UCDH FACILITY STANDARDS
ELECTRICAL

SUMMARY OF UPDATES

Electrical - 26 00 00

1. Added item A.7 to provide MCC wiring drawings inside each door. (4/27/23)
2. Added item A.8 to coordinate use of circuits on projects with UCDH FP&D and UCDH PO&M. (3/1/24)
3. Added item A.9 to require the update of existing 12kV master drawings if revisions are made to the medium voltage system as part of the project. (3/1/24)
4. Update item B.5.e to validate circuitry is accurate. (4/4/24)

Power System Study - 26 00 60

1. Added item A.5 to provide applicable studies and any required arc flash assessments. (4/27/23)
2. For any Protective Device Coordination issues found on existing systems, proposed solutions shall be coordinated with UCDH PO&M. (2/9/24)

Medium Voltage Cable, Terminations, Splices, and Structures - 26 05 13

1. Added item C.1.d to provide vault number on the manhole cover. (4/27/23)
2. Revised the looping of cables for manholes and vaults only. (7/1/23)
3. Added item C.1.e to provide ground busbar in manholes. (4/4/24)

Low Voltage Electrical Power Conductors & Cables – 26 05 19

1. Revised item A.1 to indicate the minimum size of emergency conductors to be #12 and minimum #10 AWG for emergency homeruns. (4/27/23)
2. Added item A.8 to provide dedicated neutrals for multi-wire circuits. (4/27/23)
3. Clarify A.8 for homeruns with more than one circuit in lieu of “multi-wire circuits”. (9/15/23)
4. Revised item A.1 to indicate the minimum size of emergency conductors to be #10. (2/9/24)
5. Revised item C.2 to provide 9” of slack conductor at each outlet. (4/4/24)

Grounding & Bonding For Electrical Systems – 26 05 26

1. Revised item A.2 to indicate steel or malleable grounding bushings. (4/4/24)

Pull Boxes and Junction Boxes – 26 05 32

1. Revised item A.1 to indicate minimum 2-1/8” deep boxes. (1/11/24)

Conduit, Fittings, and Raceways – 26 05 33

1. Revised item A.16 to indicate ½” trade size minimum for flexible conduit. (4/27/23)
2. Deleted item A.25.a.vii noting elbows for underground conduits to be plastic conduit. (4/27/23)
3. Added to item A.2 to allow for up to 40% maximum conduit fill. (7/1/23)
4. Added “steel” after rigid for item A.25. (9/15/23)
5. Revised item A.26.C.2. to utilize galvanized rigid metal conduit for all elbows. (9/15/23)

Identification for Electrical Systems – 26 05 53

1. Revised item A.1 to replace “sign” with “nameplate”. (4/27/23)
2. Revised item A.3 to replace “sign” with “nameplate”. (4/27/23)

3. Revised item A.4 to replace “signs” with “nameplates”. (4/27/23)
4. Revised item A.5 for the equipment identification nomenclature. (4/27/23)
5. Updated sample panel name in part A.5. (4/27/23)
6. Update item A.9. to include “In the Central Utility Plant, provide brass tags for all conduits leaving electrical gear to identify the feeder.” (7/1/23)
7. Updated item A.10.b for junction and pullbox labeling. (1/9/24)
8. Added item A.12 for disconnect labeling. (2/9/24)
9. Corrected the verbiage for item A.8 which had a portion of the verbiage as item A.9. Adjusted the following items’ numbering accordingly. (4/4/24)
10. Revised item A.9 to include circuit breaker number. (4/4/24)
11. Updated item A.10.b to include branch of power for junction and pullbox labeling. (4/4/24)
12. Update item A.7 to indicate ¼” high letters in lieu of 1/8” high letters. (4/4/24)
13. Added items A.10.a.vi and A.10.a.vii. (4/4/24)

Power Monitoring and Control Systems – 26 09 13

1. Revised item A.1.a.iv to remove manufacturer for BMS equipment and spelled out the Building Management System (BMS). (4/27/23)
2. Revised item A.1.b.iv to remove ABB manufacturer callout. (4/27/23)
3. Added to item A.1.d to update central plant lineup screen for expansion of central utility plant as well. (7/1/23)
4. Formatted items A.1.b and A.1.c. (4/4/24)
5. Removed duplicate information from A.1.b. (4/4/24)

Lighting Control Devices – 26 09 23

1. Revised item A.8 to remove Wattstopper manufacturer for the lighting control system. (4/27/23)
2. Added item A.10 to provide outdoor lighting controls for exterior lighting at non-Hospital buildings. (4/27/23)
3. Added item A.11 for contractor to provide manufacturer shop drawings for the lighting control for project. (2/9/24)
4. Added item A.12 for lighting control devices to be labeled with the devices/luminaires they control. (2/9/24)
5. Added item A.13 to provide individual lighting level controls for any luminaires greater than 6’ in length. (4/4/24)
6. Updated item A.7 to include additional monitoring and controls. (4/4/24)
7. Inserted item A.10 for open office area controls. (4/4/24)

Pad Mounted, Liquid-Filled Medium-Voltage Transformers – 26 11 19

1. Deleted item B.3 to remove General Electric Company manufacturer callout. (4/27/23)

Low-Voltage Transformers – 26 22 00

1. Updated item A.5 with additional information for 360 degree rotatable IR Port. (12/8/23)
2. Added additional approved manufacturers under item A.4. (2/6/24)
3. Added item 7 for minimum K-4 rated transformer. (2/9/24)
4. Update item 9 to clarify that external transformer vibration isolators shall be provided for projects in non-HCAI facilities. (2/9/24)
5. Removed Square D from item A.4. (4/4/24)

Switchboards & Panelboards – 26 24 00

1. Deleted item A.1.d to remove ABB/GE manufacturer callout. (4/27/23)
2. Revised item A.5 to include “UCDH PO&M approved equal” for acceptable manufacturer. (4/27/23)
3. Added item A.1.e, “Panels shall not be located behind doors.” (7/1/23)
4. Added item A.1.f for factory connections. (4/4/24)
5. Added item B.1.1 to provide electronic version of the panel schedule to PO&M. (4/4/24)

Wiring Devices – 26 27 26

1. Added to item B.2.d to provide UPS that can function connected to generator power. (4/27/23)
2. Added “and public waiting areas” in item A.6. (7/1/23)
3. Added item A.11 to “Provide welding equipment receptacles in Central Utility Plant. Coordinate exact locations with UCDH.” (7/1/23)
4. Added item A.12 to indicate that pre-wired switches or receptacles are not allowed. (2/9/24)

Low-Voltage Circuit Protection Devices – 26 28 00

1. Added to item A.8 that breakers for fire alarm system are to be a breaker with locking device on. (4/27/23)
2. Update item A.8 that breakers in red color are to be by factory, not painted.

Enclosed Controllers (Motor Starters) – 26 29 13

1. Added to item A.1 to include variable frequency drives with low harmonics and the ability to connect to the existing BMS. (4/27/23)
2. Added item A.5 for acceptable manufacturers. (4/27/23)

Automatic Transfer Switches (ATS) – 26 36 00

1. Added to item A.11 to include “UCDH PO&M approved equal”. (4/27/23)

Interior Lighting – 26 51 00

1. Revised item A.8 to add reference for box identification requirements. (4/27/23)
2. Added item A.10 to note quantity of spare luminaires to provide per project. (4/27/23)
3. Added line B.3 to state “All light fixtures in Utilities and Central Plant mounted over 15’ from the floor shall be mounted with lowering system to service the light fixture.” (8/12/23)
4. Added item A.11 for typical room lighting levels. (3/1/24)

Exterior Lighting – 26 51 10

1. Revised item A.1 to note desired Kelvin temperature of exterior lighting. (4/27/23)
2. Added item A.7 for typical lighting levels for exterior lighting. (3/1/24)
3. Revised item A.1 to indicate that all exterior luminaires shall have a Kelvin temperature of 3000K. (4/4/24)
4. Revised item A.2 for CRI as 90 in lieu of CRI of 80. (4/4/24)

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ELECTRICAL 26 00 00

A. GENERAL

1. Verify points of connection to existing UC Davis Health CUP utilities with the University Representative. New SMUD utility work shall be coordinated with SMUD and UC Davis Health. All utility services including electric, telephone, fire alarm, data, etc. are to be underground.
2. Building electrical systems shall have utilization voltages of 480/277 volts, 3 phase, 4 wire and/or 208/120 volt, 3-phase, 4-wire, or as coordinated with the University Representative. New CUP supported projects shall have primary selective electrical services for normal power and emergency power from redundant CUP feeder circuit pairs (A and B feed respectively).
3. Convenience receptacles: Provide dedicated 20-amp, 120-volt circuits to feed duplex convenience receptacles (6 maximum per circuit). Spacing shall be no more than 50 feet in corridors with a maximum distance from any end wall of 25 feet.
4. Provide housekeeping pads for all floor mounted electrical equipment.
5. New electrical equipment shall have a minimum of 25% of spare capacity during design. All new boards shall have a minimum of 25% breaker pole space available for future breaker installations.
6. New electrical services shall be designed with a minimum of 25% spare capacity available for future.
7. For motor control centers (MCC), provide MCC wiring drawing inside each door.
8. Coordinate use of circuits and panels in projects with UCDH FP&D and UCDH PO&M to eliminate duplication of circuits/panels used in other active projects.
9. Electrical Engineer to request existing 12kV normal and emergency campus one-line diagrams. The UCDH master files are drawing #22222 and #22223. Coordinate with UCDH PM/PO&M to update master files with any medium system updates in the project.

B. TESTING

1. Perform inspection and test procedures per f Inter-National Electrical Testing Association (NETA) Standard latest edition.
2. OSHPD projects shall have all testing requirements included in their TIO documentation process by the projects design professional.
3. Testing shall be performed by an independent third -party testing agency.
4. Testing shall be provided for all electrical systems, including the following:
    a. All Medium voltage equipment, feeders, terminations, splices, service transformers, switches, and interrupters.
    b. All Service and electrical equipment which also includes unit substations, switchboards, automatic transfer switches, distribution boards, and panelboards boards,
    c. All electrical overcurrent devices which also includes breakers, switches, fuses, and disconnects.

d. All electrical wiring which also includes feeders, wiring, and branch circuits.

e. All electrical devices which include receptacles, switches. Validate all circuitry is accurate.

f. All lighting and lighting system components which includes interior light fixtures, exterior light fixtures, and all lighting controls.

5. The contractor shall develop an outline of all project specific equipment to be tested as part of their project scope. Include the proposed dates and timing for testing, the parties involved in the testing, information about the proposed tests to be included, the number of tests, how the testing report will be created, and all testing protocols shall be submitted to the University Representative for review and approval.

6. For any Protective Device Coordination (i.e. HCAI PIN 70) issues found on existing electrical distribution systems in HCAI facilities, proposed solutions shall be coordinated with UCDH PO&M.

POWER SYSTEM STUDY 26 00 60

A. TESTING

1. Provide a comprehensive power system study including separate sections for Short Circuit, Protective Device Evaluation & Protective Device Coordination Studies, harmonics evaluation, and Arc-flash and shock risk assessment. Submit studies to University Representative prior to receiving final acceptance of distribution equipment shop drawings or prior to release of equipment for manufacture. Include all new and/or modified equipment and breakers. Study shall include the complete normal and emergency systems as required. All analysis shall meet the current version of NFPA 70E.

