during construction and three site visits after the Owner has used the system to ensure proper system installation and operation under the following parameters:
 - 1. Qualifications for factory-certified field service engineer: Certified by the equipment manufacturer on the system installed.
- B. During Construction:
 - 1. Make first visit prior to installation of wiring.
 - a. Review: wiring requirements, separation of power and low voltage/data wiring, wire labeling, information required on load schedules, dimmer/switching panel locations and installations, and addressing, analog phone line requirements and computer jack locations, load circuit wiring, connections to other equipment.
 - b. Confirm all control locations specific zones each switch will control and the zoning with Owner prior to roughing in the outlet boxes.
 - 2. Make second visit upon completion of installation of central dimming control system.
 - a. Verify connection of power feeds and load circuits, verify connection and location of controls, verify proper connection of panel links (low voltage/data) and address panel, energize processor panels and upload system programming, verify system operation, generate punch list of items to be resolved, verify operation of modem and test dial-up access (if installed).
 - 3. Make third visit for system sign-off: verify punch list items, make keypad programming changes, set initial timeswitch programming, train installer and owner/agent on system operation, obtain a sign-off of the system functionality. Repair or replace defective components.
 - 4. Make fourth visit to demonstrate and educate Owner on system capabilities, operation and maintenance: make minor programming changes as requested by the Owner, finalize timeswitch programming, demonstrate system for Owner's representative and Owner. Demonstrate operation of the following system components:
 - a. Index system to occupied cycle and unoccupied cycle.
 - b. Operation of switches.
- C. After Owner has occupied the building:
 - 1. After 3 months of the Owner using the lighting control system, the field service engineer shall return to the site and obtain the information on the changes required for the wall stations including the required amount of buttons requested by the Owner. Obtain the engraving information for each button from the Owner. Modify the buttons to control the zones as requested by the Owner.

2. After another month the field service engineer shall return to the site to replace the wall switches with the engraved switches.
3. After another month the field service engineer shall return to modify the buttons to control the zones as requested by the Owner.

2.4 DISTRIBUTED DIGITAL LIGHTING CONTROLS

- A. Verify cover color and engravings of low voltage switch stations with Architect prior to ordering equipment.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 26 09 43

SECTION 26 24 00

SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Equipment concrete housekeeping pads
- B. Branch-circuit panelboards
- C. Dry-type transformers
- D. Circuit breakers and fuses

1.2 RELATED WORK

- A. Section 26 05 00: Basic Electrical Materials and Methods

1.3 SUBMITTALS

- A. Provide submittals for the following materials and equipment in accordance with Section 26 00 00: Basic Electrical Requirements.
 - 1. Branch-circuit panelboards
 - 2. Dry-type transformers
 - 3. Circuit breakers and fuses

PART 2 - PRODUCTS

2.1 ELECTRICAL DISTRIBUTION EQUIPMENT

- A. Provide new, unless otherwise reviewed by the Engineer, UL-listed electrical distribution equipment that meets voltage, amperage, NEMA and dimension requirements as detailed on the Drawings. To establish the quality and features of these items, the equipment shall be equivalent to Eaton, Square D, and ABB (GE). Any proposed substitutions must meet the criteria in this Section and Section 26 00 00: Basic Electrical Requirements. All electrical distribution equipment shall be of the same manufacturer to assure uniformity in quality, compatibility, coordination, features, and replacement parts for the project and ongoing facility operation.
- B. All equipment shall have a permanent manufacturer's nameplate or label which notes rated equipment voltage, amperage, frequency, short-circuit current rating, series rating, and number of phases and wires.