2. Studies shall include all portions of electrical distribution system from the point of connection at 12,470V primary down to and including 480V and 208V distribution systems respectively. Including contributions from secondary power sources such as generators or the UC Davis Health CUP, all maximum fault condition shall be adequately covered in the study.

3. Evaluate a comprehensive harmonics evaluation as part of the power system study. This study shall demonstrate whether K rated transformers, feeders, and oversized neutral system components should be implemented.

4. The Arc Flash and shock risk assessment analysis shall include physical labels to be installed at all equipment outlining their hazard categories and required personal protective equipment (PPE).

5. For existing systems, provide Short Circuit and Protective Device Coordination study where applicable. Provide Arc-flash and shock risk assessment as required for the project.

SELECTIVE DEMOLITION FOR ELECTRICAL 26 00 90

A. GENERAL

1. Contractor shall coordinate all required power shutoff work and energizations with the University Representative prior to starting their work.

2. Where remodeling interferes with circuits in areas that are otherwise undisturbed, circuits shall be reworked as required by the contractor.

3. Contractor shall visit the Project site and verify existing device conditions and shall remove, re locate and/or rework any electrical equipment or circuits affected (whether indicated or not) due to removal of existing walls, ceilings, etc. When electrical equipment or electrical circuit is demolished, remove circuit back to the source (i.e. panel, etc.) or to the last active device to remain.

MEDIUM VOLTAGE CABLE, TERMINATIONS, SPLICES, AND STRUCTURES 26 05 13

A. MEDIUM VOLTAGE CABLE

1. Single conductors, Class B stranded, copper.
2. Insulation shall be Ethylene-propylene rubber (EPR), with 133% insulation level.
3. Jacket material type = Cross-linked polyolefin (XLPO), or polyvinyl chloride (PVC).
4. Metallic Shielding: Copper shielding tape, helically applied over semi-conducting insulation shield.
5. Cable Voltage Rating: 15 kV phase to phase.
6. Ground shield of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cables and separable insulated connector fittings, and hardware in accordance with manufacturer's written instructions.
7. In manholes, handholes, pull boxes, junction boxes and cable vaults, cables shall be fully looped around the walls for the longest route from entry to exit and sport cables on galvanized steel racks at intervals adequate to prevent sag.
8. In each manhole and pull box install permanent tags on each circuit's cables and wires to clearly designate their circuit identification the tags shall be polyethylene with black stamped letters. Tags shall have a PVC holder and shall be attached to cable 6" below all terminations with two nylon cable ties. Tag shall identify cable phase, as well as circuit number and designation as indicated on the single line diagram. Tags in manholes shall be over fireproofing.
9. Any underground feeders shall be fully concrete encased with red dyed concrete.
10. No horizontal boring allowed.

B. SPLICES AND TERMINATIONS

1. Splices and terminations shall be in accordance with IEEE 48, 386, 404 and 592.
2. Splices shall be made with standard kits and shall be one of the following types:
   a. Pre-molded, cold shrink rubber, inline splice kit.
   b. Pre-molded ethylene propylene diene monomer (EPDM) splice body kit with cable joint sealed by interference fit of mating parts and cable.
3. Conductor Terminations, General: Comply with Class 1 of IEEE Standard 48. Insulation class shall be equivalent to that of the cable upon which they are installed. Terminations for shielded cables shall include a shield-grounding strap. Termination kits shall be performance tested for compliance with IEEE Standard 48 and shall be of the following types: All terminations shall utilize separable type connectors.

a. Class 1 Termination for Shielded Cable: Modular type, furnished as a kit, with stress relief tube, multiple molded silicone rubber insulator modules, shield ground strap, compression-type connector, and end seal.

4. Ground shields of shielded cable at terminations and splices. Ground metal bodies of terminators, splices, and hardware in accordance with manufacturer's written instructions.

C. MEDIUM VOLTAGE STRUCTURES

1. Manholes
   a. Size manholes to accommodate all feeders, wiring, switching, and extensions for future.
   b. Manholes shall be reinforced concrete, precast and designed for H20-44 wheel loading. Provide knockouts for future duct connections.
   c. Electrical manholes shall be nominal 10’x12’ with inside clear height shall be nominal 8 feet-0 inches. Locate depressions in manholes for future sumps at an unused corner.
   d. Provide vault # on manhole cover.
   e. Provide ground busbar in manholes.
2. Pullboxes
   a. Minimum size of pullboxes shall be 4 feet by 6 feet, and 3 feet deep. Boxes shall be reinforced concrete type with traffic rated lids.
   b. Stamp boxes with Electrical on the top of the cover.

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES 26 05 19

A. CONDUCTORS AND CABLES

1. Conductor size shall be a minimum of No. 12 AWG. The minimum size of emergency systems conductors shall be No. 10 AWG.
2. All power and low voltage conductors shall be copper, stranded type wire, 90C, THHN/THWN or XHHW unless otherwise required by the California Electrical Code. Do not use solid type wire.
3. Insulation voltage level rating shall be 600 volts minimum.
4. Conductors sized #6 and smaller shall be solid color wire of the appropriate phase color, wire #4 and larger may be black and phased tape at all boxes and terminations.
5. 60C ampacities shall be used for sizing of all wire and cable for branch circuits and feeders at 100 amps. 75C ampacities shall be used for sizing of all wire and cables for feeders greater than 100 amps.
6. Use 10 AWG conductors for 20 Ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 Ampere, 277 volt branch circuit home runs longer than 200 feet. Increase circuit conductor sizes for ambient temperature corrections, current carrying conductor adjustments in accordance with CEC article 310, and all voltage drop provisions including California Title 24 (T24). Include completed forms signed by the design professional, contractor or commissioning agent, as applicable.

7. Cables shall be jacketed 600 volt SO type. Cable connectors shall be steel case liquid tight sized for cable diameter and shall use strain relief gland fitting to prevent tension on conductor terminals.
8. Provide dedicated neutral conductor for each circuit. Neutral conductors shall be numbered with wire numbers of circuits it services/is associated to in all junction boxes, gutters, panels, etc.
9. Control Wiring
    a. For control wiring less than 50V:
        i. Separate from all other circuits. Separate cable tray and/or conduits.
        ii. Digital signals to be in multiconductor cables (14 AWG) with a cable shield.
        iii. Analog signals to be individually shielded twisted pairs. Pairs can be combined into one cable. 18AWG.
    b. Splices are not allowed.
    c. Provide terminal strips on both ends of the conductor run. No wire nuts.
    d. Provide 10% spare wires for control circuits.
    e. Each conductor to include wire number, landing location and source location.

B. SPLICES, TAPS, AND CONNECTORS

1. Splices, taps and connectors (No. 10 AWG and smaller) - Splices and joints shall be twisted together electrically and mechanically strong and insulated with approved type insulated electrical spring connectors.
2. Splices, taps and connectors (No. 8 and larger) - Joints and connections shall be tool-applied pressure lugs and connectors. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape. Polaris type connectors may be used with prior review and approval from PO&M electrical department.
3. Full size ground wires shall be installed. Do not use raceways for the sole grounding or bonding of a branch circuit. Secure using approved methods at each box with approved bonding fittings.
4. A maximum of three branch circuits are to be installed in any one conduit, on 3 phase 4 wire system. This includes homeruns, no more than three branch circuits shall be installed.
5. Make splices in conductors only within junction boxes, wiring troughs and other enclosures as permitted by the California Electrical Code. Do not splice in panels, or panelboards.
6. Do not splice conductors in pull boxes, panelboards, safety switches, switchboard, switchgear, motor control center, or motor control enclosures.
7. Splices in conductors installed below grades are not permitted, unless approved in writing by the University Representative.
8. Outdoors and below grade use wire connectors or compression type with heat shrink style watertight splice covers. Use Scotchcast 3570G resin epoxy to waterproof connections.

C. GENERAL

1. Control, communication, or signal conductors shall be installed in separate raceway systems from electrical line voltage wiring. Color coding of the low voltage wires used for these systems are specified under the respective sections for these systems.
2. Install a minimum of nine inches (300 mm) of slack conductor at each outlet.
3. Provide wire markers on all current carrying, and neutral conductors at each board source of origin and junction boxes. Megger and record insulation resistance of all 600 volt insulated conductors in the project scope and all new feeders on the single line diagram, using a 1,000volt megger. Make tests with circuits isolated from source and load.
4. Provide flexible connections of short length to installations or equipment subject to vibration or movement and to all motors. Provide a separate bonding conductor across all flexible connections.
5. Wire Color Code - Color code all conductors. Wire sizes #6 AWG or smaller shall have integral color coded insulation. Wire sizes #4 AWG and larger may have black insulation but identified by color coded electrical tape at all junction, splice, pull, or termination points. Color tape shall be applied 1/2 lap to at least 6 inches of conductor. Color Code wires as follows:

Conductors	120/208 Volts	277/480 Volts
Phase A	Black	Brown
Phase B	Red	Violet
Phase C	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

GROUNDING & BONDING FOR ELECTRICAL SYSTEMS 26 05 26

A. GENERAL

1. Ground rods shall be copper encased steel, ¾” diameter, 10’ length, minimum.
2. All conduit bushings shall be grounding type. Steel or iron malleable.
3. Ground conductors shall be UL approved and code sized copper, with dual rated THHN/THWN insulation, color identified green.
4. Grounding conductors shall be connected to ground rods or connected to structural steel using exothermic welds or high-pressure compression type connectors.
5. New systems shall include concrete-encased electrodes consisting of bare copper conductors placed in the bottom of the structural footings. The grounding system shall include all fittings, connectors, devices, and material necessary for a complete and useable system. Bond the grounding system to building columns in new construction. Grounding system shall obtain a ground resistance of the grounding grid of not to exceed 5 ohms.
6. Install ground rods inside of Precast concrete box nominal 9" throat diameter x 14" deep with light duty concrete cover for non-traffic areas or steel plate for traffic areas. Cover shall be embossed or engraved with "GROUND ROD".
7. Power system grounding

a. Buildings shall have a main building ground bus mounted on the wall in the main electrical room. Connect the following items using CEC sized copper grounding conductors to lugs on the main building ground bus:
   i. Grounding conductor from building reference ground bus in main service switchboard.
   ii. Bonding conductor to Telecom grounding system.
   iii. Bonding conductor to metallic cold water piping system.
   iv. Bonding conductor to additional ground rods.
   v. Bonding conductor to building structural steel.
   vi. Separately derived system grounding conductors in same room.

b. At the building power system reference ground bus in the main service switchboard, connect the grounding electrode conductor from concrete encased UFER ground or alternate grounding electrodes.

8. Separately derived electrical system grounding
   a. Transformers: Provide a dual rated four or six-barrel grounding lug with a 5/8"-11 threaded hole. Drill enclosure with 11/16" bit and attach lug to enclosure utilizing a torque bolt and a dragon tooth transition washer or equal. Connect the following when present:
9. Equipment bonding/grounding
   a. Provide a CEC sized insulated copper ground conductor in all 120VAC through 600 VAC feeder and branch circuit distribution conduits and cables.

HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS 26 05 29

A. GENERAL

1. Conduit clamps, straps, and supports shall be steel or malleable iron for all exposed individual conduit runs. Clip type hangers may be used in concealed areas on individual conduit runs. Group mounted, exposed or concealed shall be supported by trapeze hangers constructed of formed steel channels and threaded rods.
2. Provide vibration isolation and all supporting hardware for vibrating electrical equipment, (e.g., transformers). Isolators shall be as recommended by manufacturer to maximize their effect. Isolators shall be as manufactured by Mason Industries, or equal.
3. Conduit Supports Single point beam clamps not allowed. Conduits shall not be attached to ceiling support wires. For individual conduit runs not directly fastened to the structure, use rod hangers. For multiple conduit runs, use trapeze type structural channel conduit support. In new construction, conduits installed inside of walls must have approved clamp supports. No twisted wire allowed.
4. Steel channels, bolts, washers, etc., used for mounting or support of electrical equipment shall be galvanized type. Where installed in a corrosive environment, stainless steel hardware shall be used.

PULL BOXES AND JUNCTION BOXES 26 05 32

A. GENERAL

1. Indoor, general purpose boxes shall be a NEMA 1 enclosure, constructed of code gauge galvanized steel. The boxes shall be constructed from a single piece of steel with folded and welded corners. Boxes shall have hinged covers or flat removable, galvanized sheet metal covers held in place with binder head sheet metal screws. Boxes shall be minimum 2-1/8" deep.
2. Outdoor boxes surface mounted above ground in wet locations shall be cast iron with a plain cast iron cover. Covers shall be neoprene gasketed and shall be NEMA 4 watertight construction. The cover shall be held in place by stainless steel screws.
3. Underground boxes - Underground boxes over 24-inches square shall be sized to provide floor space for workers to stand in the box without the need to stand on conductors in the box.
4. For recessed boxes, use an outside flanged recessed cover. For outdoor boxes mounted on exterior surfaces, use an unflanged box with weather seals.
5. Conduit openings shall be bossed, drilled and tapped in outdoor boxes.
6. Standard size metal boxes stamped from galvanized steel shall be used for indoor above ground general purpose.
7. Above ground outdoor boxes shall be cast iron with threaded hubs for vapor tight and wet locations where indicated.
8. Underground boxes 24-inches square or larger shall be high density reinforced concrete with end and side knock-outs. All such boxes shall be backfilled around the outside with concrete. Each shall be equipped with the following reinforced concrete accessories:
    a. Extensions as required
    b. Box floor
    c. Lid with hold down bolts and labeled with usage. (Steel checker plate with hold down bolts in traffic areas.)
9. Provide pull boxes or junction boxes in conduit runs over 90' long or when more than 4 quarter bends occur in a conduit run.
10. Install all boxes such that covers are accessible.
11. Cut or sheared edges shall be filed or honed, eliminating all sharp edges.
12. Boxes shall be installed with unused or open knockouts plugged.
13. Install boxes direct buried in earth or concrete flush with surface, square with surrounding structures.
14. All above ground boxes shall be labeled on the cover indicating circuit number and panel number.

CONDUIT, FITTINGS, AND RACEWAYS 26 05 33

A. GENERAL

1. The minimum size of interior conduit shall be ¾".
2. Conduits shall only be filled to 30% maximum fill. In a Central Utility Plant, conduits shall only be filled to 40% maximum fill.
3. Type MC cable shall not be used on the UC Davis Health campus.
4. Bushings shall be metallic insulated type. Weatherproof or dust-tight installations shall be liquid- tight with sealing ring and insulated throat. Bushing shall be OZ/Gedney type KR, or equal (Or equal, no known equal.)
5. Expansion and deflection fittings shall be OZ/Gedney, type DX, or equal.
6. All under floor/ground raceways will be cleaned and mandrilled before wire is installed.
7. Electrical Metallic Tubing (EMT) couplings and connectors shall be steel compression "concrete tight" type. All connectors shall be nylon insulated throat type. Fittings shall meet same requirements for finish and material as EMT conduit. Box connectors shall be equipped with insulated throat.
8. Fittings for rigid steel and IMC shall be standard threaded couplings, locknuts, bushings and elbows. Fittings shall be assembled with anti-corrosion, conductive anti-seize compound at joints made absolutely tight to exclude water. Set screw or non-thread fittings are not permitted.
9. Malleable iron, die cast, or pressure cast fittings are not permitted. All fittings shall be steel.
10. All connectors and bushings shall be steel with insulated throat.
11. Non-metallic conduit when installed on the site shall have a minimum size 1.0".
12. Non-metallic conduit shall be heavy wall, Schedule 40 PVC or Schedule 80 PVC.
13. Non-metallic conduit fittings shall be of the same material as the conduit furnished and be the product of the same manufacturer. PVC 90-degree bend elbows shall not be used. Wrapped rigid will be used in its place. Double lap of Calpico 10 mil or approved equal.
14. Flexible conduit and fittings shall be liquid tight with watertight connectors when installed in damp or wet locations.
15. Flexible conduit and fittings shall be steel insulated throat type rated as suitable for system ground continuity. Connectors for liquid tight flexible conduit shall be screw-in ground cone type.
16. Flexible conduit shall not be less than ½ " trade size and in no case shall flexible conduit size be less than permitted by the CEC for the number and size of conductors to be installed herein.
17. No aluminum flexible conduit shall be used.
18. Wireway systems shall utilize steel bases and covers.
19. Wireway systems shall have dividers between line voltage and low voltage systems.
20. Surface metal raceways - Wiremold, or equal (Series 2000, 3000, 4000, & 6000). Wireway systems smaller than Wiremold series 700, or equal are not permitted.

21. Provide completely separate raceways for the life safety, critical, equipment, and normal branch power systems in accordance with the CEC.
22. Galvanized rigid conduit shall be used in damp or wet locations including outdoor service yards and roofs, in concrete walls or block walls, in concrete vaults, when exposed in locations below 8', where subject to physical damage, and in mechanical rooms.
23. Conceal all conduits, unless approval for surface mount is obtained from the University Representative. Conduits may be exposed in non-public spaces such as electrical rooms, mechanical rooms, and penthouse or basement utility rooms.
24. Install galvanized pull line, or nylon pull rope in all spare conduits.
25. In Central Utility Plant, all conduits shall be rigid steel, including conduit to be used when embedded in concrete (i.e. concrete slab, concrete floor, etc.).
26. Uses permitted:
    a. Galvanized rigid conduit or IMC shall be used as follows:
        i. For primary and secondary service (except when installed below the ground floor slab and above the building mat slab) and for secondary unit substations, switchboard,
        ii. motor control center, dry-type transformer and panelboard feeders.
        iii. Buried in or in contact with earth to be half -lapped with omic pipe wrapping tape with sealant applied to all joints.
        iv. In poured concrete walls, floor and roof construction, provided a minimum of 2" of cover is maintained.
        v. In all walls up to the first outlet box where fed from rigid conduit in damp locations or locations exposed to the weather.
        vi. In exposed locations below 8 feet above the floor, including all mechanical rooms.
        vii. All elbows for underground plastic conduit.
        viii. All conduits for interior wiring systems whose voltage is above 600 volts.
        ix. All conduits entering refrigerated spaces.
        x. For emergency power feeders and circuits when installed outside of building.

    b. Electrical metallic tubing (EMT) shall be used as follows:
        i. Concealed in stud partitions and hollow masonry walls.
        ii. For connections from junction box to lighting fixtures except in accessible ceilings.
        iii. In suspended or accessible ceilings above 8 feet.
        iv. Exposed in dry locations above 8 feet where not subjected to mechanical damage.
        v. In furred ceiling spaces.
    c. Rigid non-metallic conduit shall be used as follows:
        i. For the branch circuit wiring for exterior lighting pole base s and bollards (horizontal runs only).
        ii. All elbows, both vertical and horizontal, shall be galvanized rigid metal conduit, not PVC.

iii. Any non-metallic PVC conduit used for emergency power systems shall be schedule 80 PVC.

iv. The communications conduit shall be schedule 40 PVC.

d. Flexible steel conduit shall be used as follows:

i. Recessed lighting fixtures. (last 6ft to the fixture, max)

ii. Motor connections.

iii. Connection between fan plenum and structure.

iv. At expansion joints.

v. At transformers and other equipment which produces vibration.

vi. At damp and wet locations or where exposed to weather, flexible steel conduit shall be liquid tight type.

vii. Tite-bite type connectors shall be used.

viii. All flexible steel conduit shall be used with code sized ground w ire installed.

ix. All homeruns shall be in conduit, do not use flexible conduits for any homeruns routed to panels.

e. All other conduits shall be electrical metallic tubing (EMT) unless otherwise noted.

f. Direct Burial Conduit

i. Unless otherwise indicated install top of conduits 24" minimum below finished grade.

ii. Utility primary conduit shall be 48" below finished grade.

iii. Medium voltage conduits installed on the UC Davis Health campus site shall be 5.0” schedule 80 PVC, or GRC when routed inside buildings.

iv. All medium voltage conduits not under building slabs or parking lots shall be encased in a minimum of 3" concrete. Concrete for primary conduit shall contain a red pigment dye to make it readily noticeable. Provide 10% red oxide per cubic yard of material.

v. Pitch the trench uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward building wherever possible.

vi. Install top of conduits approximately 6" minimum below bottom of building slabs. 6). Install top of conduits 30" minimum below grade, below roads and any other paved surfaces.

vii. Place a 4" wide, bright yellow, non-biodegradable plastic tape 12" above all underground conduit outside of building foundations.

viii. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab, and at transition at manholes and service switchgear, make transition with rigid galvanized elbows and extend through slab or above grade with galvanized rigid steel conduit. For corrosion protection, where the elbow penetrates surface, wrap with vinyl all-weather electrical tape for 6" above and below concrete surface.

ix. For all underground runs of two or more conduits, separators or spacing blocks made of plastic or other suitable nonmetallic, nondecaying material shall be placed on not greater than four foot on center. They shall be of the interlocking type both horizontally and vertically. Ducts shall be anchored to prevent movement during placement of concrete.

x. 10) Before installing the last 8" of lift of backfill for all primary feeders and for secondary service feeders, install plastic identification tape warning of buried electrical lines the full length of duct bank trench.

g. Raceway Installations Within Concrete

i. Conduits shall not be installed within shear walls unless specifically coordinated with the structural engineer. Conduits shall not be run directly below and parallel with load bearing walls.

ii. Conduit stub-up penetrations through slabs shall be installed with the top of a threaded conduit coupling flush with the finished slab.

iii. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.