- C. All equipment shall be fully-rated unless otherwise noted on the drawings as "series-rated", or "series-rated acceptable".
- D. All equipment enclosure metalwork shall be factory-treated with alkaline cleaner, zinc phosphate, sealer and rinses, and factory-painted with a minimum of two 3-millimeter coats of electrostatically-applied and baked-on ANSI 61 light gray or equivalent powdercoat finish.
- E. Exterior enclosures shall be weatherproof and include full door gaskets made of unshrinkable, fire and water-resistant material.
- F. All equipment doors shall open and close freely, be properly aligned and level with the enclosure, and have hardware to hold the door open at a minimum of 90 degrees.
- G. When identified on the drawings, provide digital customer metering which measure real-time and maximum demand amperes, kilowatts, kilovolt-amps, and kilovolt-amps-reactive; real-time line and phase voltages of all phase; real time frequency and power factor; and kilowatt-hour usage.
- H. For equipment without a circuit directory card, provide engraved nameplates, mounted to the face of the assembly, for all main and feeder circuits per nameplate detail provided on the drawings.
- I. Electrical Equipment containing a service entrance disconnect:
 - 1. Shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.
 - 2. Provide double padlock (Owner and utility) hasp attachment equivalent to Square D for the exterior switchboard doors at the metering compartment(s).
 - 3. Provide a fully-rated removable link between the ground and 100% rated neutral buses.
- J. PANELBOARDS
 - 1. Panelboards shall be minimum 20" wide with 5" gutter space all around, constructed of Code-gauge galvanized steel and shall be flush or surface mounted as shown on the Drawings.
 - 2. Provide factory-installed copper bus bars with amps rating and withstand (AIC) bracing as shown on the Drawings. Bus bars shall be factory-tapped for future devices. Provide separate full-size factory-tapped copper ground and insulated 100% rated neutral buses inside the panelboard enclosure.
 - 3. Panelboards to have either weatherproof padlockable doors (exterior) or integral locking door (interior) masterkeyed with all other panels in the project or on site as applicable. Interior panelboard doors more than 36 inches high shall have three-point locking latches at the top, middle and bottom of the door.
 - 4. Panelboards shall be equivalent to Square D NF and NQOD series.
- K. DRY-TYPE TRANSFORMERS
 - 1. Transformers shall be dry-type, air-insulated and air-cooled with rodent screens and 2-1/2% FCAN and FCBN taps accessible behind the removable front cover. The windings may be aluminum or copper. Transformers between 15 and 1000 kVA shall be energy-efficient per

DOE 2016 minimum requirements. Transformers shall be rated for 150 degrees Centigrade maximum temperature rise. The maximum temperature of the top of the enclosure shall not exceed 50 degrees Centigrade above a 40 degree Centigrade ambient. Insulation shall be Class "H", non-explosive and fire-resistant with the appropriate materials and binders for required mechanical strength.

2. Install transformers on exterior-rated sound and vibration-isolating pads in addition to isolation pads integral to the transformer enclosure. Transformers shall not exceed the following NEMA-standard maximum sound levels:

a.	0 – 9kVA	40dB
b.	10 – 50kVA	45dB
c.	51 – 150kVA	50dB
d.	151 – 300kVA	55dB
e.	301 – 500kVA	60dB
f.	501 – 700kVA	62dB
g.	701 – 1000kVA	64db

3. Provide the following certified test data if requested by the Engineer:
 - a. Resistance measurements of all windings at rated voltage and tap extremes.
 - b. Ratio tests on rated voltage and tap connections – required to be within 1% between phases.
 - c. Polarity and phase relation tests on the rated voltage connection.
 - d. No-load loss at rated voltage.
 - e. Excitation current at rated voltage.
 - f. Impedance and loss at rated voltage and load.
 - g. Sound levels at rated voltage and load.
 - h. Applied potential data.
 - i. Induced potential data.

L. CIRCUIT BREAKERS

1. Typical feeder and branch circuit breakers shall be molded-case, status-indicating (OFF, TRIPPED, and ON), quick-make, quick-break, bolt-on, with voltage, amperage and AIC ratings as noted on the Drawings.
2. Unless otherwise noted, all circuit breakers are to be new. Where required by existing conditions, the use of reconditioned circuit breakers is to be reviewed by the Engineer, and provided with report of certification and testing from a recognized testing agency, that verifies the recondition breaker has been tested in accordance with and meets manufacturer trip curve and breaker characteristic requirements.

3. Breaker trip mechanisms below 400 amps shall be thermal-magnetic, except for motor-circuit protector (MCP) breakers, which shall be adjustable magnetic trip.
4. Breakers 400 amps and above shall be electronic trip equal to Square D Micrologic Standard Function with adjustable long, short and instantaneous trip settings.
5. Breakers noted to be 100% rated and/or ground-fault shall be electronic trip equal to Square D Micrologic Full Function with adjustable long, short and instantaneous trip settings.
6. Multiple-pole breakers shall be single-handle type which interrupt all poles upon trip.
7. Provide Per the requirements of NFPA 72, for each fire alarm system control and extender panel circuit disconnecting means:
 - a. Circuit breaker with red hand and "Fire Alarm Circuit" marking, equivalent to Eaton BABF1020 Bolt-on Fire Alarm Circuit Breaker.
8. Mark the written circuit directory "Fire Alarm Circuit Control". Provide HACR Heating, Air Conditioning and Refrigeration rated breakers where mechanical equipment is UL-listed with such breakers and fuses are not provided for the equipment.
9. Provide labeled SWD switching duty breakers for night-light circuits and other circuits to be used as switching devices.
10. Provide GFCI breakers with "push-to-test" buttons for wet location circuits without integral GFCI protection or where shown on the Drawings.