IDENTIFICATION FOR ELECTRICAL SYSTEMS 26 05 53

A. GENERAL

1. Provide engraved plastic-laminate nameplate on each electrical device or piece of electrical equipment in the building, or project including:
   a. Electrical cabinets, panels, boards, disconnects, switches, control panels, devices, and enclosures.
   b. Access panel/doors to electrical facilities.
   c. Transformers, inverters, and UPS equipment
   d. Automatic transfer switches and generator equipment.
2. Each individually mounted circuit breaker, and each breaker in the switchboards, secondary unit substations, and distribution panels shall have a sign.
3. Nameplate shall have ½” high text lettering on 1-1/2” high sign (with 2” high used for signs with multiline text).
4. Nameplates shall be color coded for the systems they serve as follows:
   a. 480/277 volt normal power equipment shall be identified with white faceplate with green core.
   b. 480/277 volt critical branch power equipment shall be identified with white faceplate with yellow core.
   c. 480/277 volt life safety branch (or emergency branch at non-hospital buildings) power equipment shall be identified with white faceplate with red core.
   d. 480/27 volt equipment branch power equipment shall be identified with white faceplate with blue core.
   e. 480/277 volt Inverter, UPS, or Solar power shall be identified with white faceplate with orange core.
   f. 208/120 volt normal power equipment shall be identified with green faceplate with white core.
   g. 208/120 volt critical branch power equipment shall be identified with yellow faceplate with white core.

h. 208/120 volt life safety branch (or emergency branch at non-hospital buildings) power equipment shall be identified with red faceplate with white core.

i. 208/120 volt equipment branch power equipment shall be identified with blue faceplate with white core.

j. 208/120 volt Inverter, UPS, or Solar power shall be identified with orange faceplate with White core.

5. Equipment identification is to indicate the following

   Bldg/Floor/Riser(optional) Branch Voltage Panel

   Bldg = Building #

   Floor = Floor # (i.e.1= first floor; 4 = fourth floor)

   Riser = Name of Riser (i.e. A='A' electrical system riser of building; Y='Y' electrical system riser of building; leave blank if not applicable)

   Branch = Branch of power (i.e. N=normal; LS=Life Safety; C=Critical, EQ=Equipment)

   Voltage = voltage of panel (i.e. H-277/480V; L=120/208V)

   Panel = 2 (i.e. add '2' at the end of the name for second panel with the same name)

   Example:

   34/2/LSH2 = building 34, second floor panel, Life Safety Branch, 277/480V, second panel)

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

7. All electrical devices and switches shall have engraved device covers, 1/4" high letters. Include panel name and circuit number. Critical, life safety, and equipment branch devices shall have nameplates engraved in red. Normal branch devices shall have nameplates engraved in black.

8. All conductors shall be marked and identified. Include voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present.

9. Provide brass tags, 2" diameter 19 gauge, die stamped and punched for fasteners. Tags shall be used to identify each individual conductor landed at ground buses. For example, "UFER", "Building steel", "Cold water bond", etc. In the Central Utility Plant, provide brass tags with circuit breaker number for all conduits leaving electrical gear to identify the feeder.

10. Box Identification

    a. After box installation and wire termination completion provide color coded junction box covers for all above ceiling junction boxes. Covers shall be painted with a masked stripe down the middle for hand inscription with black indelible marker. Color schemes shall conform to:

       i. Normal power- Green background, black marker with circuiting information contained.

       ii. Equipment power- Blue background, black marker with circuiting information contained.

       iii. Critical power- Yellow background, black marker with circuiting information contained.

       iv. Life Safety power- Red background, black marker with circuiting information contained.

v. Fire alarm system – Red junction boxes, red raceways, red background, black marker with circuiting information contained.

vi. Inverter power – Orange junction boxes, black marker with circuiting information.

vii. 125vdc start circuit – Red and black junction boxes, red and black raceways.

b. Using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, with the following information:

Line 1 : Panel designation

Line 2 : Circuit number

Line 3: Voltage

Line 4: Branch of Power

Example:

LSH2

1, 3, 5

277

Life Safety

c. All junction and pull boxes for wiring systems above 600V shall be identified with high voltage warning labels installed every 20 linear feet in accordance with OSH A standards. All boxes shall also be painted red.

11. For disconnects for equipment (including integral manufacturer disconnects) shall have a nameplate including name of equipment, panel and circuit(s) it is fed from, and the room number of the panel. The nameplate shall be the color of the branch of power per item A.4 above.

12. Fasteners for equipment or device tag identification shall be self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot be used or should not penetrate the substrate material of the equipment. Disconnects for equipment, including built manufacturer disconnect, shall have a nameplate with the name of the equipment, with branch color, panel, circuit or circuits fed from, room number of the panel fed from.

13. Provide updated, type written, panelboard schedules for all branch circuit work completed as part of renovation and/or new construction projects. Schedules shall include the load description and the room number or area the load is installed.

14. For 12kv cable identification in vaults, provide cable ID off of drawings 22222, 22223 and Central Plant breaker numbers.

POWER MONITORING AND CONTROL SYSTEMS 26 09 13

A. GENERAL

1. New electrical services, main switchboards, and significant renovation project shall have new metering on the main boards. These meters shall be connected to the existing ABB monitoring and control system (PMCS).

a. System requirements

i. Monitor the load measured by electronic power meters installed on each of the main breakers in new 15kV switchgear and secondary mains of new unit substations.

ii. Monitor the load measured by the trip devices on all feeder circuit breakers in all secondary unit substations. Monitor trip status.

iii. Configure Demand Reports for new electronic power meters on unit substation or service mains.

iv. For buildings not served by the Central Utility Plant electrical distribution system, provide a seamless integration with the existing UC Davis Health campus.

b. Building Management System (BMS) Equipment shall be General Electric (EPM6000), or equal.

c. Where new metering is added to existing facilities, the existing facility overview screen shall be updated to include the new monitoring equipment.

d. Where new buildings are added and/or expansion of the Central Utility Plant is provided, the existing central plant lineup screen shall be updated to reflect changes made as part of the individual project. Metering system shall aggregate the load at each board and include all functions necessary to support OSHPD meter trends for load validation.

i. The metering system shall be consistent across the UC Davis Health campus, manufactured by Square D or ABB as coordinated with the PO&M electrical department.

ii. The meters shall all be networked to the existing ABB power monitoring server in the Central Plant. A single head end interface allowing for remote access via the internet. Include all parts and pieces necessary for PO&M to log into the system from their remote computers at their office space.

iii. The system shall locally store a minimum of 1 year of data on each meter installed.

iv. The meter shall not rely on a separate 120v cord and plug for its power connection.

v. Integrate the new meter installations with the new board installations.

vi. Meters may be furnished integral to boards, or in separate adjacent enclosures.

LIGHTING CONTROL DEVICES 26 09 23

A. GENERAL

1. Provide complete lighting control system consisting of relay panels, switching and dimming room controllers, addressable drivers, switching/dimming control stations, scene controls, emergency lighting transfer devices, daylighting photocells, occupancy sensors, remote input/output modules, raceways and wiring with network control interface.

a. Coordinate integration with Division 25 BAS when required.

b. All lighting control stations serving fixtures on the emergency, life safety, or critical branch shall be red in color.

c. All controls shall be compliant with the California Energy code – Title 24 requirements.

2. The lighting control system shall utilize distributed lighting controls, hybrid, or a centralized system approach and be capable of wireless, wired, or hybrid wireless/wired architectures. System shall be capable of networked, or standalone operation.
3. The lighting control system shall be programmable and the status readable using a USB connection to the UC Davis Health's computer operating system running the supplier's software package. Systems which require the computer to stay on-line and connected 24/7 are not acceptable.
4. One set of any interconnecting cables, adapters and/or software program required to operate, troubleshoot, program, display the status of or interface with the system shall be supplied. Software and cable or adapter costs shall be included.
5. The lighting control system manufacturing company shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment for not less than 5 years.
6. The lighting control system must have remote access ability for the factory to access the system and help troubleshoot, program, or alter the system without being on-site. This factory service must be available 24 hours a day, 365 days a year.
7. The lighting control system shall have the capability of integrating into Building Automation System (BAS) or Energy Management System (EMS) with the key feature being the ability to, but not limited to, monitoring the lighting zones, monitoring the lighting zone occupancy status, monitoring on/off status, monitoring % output as well as the ability to command zones on/off and % output.
8. The building interior lighting control system shall be Acuity nLight.
9. Lobby and Common Areas: Occupancy sensors will turn the lights on and off from the high trim to the low trim setpoints. If it applies, the area shall have dimming zones controlled by daylight sensors. Minimum lighting levels shall be maintained at the path of egress. Local control stations will provide override switching during off-times. Include these spaces on networked lighting controls system.
10. Open Office Areas: Provide luminaire level (not zone level) controls to allow for future space configuration.
11. For exterior lighting at non-Hospital Building, provide outdoor lighting controls to meet current Energy Code requirements. Provide final manufacture shop drawings for lighting control in electronic file format.
12. Contractor to provide final manufacturer shop drawings (in electronic format) for the lighting controls for the project.
13. Each lighting control device shall be labeled with what devices/luminaires it controls.
14. Provide individual lighting level controls for any luminaires greater than 6' in length.

SECONDARY UNIT SUBSTATIONS 26 11 16

A. GENERAL

1. Provide secondary unit substations for indoor/outdoor single -ended or double-ended configurations.

2. Construction: Provide totally enclosed, metal-clad secondary unit substation constructed of bolted or welded sheet steel, front operable free-standing, adequately braced for rated interrupting capacity without distortion or damage. Make provisions for future additions. Design housing for floor mounting, complete with channels and necessary hardware.
3. Housings: Ventilate housing to provide "natural chimney effect".
4. Bus: Provide ground bus extending entire length of unit substation.
5. Equipment Assembly: Assemble, wire, and test substations at factory. Equipment components shall be the responsibility of one manufacturer.
6. The transformer unit supply shall consist of an HV flange and an LV flange. Connections between the primary device and transformer shall be cable, and between the transformer and secondary shall be flexible braided bus.

B. PRIMARY SECTION

1. Switch Types
   a. For Emergency Branch Unit Substation: Provide primary section consisting of 3-pole air interrupter fused switches. Size fuses to properly protect transformer. Include one extra set of primary fuses. Switch arrangement shall be for a primary selective system. Provide lugs to permit primary cables to be looped into and out of switch so that more than one switch can be connected to a primary circuit.
   b. For Normal Branch Unit Substation: Provide primary section consisting of 3-pole air interrupter fused switches. Size fuses to properly protect transformer. Include one extra set of primary fuses. Switch arrangement shall be for a primary selective system. Provide lugs to permit primary cables to be looped into and out of switch so that more than one switch can be connected to a primary circuit.
2. General
   a. The primary switches shall consist of deadfront, completely metal enclosed free-standing structure(s) containing interrupter switches and fuses (when appropriate) of the number, rating, and type noted on the drawings or specified herein. All switches shall meet or exceed all applicable NEMA, ANSI, and IEEE Standards.
   b. The load interrupter switches shall be quick-make, quick-break three pole, gang operated, with stored energy operation. Each switch shall have the following minimum ratings:

i.	System Voltage	12.47 kV three phase three wire
ii.	Maximum Design Voltage	15 kV
iii.	Basic Impulse Level	95 kV
iv.	Amperes Continuous	600 Amps
v.	Amperes Interrupting	30,000 Amps
vi.	Momentary (Switch Closed, 10 Cycle)	30,000 Amps Asym.
vii.	Fault Close	40,000 Amps Asym.

   c. A manual over toggle type mechanism shall be supplied which utilizes a heavy duty coil spring to provide opening and closing action of the switch. The speed of opening and

closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position.

d. The interrupter switch shall have separate main and make/break contacts to provide maximum endurance for fault close and load interrupting duty. The switch assembly shall have insulating barriers between phases and between outer phases and the enclosure.

e. The switch assembly shall be integrally designed and produced by the manufacturer of the interrupter switches, fuses, and enclosures to assure a completely coordinated design and establish one source of responsibility for the equipment's performance.

C. CONSTRUCTION

1. The following features shall be supplied on every three pole, two position open-closed switch:
   a. A high impact viewing window that permits full view of the position of all three switch blades through the closed door.
   b. For fused units, a fuse access door interlocked with the switch so that:
      i. The switch must be opened before access to the fuses is possible.
      ii. The door must be closed before the switch can be closed.
   c. A grounded metal barrier in front of every switch to prevent inadvertent contact with any live part, yet still allow for a full-view inspection on the switch blade position.
   d. Provision for padlocking the switch in the open or closed position.
   e. Permanent "Open-Closed" switch position indicators.
2. Fault protection shall be furnished by fuses where indicated on the contract drawings. Fuses shall have a minimum interrupting rating of 30,000 Amperes symmetrical at 15 kV and shall be expulsion type. Furnish three spare refills for each fused switch and provide a storage rack on the inside of the main door for these spare fuses.
3. One two-hole NEMA pad per phase shall be provided for attaching field installed cable termination suitable for copper cable of the number and sizes indicated on the drawings. Sufficient vertical space shall be supplied for field installed electrical stress relief termination system.
4. All bus shall be tin plated aluminum and be mounted on NEMA rated glass polyester insulators. All bussing shall be braced for the maximum available fault current.
5. Enclosure construction shall be of the universal frame type using dieformed, welded, and bolted members. All enclosing covers and doors shall be fabricated from not less than 11-gauge steel. To facilitate installation and maintenance of cables and bus, the top and rear covers shall be removable.
6. Each switch cubicle shall have a single, full length, flanged front door or two hinged front doors over the switch and fuse assembly where applicable and shall be equipped with padlockable means.
7. All enclosing and supporting steel shall be thoroughly cleaned and phosphatized to assure proper surface for prime and finish coats.

8. Small wiring, fuse blocks and terminal blocks within the switch shall be furnished as required. All groups of control wires shall be labeled with wire markers and all wires leaving the switch shall be provided with terminal blocks having suitable numbering strips.
9. A nameplate shall be mounted on the front door of the switch cubicle.
10. Supply Kirk key interlocks between pairs of switches at each unit substation to prevent switch operation unless the associated low voltage main device is open.
11. 15 kV station class surge arrestors shall be provided per Section 26 14 23 and connected at the incoming terminations and securely grounded to the metal structure for the secondary unit substation.

D. TRANSFORMER SECTION (DRY)

1. The transformer shall be of explosion resistant, fire-resistant, air insulated, dry type construction, cooled by the natural circulation of air through the winding.
2. The ratings of each transformer shall be as follows:
   a. KVA Rating: 750 KVA at 80°C/997.5 kVA at 150°C AA/FA or 1500 KVA at 80°C/2000 KVA at 150°C AA/FA or KVA size as required to support the specific load of the subject project scope.
   b. Impedance: 5.75%
   c. HV: 12.47 kV Delta
   d. HV BIL: 95 kV
   e. HV Taps: ±2 to 2-½% full capacity
   f. LV: 480Y/277 volts Delta
3. Units shall be forced air (FA) units and shall contain all necessary components and wiring for automatically increasing the KVA rating to 133%. They shall include a temperature indicator and control device. Contacts for alarm as well as for starting and stopping fans shall be included. Control power for fans shall be obtained from a control transformer within the secondary switchboard or other external source as shown on the drawings. Provide hand-off-auto switch for fan control.
4. The electrical insulation system shall utilize Class H material in a fully rated 220°C system. Transformer design temperature rise shall be based on a 30°C average ambient over a 24 - hour period with a maximum of 40°C. Solid insulation in the transformer shall consist of inorganic materials such as porcelain, glass fiber, electrical grade glass polyester or Nomex. All insulating materials must be rated for continuous 220°C duty. The insulation between the high and low voltage coils shall be more than sufficient for the voltage stress without the need of a varnish.
5. The low voltage winding shall be pressure wound on a rectangular mandrel. Multiple strands of aluminum conductor shall be used for each turn. Turn -to-turn insulation shall consist of a combination of inorganic paper, high temperature fiber winding insulation and high temperature phenolic varnish. A flexible mica plate shall be wrapped over the cooling duct spacers of the low voltage winding to insulate it from the high voltage winding. The high voltage winding shall then be tension wound indirectly over the mica barrier to form a single rigid unit. Special inorganic paper and high temperature molded glass fiber spacers shall provide the layer-to-layer insulation within the high voltage winding.

6. The completed winding assembly shall be completely dried in special ovens, vacuum impregnated with silicone varnish, and fully cured to provide a 150°C rise (220°C hot-spot) insulation system.
7. The resin shall be polyester having high resistance to moisture. The transformer shall be designed for a temperature rise of 80°C and shall be capable of operating at 35% above base nameplate KVA capacity continuously without any loss of life.
8. The transformer shall be supplied in a knockdown case design, for ease in fitting through limited openings, and shall be of 13 gage sheet minimum steel construction, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate ventilating grills.
9. Transformer shall include diagram instruction plate, provisions for lifting and jacking, removable case panel for access to high voltage strap type connector taps for de-energized tap changing, drip proof cover, two ground pads with continuous copper ground bus.

E. SECONDARY SECTION

1. General
    a. Provide key interlocks for main breaker and high voltage switch to prevent opening of switch without first opening main breaker.
    b. Provide secondary section with required number of bolted sheet steel enclosures for proper installation of circuit-breakers and ancillary equipment indicated.
    c. Fasten vertical sections together to form complete, and rigid structure. Provide hot-dip galvanized bolts, nut, and lock washers for fastening purposes.
    d. Provide studs, buswork, and complete provisions for installing future circuit-breakers; also include provisions for mounting current transformers and meters.
    e. AC Dead-Front Distribution Switchboards: Provide factory-assembled, dead-front, metal-enclosed, self-supporting secondary power switchboards, of types, sizes, electrical ratings and characteristics indicated; consisting of vertical panel units, and containing circuit-breakers of quantities, ratings, and types indicated. Provide copper main bus and connections to circuit- breaker branches of sufficient capacity to limit rated continuous current operating temperature rise of no greater than 65°C above average ambient temperature of 40°C; with main bus and tap connections silver-surfaced and bolted tightly according to manufacturer's torquing requirements for maximum conductivity. Brace bus for short-circuit stresses up to maximum interrupting capacity. Provide accessibility of line and load terminations from front of switchboard. Provide mimic bus on front of each switchboard. Equip units with built-in lifting eyes and yokes; and provide vertical individual panel units, suitable for bolting together at project site. Switchboards shall be type General Electrical Powerbreak II, or equal, no known equal. Construct switchboard units for the following environment:
    f. Installation: Indoors, NEMA Type 1.
    g. Provide accessory and instrumentation small wiring, necessary fuse blocks and terminals blocks within the switchboard. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips.

2. Bussing
    a. All bus bars shall be copper with bolted connections at joints. The bus bars shall be of sufficient size to limit the temperature rise to 65°C rise based on UL tests and rated to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having an available fault current of 65000 amperes symmetrical at rated voltages. Provide full capacity neutral.
    b. A ground bus rated a minimum of 25% of main bus ampacity shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the unit substation. An incoming ground lug shall be furnished. Other ground lugs shall also be supplied for feeder circuits as shown in the schedules on the drawings.
    c. All hardware used on conductors shall be high-tensile strength and plated. All terminals shall be of the anti-turn solderless type suitable for CU or A1 cable of sizes indicated for 75°C.
3. Construction
    a. The vertical sections shall align front and rear with depth as shown on the drawings. Mains and feeder devices shall be individually mounted with line and load bus connections. Devices shall be front removable and load connections front accessible.
    b. Main and tie devices shall be individually mounted and arranged for drawout construction. Feeder devices shall be group mounted. All circuit breaker devices shall be individually removable from the front of the switchboard.
4. Metering
    a. Provide a separate customer metering compartment with front hinged door and include the following:
    b. Manufacturer's standard electronic metering package including ammeter, voltmeter, power factor, KWHR demand meter, instantaneous KVA, and peak demand readings for the system. Provide auxiliary dry contacts to allow metering data to be transmitted to a remote central monitoring station. Provide all required current and potential transformers.

F. OVERCURRENT DEVICES - GENERAL

1. Main and tie protective devices in all secondary unit substations shall be drawout mounted power circuit breaker with interrupting rating, frame, and trip ratings as coordinated.
2. Feeder protective devices shall be individually mounted, insulated case breaker type with frame and trip rating as shown on the drawings and have additional characteristics as specified.
3. Provide interface for each circuit breaker for the project equipment monitoring system. All ground fault currents, circuit breaker trips, and reason for breaker opening (i.e., ground fault, overload, etc.) shall be reported to and recorded by the project equipment monitoring system. Coordinate between the breakers and the equipment monitoring system to insure compatibility.
4. Breakers shall be manually operated (MO) unless electrically operated (EO) is required. Electrically operated breakers shall be complete with control switch plus red and green indicating lights to indicate breaker position.

PAD MOUNTED, LIQUID-FILLED MEDIUM-VOLTAGE TRANSFORMERS 26 11 16

A. GENERAL

1. Windings Material: Aluminum.
2. Surge Arresters: Comply with IEEE C62.11, Distribution Class: metal-oxide-varistor type, fully shielded, separable-elbow type, suitable for plugging into the inserts provided in the high-voltage section of the transformer. Connected in each phase of incoming circuit and ahead of any disconnecting device.
3. Winding Connections: The connection of windings and terminal markings shall comply with IEEE C57.12.70.
4. Efficiency: Comply with 10 CFR 431, Subpart K
5. Insulation: Transformer rating shall be the average winding temperature rise above a 30 deg C ambient temperature shall not exceed 65 deg C and 80 deg C hottest-spot temperature rise at rated KVA when tested according to IEEE C57.12.90, using combination of connections and taps that give the highest average winding temperature rise.
6. Tap changer: External handle, for de-energized operation.
7. Tank: Sealed, with welded on cover. Designed to withstand internal pressure of not less than 70 psi (50 kPa) without permanent distortion and 15 psig (104 kPa) without rupture. Comply with IEEE C57.12.36.
8. Enclosure Integrity: Comply with IEEE C57.12.28 for pad-mounted enclosures that contain energized electrical equipment in excess of 600 V that may be exposed to the public.
9. Mounting: An integral skid mounted frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.
10. Insulating Liquids
    a. Mineral Oil: ASTM D 3487, Type II, and tested for compliance with ASTM D 117.
    b. Less-Flammable Liquids:
        i. Edible-Seed-Oil-Based Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic, having passed the Organization for Economic-Co-operation-and-Development G.L. 203 with zero mortality and shall be certified by the U.S. Environmental Protection Agency as biodegradable, meeting Environmental Technology Verification requirements.
        ii. Biodegradable and Nontoxic Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92.
11. Sound level shall comply with NEMA TR 1 requirements.
12. Corrosion Protection
    a. Transformer coating system shall be factory applied, complying with requirements of IEEE C57.12.58, in manufacturer's standard color green.

b. Fabricate front sill, hood, and tank base of single-compartment transformers from stainless steel according to ASTM A 167, Type 304 or 304L, not less than No. 13 U.S. gauge,

c. complying with requirements of IEEE C57.12.28, standard color green.

d. Base and Cabinets of Two Compartment Transformers: Fabricate from stainless steel according to ASTM A 167, Type 304 or 304L, not less than No. 13 U.S. gauge. Coat transformer with manufacturer's standard green color coating complying with requirements of IEEE C57.12.28.