M. FUSES

1. Provide fuses at motor and equipment disconnect switches where required and at control circuits. Provide fuse blocks or holders for control circuits.
2. Fuses rated for maximum 600V and 600A or less shall be equivalent to Bussman FRN or FRS dual-element Class RK-1 rejection type.
3. Fuses rated for maximum 600V and over 600A shall be equivalent to Bussman KRP Class L.
4. Provide three spare fuses of each type and rating.

PART 3 - EXECUTION

3.1 EQUIPMENT CONCRETE HOUSEKEEPING PADS

- A. Provide concrete housekeeping pads for all new ground-mounted electrical distribution equipment, including, but not limited to, switchgear, switchboards and transformers.
- B. Housekeeping pads shall be constructed of minimum 2,500 PSI concrete, and shall be minimum 8" deep with top of pad minimum 3" above surrounding grade. Provide chamfered edges on top of pad. Provide #4 reinforcing bar in both directions at 12" on-center at mid-depth of slab.
- C. Refer to project concrete specifications for specific pad installation and testing requirements.

3.2 ELECTRICAL DISTRIBUTION EQUIPMENT

- A. Install equipment level, aligned and rigidly attached to structure as detailed on the Drawings.
- B. Maintain Code-required clearance and access around all distribution equipment.
- C. Perform visual, mechanical and electrical inspection and testing of the entire system per Section 26 00 00: Basic Electrical Requirements.
- D. SWITCHBOARDS, DISTRIBUTION PANELS AND PANELBOARDS
 - 1. Flush panelboards in fire-rated assemblies shall be surrounded by equally-rated layers of fire-rated gypsum board to maintain the assembly fire-rating.
 - 2. Provide factory protective closure plates at all breaker spaces.
- E. TRANSFORMERS
 - 1. Make connections to transformers with liquidtight flexible metal conduit as specified in Section 26 05 00: Basic Electrical Materials and Methods.
 - 2. Set transformer secondary voltages via the taps to nominal system voltage, maximum 102.5% of rated voltage at no load and a minimum of 98% of rated voltage at full load.
 - 3. Provide metallic non-flammable and corrosion-resistant shields where transformers are installed within 12" of combustible surfaces.

END OF SECTION 26 24 00

26 50 00

LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Lighting fixtures
- B. Exit and emergency egress lighting system
- C. Supports, bases and suspension systems

1.2 RELATED WORK

- A. Section 26 00 00: Basic Electrical Requirements
- B. Section 26 05 00: Basic Electrical Materials and Methods
- C. Section 26 09 43: Lighting Control System

1.3 SUBMITTALS

- A. Provide submittals for the following materials and equipment in accordance with Section 26 00 00: Basic Electrical Requirements.
 - 1. Lighting fixtures, lamps and ballasts
- B. For any light fixture that is substituted for those specified, the fixture shall not contain a lamp that is not already specified in the Light Fixture Schedule. Additionally, where a light fixture has been specified that does not project more than 4" from wall to meet ADA requirements, the substituted light fixture shall also meet this requirement.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

- A. Provide fully installed and lamped fixtures and accessories as scheduled in the Light Fixture Schedule and as shown on the Drawings. Where colors and finishes are not clearly noted on the Fixture Schedule, verify these items with the Architect and Engineer and provide color or finish samples if requested. Wet location fixtures shall be weatherproof and installed per manufacturer's instructions to maintain weatherproof seal. Provide additional clear silicone caulking between fixture backing and structure and at threaded hubs.
- B. Fixture diffusers shall be manufactured to comply with fire and smoke rating requirements of the California Building Code, Sections 2606.7.2, 2606.7.5 and/or Chapter 8.
- C. Where recessed light fixtures are immersed in insulation provide 'I.C.'" rated housings.

2.2 LED FIXTURES

1. Provide LED source fixtures with integral drivers as noted in the Fixture Schedule.
2. Diodes in every LED fixture type in the same rooms or areas to be from the same manufacturer for color consistency unless otherwise noted. Minimum 80 color rendering index (CRI) unless otherwise noted in fixture schedule.
3. Manufacturer must provide actual delivered lumens from the fixture. LM79 and LM80 testing required from diode manufacturer and fixture manufacturer.
4. Minimum 5 year warranty on diodes, fixture, and driver. Minimum average life (L70) of 50,000 hours with field-replaceable LED boards and drivers.

2.3 LED DRIVERS

- A. Provide drivers that are matched to the LED lamps by the manufacturer for proper dimming/control, voltage and operation.
- B. Drivers shall be UL-listed, shall carry a five-year warranty, and shall be listed with the California Energy Commission where applicable.