B. MANUFACTURERS

1. ABB Control, Inc.
2. Eaton Corporation, Cooper Power Systems.
3. S&C Electric Company.
4. Siemens Energy and Automation, Inc.
5. Square D, Schneider Electric.

C. PRIMARY FUSING

1. Designed and rated to provide thermal protection of transformer by sensing overcurrent and high liquid temperature.
   a. 150 KV BIL current-limiting fuses, conforming to requirements of IEEE C37.47.
   b. Interrupting Rating: 50,000 rms Asymmetrical at system voltage.
   c. Fuse Assembly: Bayonet-type, liquid-immersed, expulsion fuses in series with liquid-immersed, partial-range, current-limiting fuses. Bayonet fuse shall sense both high currents and high oil temperature to provide thermal protection to the transformer.
   d. Provide bayonet fuse assembly with an oil retention valve and an external drip shield inside the housing to eliminate or minimize oil spills. Valve shall close when fuse holder is removed and an external drip shield is installed.
   e. Provide a conspicuously displayed warning adjacent to bayonet fuse(s), cautioning against removing or inserting fuses unless transformer has been de-energized and tank pressure has been released.

D. HIGH-VOLTAGE SECTION: DEAD FRONT DESIGN

1. High-Voltage Section: Dead front design.
   a. To connect primary cable, use separable insulated connectors; coordinated with and complying with the requirements of Section "Medium-Voltage Cables". Bushings shall be one-piece units, with ampere and BIL ratings the same as connectors.
2. Bushing inserts
   a. Conform to the requirements of IEEE 386.

b. Rated at 200 A, with voltage class matching connectors. Provide a parking stand near each bushing well. Parking stands shall be equipped with insulated standoff bushings for parking of energized load-break elbow connectors on parking stands.

c. Provide insulated protective caps for insulating and sealing out moisture from unused bushing inserts and insulated standoff bushings.

3. Load-Break Switch

a. Radial-feed, liquid immersed type with voltage class and BIL matching that of separable connectors, with a continuous current rating and load-break rating of 200 or 600 amperes, and a make-and-latch rating of 12 KA rms symmetrical.

b. Switch shall not be located inside the transformer equipment and shall not require hot stick operation for switching of circuit feeds.

E. LOW-VOLTAGE SECTION

1. Bushings with spade terminals drilled for terminating the number of conductors indicated on the Drawings, and the lugs that comply with requirements of Section “Wires and Cables”.
2. Metering: Coordinated with and complying with requirements of Section “Powering and Monitoring and Control System”. Install the following:

a. Sensors.

b. BAS interface.

c. Kilowatt-hour meter.

d. Kilowatt-hour demand meter.

F. CAPACITIES AND CHARACTERISTICS

1. Power Rating (KVA): Per design consultant load calc.
2. Voltage Ratings: 12.47 KV – 480/277 V.
3. Taps: Comply with IEEE C57.12.26 requirements.
4. Transformer BIL (KV): Comply with IEEE C57.12.26 requirements.
5. Minimum Tested Impedance (Percent at 85 deg C: 5.5.
6. K-Factor: 1, complying with UL 1562.
7. Comply with FM Global Class No. 3990.
8. Comply with UL listing requirements for combination classification and listing for transformer and less-flammable insulating liquid.

G. TRANSFORMER CHARACTERISTICS

1. Drain and filter connection.
2. Filling and top filter press connections.
3. Pressure-vacuum gauge.
4. Dial-type analog thermometer with alarm contacts.

5. Magnetic liquid level indicator with high and low ala rm contacts.
6. Automatically resetting pressure-relief device. Device flow shall be as recommended by manufacturer.
7. Stainless-steel ground connection pads.
8. Machine –engraved nameplate, made of anodized aluminum or stainless steel.
9. Sudden pressure relay for remote alarm or trip when internal transformer pressure rises at field-set rate. Provide without seal-in delay.

MEDIUM VOLTAGE FUSIBLE INTERRUPTER SWITCHGEAR 26 13 16

A. GENERAL

1. Manufacturer: GE (ABB), Schneider Electric (Square D)
2. Metal enclosed switchgear ratings:
   a. The distribution system will be a grounded delta with two circuits, A and B.
   b. The ratings for the integrated switchgear assembly shall be as designated below.

i.	KV, Nominal	12.47
ii.	KV, Maximum Design	17.0
iii.	KV, BIL	95
iv.	Main Bus Continuous, Amperes	600
v.	Short Circuit Ratings Amperes, RMS Sym metrical	40,000
vi.	MVA Three-Phase Symmetrical at rated Nominal Voltage	960

   vii. The momentary and duty-cycle fault-closing ratings of switches, momentary rating of bus, and interrupting ratings of fuses shall equal or exceed the short-circuit ratings of the metal-enclosed switchgear.

   c. Certificationof Ratings
      i. The manufacturer shall furnish, upon request, certification of ratings of the basic switch and fuse components and the integrated metal-enclosed switchgear assembly consisting of the switch and fuse components in combination with the enclosure(s).
      ii. The integrated switchgear assembly shall have a BIL rating established by test on switchgear of the type and kind to be furnished under this specification. Certified test abstracts establishing such ratings shall be furnished upon request.

B. CONSTRUCTION

1. Enclosure
   a. The enclosure of each bay shall be unitized monocoque construction to maximize strength, minimize weight, and inhibit corrosion.
   b. The basic material shall be 11-gauge hot-rolled, pickled and oiled steel sheet.
   c. Each bay containing high-voltage components shall be a complete unit in itself, with full side sheets resulting in double-wall construction between bays. Side and rear sheets shall not be externally bolted.

d. The base shall be a continuous steel channel of 7-gauge material and shall extend completely around all four sides of each bay.

e. All hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subjects to abrasive action from mechanical motion shall be of either non-ferrous materials, galvanized, or zinc-plated ferrous materials.

f. Nominal bay dimensions shall be 46" wide x 46" deep x 90" tall.

2. Doors

a. Doors shall be constructed of 11-gauge hot-rolled, pickled and oiled steel sheet.

b. Doors shall have 90-degree flanges and shall overlap with the door openings.

c. Doors providing access to interrupter switches or interrupter switches with power fuses shall be provided with a wide-view window, constructed of an impact-resistant material, to facilitate checking of switch position without opening the door.

d. Access control shall be provided as follows:

i. Doors providing access to interrupter switches only, which are operated by stored- energy type switch operators, shall be mechanically or key interlocked to guard against operating the interrupter switch if the door is open.

3. Screen Doors

a. Each bay or compartment thereof containing high-voltage components shall be provided with a protective screen door, bolted closed, to guard against inadvertent entry to bays containing these components when the enclosure door is open.

b. Each bay containing a control-power transformer shall be provided with a protective screen door, bolted closed, to guard against inadvertent contact with the primary fuse when the enclosure door is open. The screen door shall be interlocked to ensure that the secondary load has been disconnected prior to removal of these fuses.

4. Insulators

a. The interrupter-switch and fuse-mounting insulators, main-bus support insulators, insulated operating shafts, and (if applicable) push rods shall be of a cycloaliphatic epoxy resin system or of a porcelain system.

5. High-Voltage Bus

a. Bus and interconnections shall consist of copper bar of a minimum 98% IACS conductivity.

b. The bus supports, bus, and interconnections shall withstand the stresses; associated with short-circuit currents up through the maximum rating of the switchgear.

6. Ground Bus

a. A ground bus of short-circuit rating equal to that or the integrated assembly (or a ground connection, in the case of single-bay switchgear) shall be provided, maintaining electrical continuity throughout the integrated assembly.

b. The ground bus shall consist of aluminum bar of a minimum 56% IACS conductivity.

c. Bolted connections shall be as specified for the main bus, except that only one Belleville spring washer shall be required per bolt for attachment of ground bus to the nickel-plated steel bracket.

d. For multi-bay metal-enclosed switchgear assemblies, two ground cable connectors accommodating No. 2 through 500kc mil conductors shall be provided for connection of ground bus to station ground.

7. Low Voltage Components

a. All low-voltage components, including switch operators not integrally mounted in the switchgear, meters, instruments, and relays, shall be located in grounded, metal-enclosed compartments separate from high voltage to provide isolation and shall be arranged to allow complete accessibility for operation without exposure to high voltage.

b. Low-voltage wiring, except for short lengths such as terminal blocks and the secondaries of sensing devices, shall be in grounded conduit, cable trays, or raceways where necessary to isolate such wiring from high voltage.

8. Cable-Termination Space

a. Provide full front access for easy positioning and removal of cable pulling sheaves.

b. Provide free access without interference from non-removable structural members or from mechanical linkages between the interrupter-switch blades and operating mechanism.

9. Finish

a. The finish shall be light gray, No. 61 ANSI Standard Z55.1.

b. A packaged kit of refinishing materials - with complete instructions - shall be included with each shipment of metal-enclosed switchgear for touch-up in the field.

10. Louvers shall be provided at the top and bottom of the front and rear of each bay.

11. Lifting eyes shall be removable.

C. BASIC COMPONENTS

1. Interrupter Switches

a. Interrupter switches shall have a one-time or two-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the integrated switchgear assembly. These ratings define the ability to close the interrupter switch either alone (unfused)or in combination with the appropriate fuse, once or twice (as applicable) against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current.

b. Interrupter switches shall utilize a quick-make mechanism. For interrupter switches operated by stored-energy switch operators, the quick-make mechanism shall be integral part of the switch operator.

c. Interrupter switches shall be provided with a single blade per phase for circuit closing including fault closing, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades shall not be permitted.

d. Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. Circuit interruption shall take place completely with the interrupter, with no external arc or flame. Any exhaust shall be vented in a controlled manner through a labyrinthine muffler or a deionizing vent.

e. Interrupter switches shall have a readily visible open gap when in the open position to allow positive verification of correct switch position.

f. Entrance and tie modules shall have key interlocks to guard against access to fuses unless all switches are open.

2. Power Fuses

a. Each main and feeder switch module shall be fused with electronic fuses, S and C Fault Filter, no known equal, sized as scheduled on the drawings.

b. Fuses for the service entrance modules shall have inverse-curve-type time-current characteristics. Fuses for the feeder modules protecting transformers in unit substations shall have time-delayed compound-curve-type time-current characteristics.

3. Voltage-Sensing Devices

a. Voltage-sensing devices for use with open-phase detectors shall be capacitively coupled voltage sensors on three phases.

b. The voltage sensors shall directly replace apparatus insulators at the hinge end of fuses or the lower terminal of interrupter switches. Voltage sensors shall be constant-current-output devices that do not require primary fuses.

c. The output voltage of the voltage sensors shall be directly proportional to line-to-ground-voltage and shall have relay accuracy over an ambient temperature of -40°F to +160°F.

d. The output of the voltage sensors shall be connected to a secondary burden that does not require adjustment to compensate for a difference between system line-to-ground voltage and the sensor's rated nominal line-to-ground voltage.

e. There shall be test jacks and adjustment screws to allow for measuring and adjusting the voltage-sensors signal inputs.

4. Arrestors

a. Cable terminations shall be furnished with each switch and shall be made with modular non - tracking rubber cable terminators with integral internal stress relief device. Terminators for use on 15 kV grounded wye system shall be rated at 15 kV with 110 kV, 1.2 x 50 wave and 30 kV corona extinction. Provide cable terminations for the quantity and size of cables for each switch.

LOW-VOLTAGE TRANSFORMERS 26 22 00

A. GENERAL

1. The distribution system will be a grounded delta with two circuits, A and B.
2. The ratings for the integrated switchgear assembly shall be as designated below.

a. Transformer cooling fans or moving parts may not be used, except in unit substation equipment.

b. All dry type transformers rated 15 kVA and larger shall have two 2 -1/2 percent full capacity taps above normal (FCAN) and four 2-1/2 percent full capacity taps below normal (FCBN) rated primary voltage.

3. Dry type transformers shall be copper-wound. Temperature rise ratings shall comply with:

a. 25 KVA and smaller; Insulation Class 185 degrees C, 115 degrees C temperature rise.

b. 30 KVA and larger; Insulation Class 220 degrees C, 150 degrees C temperature rise.

4. Transformer manufacturers shall be:

a. PowerSmith

b. UCDH PO&M approved equal

5. Provide hinged lockable doors on transformers with 360 degree rotatable IR port.
6. Transformers shall meet the following sound level ratings:
   a. 0 – 9 KVA 40 dB
   b. 10 – 50 KVA 45 dB c. 51 – 150 KVA 50 dB
   c. 151 – 300 KVA 55 dB
   d. 301 – 500 KVA 60 dB
   e. 501 – 750 KVA 62 dB
7. Provide minimum K-4 rated transformer. Where transformer will serve nonlinear loads, prepare power system to study harmonics.
8. Provide K rated transformers where required in the contractor prepared power system study harmonics section or where known nonlinear loading exists.
9. Housekeeping pads are required for floor mounted transformers. Provide external vibration isolators for non-HCAI facilities.
10. Transformers shall meet US Department of Energy's Candidate Standard Level Three (CSL-3) efficiency. Transformers shall be designed to exceed the latest requirements of the California Code of Regulations Title 20 and Title 24 and NEMA TP-1 efficiency standards. Transformer efficiency shall meet or exceeds the January 1, 2016 energy efficiency levels listed in DOE 78 FR 23335 (April 18, 2013), 10 CFR 431.196 or the most current energy standards if more stringent
11. Use flexible conduit indoors in dry locations or liquid -tight flexible conduit in damp/wet locations, two-foot minimum in length, for primary and secondary connections to transformer case. Make connections to side panels of enclosure, except for floor mounted transformers fed from directly below enclosure.
12. Transformers not specifically designed for wall mounting, shall be spaced a minimum of 6" from adjacent walls, ceiling and equipment.
13. Install the transformers on the noise and vibration isolation pads designed to suppress the transformer noise from the building structure. Select and arrange the pads in accordance with the weight and mounting of the transformers. These pads are in addition to any internal vibration pads. Provide a neoprene sleeve over the portion of the bolt that passes through the transformer base or mounting bracket. Provide a rubber washer between the bolt head and the mounting channel.
14. Provide noise and vibration analysis when transformers are installed above ground level.

SWITCHBOARD AND PANELBOARDS 26 24 00

A. GENERAL

1. All switchboard and panelboard bussing shall be copper.

a. All neutral bussing shall be 200% rated. Increase neutral ratings of feeders to 150% or 200% when K rated transformers are used or as coordinated with the expected harmonic profile of the loads served.

b. Provide a listed surge protective device (SPD) on all emergency power system panels and switchboards.

c. Boards breakers shall match the kAIC rating and manufacturer of the enclosure.

d. Switchboard and panelboard manufacturers shall be:

   i. Square D (Schneider Electric)

   ii. UCDH PO&M approved equal

e. Panels shall not be located behind doors.

f. All factory connections including factory installed breakers must be torque tested and verified.

B. PANELBOARDS

1. Panelboards shall be furnished with door in door style hinged trims.
2. Provide board with integral lock. All boards on the project shall be keyed alike.
3. Ground bus shall be full size, include an isolated ground bus when isolated grounding equipment is utilized.
4. Boards shall be rated for fault current as coordinated with results of contractor prepared power system study, and minimums as follows:

   a. 120/208 volt branch circuit panels 10,000 AIC

   b. 120/208 volt distribution panels 18,000 AIC

   c. 277/480 volt branch circuit panels 35,000 AIC

   d. 277/480 volt distribution panels 42,000 AIC

5. Main circuit breakers shall be bus connected to the panel, vertically mounted, and not group aligned in branch breaker positions, include lockoff hardware.
6. When required provide a digital Panelboard metering System. The system shall be provided with all features and requirements necessary to interface with the existing infrastructure. Upgrades in the existing BMS, GE PMCS, or Metasys systems shall be provided as necessary to integrate the panelboard metering system.
7. Branch breakers shall be bolt on style molded case, thermal magnetic trip type.
8. Include adjustable trip breakers where required to achieve selective coordination or limit fault current as coordinated with the results of the contractor prepared power system study.
9. Stub (2) spare one-inch conduits to accessible location above ceiling out of each recessed panelboard.
10. Provide a typewritten index of circuits inside the door of the panelboard. Type directing to indicate actual field installation, with odd numbering on left and even numbering on right.

    a. Load descriptions must be accurate. Do not just label loads as “receptacles or lighting”.

    b. The room numbers and locations of the loads/devices MUST be included in the description.

c. Index must include what panel and circuit or breaker feeding the panel along with the room location of the panel or breaker feeding the panel.

11. Provide electronic version of panel schedule to PO&M. Utilize PO&M panel schedule template.

C. SWITCHBOARDS

1. All switchboard sections shall be front or rear accessible factory-assembled, dead front, metal- enclosed, and self-supporting.
2. Switchboard short circuit withstand rating shall be minimum 65,000AIC unless otherwise coordinated.
3. Main circuit breaker shall be power drawout type or insulated case circuit breakers, individually mounted.
4. Feeder circuit breakers shall be group mounted, 100% rated for continuous duty.
5. Include electronic fully adjustable trip breakers where required to achieve selective coordination or limit fault current as coordinated with the results of the contractor prepared power system study.
6. Provide a microprocessor-based power metering System. The system shall be provided with all features and requirements necessary to interface with the existing GE PMCS Systems and the existing JCI Metasys system. Upgrades in the existing GE PMCS and Metasys systems shall be provided as necessary to integrate the panelboard metering system.
7. When installing new switchboards in Type 1 OSHPD projects provide power drawout circuit breakers for all breakers in the switchboards.
8. Double ended main and tie breakers shall be individually mounted and arranged for drawout construction. Feeder devices shall be individually mounted for drawout construction and compartmentalized. All circuit breaker devices shall be individually removable from the front of the switchboard.
9. Provide a trolley system at the top of switchboards when utilizing power drawout style circuit breakers.
10. Include neutral to ground disconnect link at service rated equipment installations.

WIRING DEVICES 26 27 26

A. GENERAL

1. All devices installed at medical facilities shall be hospital grade, 20 amp minimum.
2. All devices installed at teaching and non OSHPD office facilities shall be heavy duty industrial grade, 20 amp minimum.
3. All electrical devices and switches shall have engraved device covers, Critical, life safety, and equipment branch devices shall have devices in red and nameplates engraved in red text. Normal branch devices shall have nameplates engraved in black text. All other device colors shall be as coordinated with the project architect or the University Representative.

4. Ground fault circuit interrupter (GFCI) receptacles: 3 wire grounded, white, or match existing finish, rated 20 amps, 125V. All GFCI devices shall be standalone type, not feed through protected.
5. Provide locking in use metallic covers for exterior weatherproof outlets. All exterior receptacles shall be weather resistant type, GFCI.
6. Device covers shall be stainless steel type and engraved for panel and circuit. In tamper proof areas such as pediatrics and psychology and public waiting areas provide tamper proof devices and screws.
7. Mount receptacle vertically with the grounding U at the top. For horizontally mounted receptacles mount receptacle with neutral side up.
8. Branch circuiting for the life safety, critical, and equipment branch devices shall have dedicated neutrals. All circuits in patient rooms shall have dedicated neutrals.
9. Provide controlled receptacles as coordinated with California Title 24. An optional strategy using any alternate compliance via computer software shutdowns may be discussed with the AHJ.
10. Unless otherwise noted on drawings, mounting heights to center of devices shall be as follows:
    a. Switches: 42 inches
    b. Receptacles: 18 inches
11. Provide welding equipment receptacles in Central Utility Plant. Coordinate exact locations with UCDH.
12. No pre-wired switches or receptacles allowed.

B. TELECOMMUNICATIONS SPACE ELECTRICAL REQUIREMENTS

1. Convenience duplex receptacles shall be installed on a 20A/1P dedicated circuit in the room.
2. Where Equipment Rack and Cabinets exist with active electronics, power connections are required. Coordinate with the University Representative and IT to confirm how many powered rack locations are required in each telecom space. At a powered rack location provide:
    a. One (1) duplex 20 Amp, 120V AC NEMA 5-20R-receptacle on normal power above the rack.
    b. One (1) 120/208V, 3 phase, 5 wire, NEMA L21-30R-receptacle on normal power above the rack.
    c. One (1) 120/208V, 3 phase, 5 wire, NEMA L21-30R-receptacle on UPS power above the rack.
    d. All UPS power configurations shall be evaluated on a case by case basis with the University Representative and IT to determine desired UPS system configuration (central vs. rack mount vs. other). UPS must be able to function on generator power.

LOW-VOLTAGE CIRCUIT PROTECTION DEVICES 26 28 00

A. GENERAL

1. Overcurrent protective devices shall satisfy all CEC mandated selective coordination requirements (e.g. CEC Articles 517, 620, 645, 695, 700, 701, 708) in addition to any project specific selective coordination requirements above and beyond CEC requirements.
2. Series ratings of breaker devices shall not be used.
3. Breakers installed in equipment shall match the manufacturer and kAIC rating of the equipment.
4. Mounting shall be “bolt-on” type, removable without disturbing any other breaker.
5. Molded case circuit breakers shall not be used above 800 amps.
6. Insulated case circuit breakers shall be used above 800 amps.
7. Power circuit breakers shall be used in service switchboards, unit substations, and OSHPD type 1 buildings.
8. Circuit breakers serving the fire alarm system shall be red in color (by factory, no painted) with breaker locking device on.
9. Include lock off hardware for maintenance and lock out tag out.
10. Over current protective devices shall be provided with trip styles, adjustability features, frames, kAIC ratings, and coordination characteristics as coordinated with the results of the contractor prepared power system study. All adjustable breaker settings shall be field set by the contractor and tested.