2.5 REMOTE LOW VOLTAGE TRANSFORMERS AND LED POWER SUPPLIES

- A. Refer to the Luminaire Schedule and Remote Transformer Schedule on the drawings for the recommended transformer or driver types and sizes.
- B. Electrical Contractor is responsible for final sizing of all transformers/drivers calculating voltage drop and determining wire sizes. Contractor is responsible to verify the compatibility of all transformers/drivers with the manufacturer's recommendations for each luminaire.
- C. Manufacturers: As noted on drawings.

2.7 EXIT AND EMERGENCY EGRESS LIGHTING

A. EXIT SIGNS AND EMERGENCY BALLASTS

1. All exit signs shall have factory-installed and sealed nickel-cadmium batteries which power the units at a minimum of 90% of full wattage for no less than 90 minutes. Battery packs shall be warranted for a minimum of 3 years.
2. Provide protective cages for exit signs and emergency lights that are installed in damaged prone areas including gymnasiums, locker rooms and multi-purpose rooms as manufactured by STI, telephone 800-888-4784. Cage shall be sized appropriately for the specified exit and emergency light. Oversized cages are not acceptable.

PART 3 - EXECUTION

3.1 LIGHTING FIXTURES

- A. Verify the exact fixture locations with the architectural reflected ceiling plans, elevations and floorplans.
- B. Verify the exact ceiling types and conditions in the field and provide fixtures with the appropriate frames, flanges, fittings and accessories for proper installation. For recessed fixtures install trims tight to ceiling with no gaps or light leaks.
- C. Install fixtures with supports and suspension systems per Code requirements, as recommended by the manufacturer and as detailed on the Drawings. Do not support fixtures from suspended ceiling grids, ductwork, piping, etc. Install pendant light fixtures at heights indicated on drawings.
- D. For wall mounted light fixtures the mounting heights shown on Drawings are measured from the finished floor to centerline of outlet box or recessed housing.
- E. Maintain required fire and plenum ratings of ceilings and assemblies with approved fire-rated fixture enclosures and/or approved materials.
- F. Fixtures shall be installed plumb and level with structure and with each other without distortion and light leaks. Clean fixture reflectors and trims of fingerprints, dirt and construction debris prior to Project Closeout.
- G. Install lighting fixtures in electrical rooms, mechanical rooms and similar areas to avoid conflicts with exposed conduit, ductwork, piping, etc., and to provide reasonably uniform lighting in these work areas.
- H. Suspended fixtures shall be installed to allow 45 degrees swing movement free of obstruction. Canopies in sloped ceilings may require 60 degree swivel capacity to meet this requirement.
- I. Provide touch-up painting to repair small scratches or marring of fixtures. Obtain paint from fixture manufacturer.
- J. Fixtures that are damaged prior to project closeout and wet location fixtures that are penetrated by water in the warranty period shall be replaced at no cost to the Owner.
- K. Clearly mark all junction box cover plates with a permanent ink felt pen identifying the respective branch circuit, control relay and dimmer module contained in the box.
- L. Coordinate the installation of exit signs with other trades to ensure the signs are visible as intended.

3.2 LAMPS

- A. Prior to project closeout, provide a lamp burn-in for all fluorescent lamps for 100 consecutive hours, and all other lamp types for 48 consecutive hours. Replace any lamps that do not burn properly.
- B. Do not install lamps with bare hands. Install lamps using gloves that do not transfer oils or other properties that could damage or reduce the life of the lamp.

3.3 BALLASTS, DRIVERS AND POWER SUPPLIES

- A. Replace objectionably noisy ballasts, drivers, and power supplies at no cost to the Owner.
- B. Verify proper operation of emergency ballasts and replace those that do not operate at the specified output.
- C. Coordinate locations of remote ballast, drivers and power supplies with Architect prior to rough-in. Provide proper access and ventilation.

3.4 EXTERIOR LIGHTING CONDUIT AND WIRES

- A. Refer to Sections 260519 for wiring requirements and Section 260533 for pullbox requirements.
- B. Install minimum 1" diameter conduit and #10 AWG conductors for site lighting. Refer to the drawings for additional requirements.
- C. Provide slack of approximately 3 feet of cable length in each pullbox.
- D. Install watertight conductor splices that encapsulate wire splices.

3.5 PROJECT CLOSEOUT

- A. Verify the light fixture and lighting controls are working in a manner acceptable to the Owner.
- B. Replace non-operating lamps and drivers, as required.
- C. Test emergency lighting system for 90 minutes in the presence and acceptance of the Owner. After testing wait 24 hours and retest each fixture briefly for proper operation.
- D. Adjust and aim lighting as directed by the Engineer. Provide lifts, ladders and personnel as required, and aim light fixtures at night at a time coordinated with the Engineer.
- E. Provide a list of lamps used in the project cross referenced to the fixture types with specific wattage, color, beam spread, manufacturer and model number.

END OF SECTION 26 50 00