ENCLOSED CONTROLLERS (MOTOR STARTERS) 26 29 13

A. GENERAL

1. Provide single phase manual motor switches (MMS) for all motors smaller than ½ hp unless indicated otherwise. For all motors ½ HP and larger or as indicated on the drawings, provide 3 phase full voltage magnetic across the line starters or variable frequency drive (VFD) with low harmonics. VFD shall have auxiliary points for connection to the existing Building Management System.
2. Auxiliary Contacts - Each starter to have a minimum of two Normally Open (NO) auxiliary contacts with provision to add a minimum of two more.
3. Selector Switch -To have HOA (Hand-Off-Auto) selector switch mounted in cover.
4. Pilot Light – Red LED pilot light mounted in cover to be activated through a starter auxiliary contact, (not across the coil, or parallel with the coil).
5. Acceptable manufacturers shall be:
    a. ABB for variable frequency drives (VFDs)
    b. Square D for motor control centers (MCCs)
    c. UCDH PO&M approved equal

AUTOMATIC TRANSFER SWITCHES (ATS) 26 36 00

A. GENERAL

1. Transfer switches shall be closed transition bypass isolation type. The transfer switch shall be Draw-out with self-aligning jaws.
2. Switches shall be closed transition type but capable of programming for open and/or adjustable time delayed transitions.
3. Switches shall be four pole type everywhere when a neutral accompanies the feeder, as coordinated by the electrical engineer, with facility ground fault protection scheme and separately derived sources.
4. Switches shall be UL 1008 listed.
5. Coordinate new transfer switch withstand and closing rating (WCR) with all circuit breaker settings to ensure selective coordination of breaker short time settings.
6. Switch shall be provided with a separated and isolated digital user control panel. Panel shall be mounted at the face of the switch, have visual display for current switch status, with touch screen to
    a. Adjustments for all separate time delays, exerciser, transfer status, ATS statistics, and historical event log.
    b. Power quality meter monitoring information for voltage, frequency, phase, KW, KVA, PF, and trending.
7. Include communications modules capable of integration to the building management system via RS485, Modbus TCP/IP, BACnet IP and SNMP protocols.
8. Switches shall be furnished with normally open/closed 125V DC contacts (use the closed contacts) for integration with the central plant 125V DC start/stop signaling system.
9. New ATS equipment shall have position monitoring via the BMS and be furnished with selective load shed capabilities for interface to the future UC Davis Health campus load shed add scheme. Per CEC 517.31(B) Optional standby CUP served ATS equipment shall be shed in the event of overloading.
10. Provide generator start circuit monitoring system.
11. Manufacturer shall be ASCO, series 7000 or UCDH PO&M approved equal.
12. In the Hospital, a Remote Status Panel is located in the Fire Command Center and communicates via RS 485 port from each transfer switches respective microprocessor control panel. Provide LED indicators for each automatic transfer switch in the Fire Command Center. These LED's shall consist of a red lamp to indicate connection to the emergency source and a green lamp to indicate connection to the normal source, one lamp of each color for each automatic transfer switch. Clearly label each pair of red/green lamps as to which ATS they are indicating, pole branch of the ATS and the floors or area served, i.e., "ATS-EQ, equipment branch."
13. Transfer switch to have a full rated neutral with lugs for NORMAL, EMERGENCY and LOAD neutral conductors inside cabinet (4 pole with a switched neutral). Equipped with direct acting linear operators for simple, reliable and fast acting during automatic operation.

SURGE PROTECTION DEVICES 26 43 13

A. GENERAL

1. Provide surge protective device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, and panelboards.
2. 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. Device shall have an audible alarm under any fault condition.
3. SPD units shall be furnished in two Types. Type 1 and Type 2 as outlined below:
    a. Type 1: Permanently connected SPDs installed on the line or load side of main disconnect device(s), at main switchboards. This type closely relates to the devices previously referred to as secondary surge arrestors. These Type 1 SPDs should be specially suited to conduct the high energy impulses from lightning strikes.
    b. Type 2: Permanently connected SPD installed on the load side of the service panel main disconnect device(s). This type most closely relates to devices that were previously classified as Transient Voltage Surge Suppression (TVSS). These Type 2 SPDs are especially suited for distribution boards and panelboard applications.
4. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments. The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum Surge Current Capacity Table			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations	250kA	125kA
B	High Exposure Roof Top Locations (Switchboards and Panelboards)	160kA	80kA
A	Branch Locations (Panelboards)	120kA	60kA

5. All SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

INTERIOR LIGHTING 26 51 00

A. GENERAL

1. All interior lighting fixtures shall be LED type. UL 8750 recognized or listed as applicable. UL listed or Nationally Recognized Testing Laboratory (NRTL) listed.
2. All interior lighting shall have a Kelvin color temperature of 3,500K.
3. A minimum Color Rendering Index (CRI) of 90 shall be used for all fixtures.

4. Fixtures shall utilize 0-10v dimming (for dimming from 100% to 1%) as the standard controls protocol but other technologies may be implemented, as coordinated with the project's lighting control system.
5. IESNA L70 lifetime minimum 80,000 hours. Tested in accordance with IESNA LM-79 and IESNA LM-80 test data.
6. Minimum efficiency of 90 lumens per watt and on the Design Lighting Consortium's (DLC) current qualified Products list (QPL).
7. Recessed luminaires in suspended ceilings shall be supported by connecting two support wires to the luminaire at diagonal opposite corners for luminaires weighing 56 pounds or less. Connect four wires, one at each corner for luminaires weighing more than 56 pounds.
8. All concealed junction box cover plates for the lighting branch circuit system shall be clearly marked with a permanent black ink felt pen identifying the branch circuit (both panel designation and circuit number) contained in the box. Refer to Box Identification requirements under Campus Design Guidelines.
9. Lighting levels shall conform to Illuminating Engineering Society of North America (IESNA) standards (see the IESNA Lighting Handbook: Reference & application or the IESNA Lighting Ready Reference). Zone lighting or task lighting shall be utilized whenever energy efficiency can be improved by these measures. Comply with current California Title 24 Energy Code published by the California Building Standards Commission.
10. Furnish spare quantity of installed luminaires per luminaire type as follows:
    a. For 1-20 of a luminaire type, provide [1] extra luminaire.
    b. For 21-50 of a luminaire type, provide [5] extra luminaires.
    c. For 51-100 luminaire type, provide [10] extra luminaires.
    d. For any quantities of 101 or more, coordinate with UCDH PO&M for quantity of extra luminaires required.
11. Typical Lighting Levels:

Room/Space	Lighting Level (footcandle, FC)
Patient Room	50
Nurses Station	30 (General)/50 (Workstation)
Corridor	5-10
Waiting Area	10
Lobby	5
Office	30-50
Pharmacy (Work/prep area)	100 (at horizontal work plane)

B. FIXTURES

1. All fixtures shall utilize LED modules and compatible drivers unless otherwise noted. Provide recessed and surface fixtures with all mounting hardware and mounting ceiling trims for a

complete installation in the type of ceiling which they are intended to be installed. Provide access to LED modules and drivers through the lens or below the ceiling, without the removal of the entire fixture or permanent ceiling.

2. Pendant mounted fixtures to be provided with mounting cable, stems, ball aligners, feed cable, canopies, swivel hangers, safety cables and all mounted hardware to conform to the state of California Seismic safety standards. In indirect linear systems provide clear dust covers to facilitate cleaning. Covers to be manufacturer provided, not field fabricated.
3. All light fixtures in Utilities and Central Plant mounted over 15' from the floor shall be mounted with lowering system to service the light fixture.

C. LED LIGHTING DRIVERS

1. LED type. UL 8750 recognized or listed as applicable. UL listed or Nation ally Recognized Testing Laboratory (NRTL) listed.
2. Drivers to be UL listed or NRTL listed for the type of load that they are used. Compliant with California Energy Code requirements.
3. Compatibility of driver and LED light engine must be tested and ensured by fixture manufacturer. Warranty of the fixture, driver and light engine by the fixture manufacturer. Provide manufacturer's warranty covering 5 years on drivers from date of installation.
4. Inaudible in a 27 dBA ambient.
5. No visible change in light output with a variation of +/- 10 percent line voltage input.
6. Make replacements available for minimum of ten years from date of manufacture.
7. Drivers shall have a maximum THD of 20%.

D. SPECIALTY APPLICATIONS

1. In MRI rooms provide luminaires with high CRI and low level dimming 100-1% and off. Utilize only LED fixtures to meet or exceed TESLA rating of MRI machines within the procedure rooms. Dimming 100-1% and off in control area. All luminaires to have cleanable surfaces.
2. In radiology, ultrasound, Nuclear Camera, CT Scanner, mammography and other similar use rooms, provide high CRI and low level dimming 100-1% and off. Multi-system preferred. Dimming 100-1% and off in control area. All luminaires to have cleanable surfaces.

E. EXIT SIGNS

1. LED color shall be red. Face color white, painted metal. Provide clear polycarbonate vandal resistant shields outdoors, in parking structures and where required by the use of the space.
2. Provide face configurations, chevron directional arrows, and canopy or wall mounting provisions (universal installation type) as coordinated with the egress plan.
3. Tritium exit signs shall not be used on the UC Davis Health cam pus. Where existing tritium exits signs are found in areas of remodel, they shall be disposed of following EPA guidelines. And replaced with LED type.
4. Connect exit signs to unswitched emergency circuit where available in the building. Where emergency circuits or inverter are not available provide self-powered exit signs.

EXTERIOR LIGHTING 26 51 10

A. GENERAL

1. All exterior lighting fixtures shall be LED type with a kelvin color temperature of 3,000K.
2. Minimum color rendering index (CRI) of 90, with a minimum of 80,000 hours, and an efficiency of 80 lumens per watt and be on the DLC's QPL.
3. Provide fully gasketed, exterior fixture lens and diffuser frames to prevent moisture, debris, and insects from entering the fixture housing.
4. Site lighting fixtures shall be provided to match the existing UC Davis Health campus standard fixtures: Gardco style CA. Include concrete foundations.
5. All junction box cover plates for site lighting shall be clearly marked on the inside with a permanent black ink felt pen identifying the branch circuit (both panel designation and circuit number) contained.
6. All fixtures shall be designed to minimize light pollution and glare, while meeting the light distribution requirements for a given area. A designation of full cutoff shall be considered, but not the sole criteria in evaluating a fixture's ability to minimize light pollution and glare.
7. Typical Lighting Levels:

Area	**Lighting Level (footcandle, FC)**
Primary Egress Pedestrian Pathway	2
Other Pedestrian Pathway	1
Parking Lots	0.5 to 1