**PART 1 - GENERAL**

* 1. **SUMMARY**

1. Section Includes: Main switchboard, including metering facilities required by the utility company.
2. Related Requirements:
   1. Division 01 - General Requirements.
   2. Section 03 30 00: Cast-In-Place Concrete.
   3. Section 26 05 00: Common Work Results for Electrical.
   4. Section 26 05 13: Basic Electrical Materials and Methods.
   5. Section 26 05 26: Grounding and Bonding.
   6. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
   7. Section 26 10 00: Service Entrance.
   8. Division 27: Communications.
   9. Division 28: Electronic Safety and Security.
3. Related Industry Standards: The most current version of the following industry standards.
4. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
5. California Electrical Code (CEC).
6. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
7. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
8. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
9. UL/ANSI 891 – Standard for Safety Switchboards.
   1. **SUBMITTALS**
10. Provide in accordance with Division 01.
11. Shop Drawings:
    1. Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size or capacity of equipment and bussing, location of each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.
12. Fault Current, Coordination and Arc-Flash Reports: the following reports shall be prepared using SKM Systems Analysis, ETAP Powering Success, EasyPower, or equal.
    1. Provide a short-circuit and coordination report signed and stamp by a registered electrical engineer. Studies shall be in accordance with applicable IEEE guidelines. Submit two copies of each study for review prior to ordering and installing equipment.
    2. Provide a system coordination study for main and branch circuit protective devices including transformers secondary protective devices. Study shall be recorded on log paper. The circuit protective devices shall be set based on the coordination study. A final written record of protective device settings shall be submitted to Architect and Engineer.
    3. Provide a complete arch-flash report based on installed equipment, and feeders’ sizes and lengths. Prepare the report in accordance with code requirements and IEEE 1584 standard. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.
    4. Provide installation detail and seismic anchorage notes for switchboards.
13. Provide a connection schematic diagram.
    1. **SUBSTITUTIONS**
14. Switchboards that deviate from these requirements shall not be accepted without written approval from OWNER’S Design Standards and Maintenance and Operations Technical Units. When deviating or proposing substitutions the following information shall be submitted:
15. Substitution request form substantiating reasons for the deviation and benefits to the OWNER.
16. Proposed substitutions requests shall provide proof of compliance with transformers characteristics indicated in this specifications section.
17. Documentation must comply with contract general provisions.
    1. **QUALITY ASSURANCE**
18. Installation shall be performed by State approved/ certified electricians.
19. Switchboards shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under REFERENCES.
20. Provide labor, engineering, design, testing, supervision, material and equipment required.
21. Equipment shall be new and high quality. Manufacturer shall have been continuously manufacturing distribution transformers for at least 10 years.
    1. **COMMISSIONING**
22. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of power distribution systems and assemblies, including submittal review, installation, testing, documentation, and training as indicated in section 26 0800 – Electrical Systems Commissioning.
23. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 9113, General Commissioning Requirements.
24. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER’s Commissioning Services Provider.
    1. **WARRANTY**
25. Provide a one-year labor warranty.
26. Switchboards shall be warranted to be free from defects in materials and fabrication for a period of three years from the date of substantial completion.
27. Warranty period begins at project acceptance for beneficial occupancy.
28. Warranty exclusions for third party components is not acceptable.

**PART 2 - PRODUCTS**

* 1. **SWITCHBOARDS**

1. General Description: Switchboards shall be product of W.A. Benjamin Electric, Cutler, Hammer, General Electric, or equal, and shall conform to the following requirements:
2. Complete assembly, including steel framing and covers, bus system, and breaker mounting, shall satisfy applicable provisions of UL 891 and NEMA PB-2 and the California Electrical Code for low-voltage distribution switchboards. Switchboards shall be furnished with UL labels.
3. Switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit-breaker type, unless otherwise indicated and shall contain equipment indicated and specified. Switchboard shall be complete with pull, service, and distribution sections as required.
4. Required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets so that cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with assembly holes die-stamped or jig drilled; openings for interconnections shall be so placed that cabinet can be located in any position in assembly without drilling or cutting holes on job. Deliver switchboard to Project site in completely assembled sections and provide required assembly bolts and blanking plates. Front plates and doors shall be of not less than 12 gage furniture steel, completely removable, secured to cabinet with machine screws, with cup washers uniformly and symmetrically spaced. Provide hinged wire gutter covers for distribution sections. Equipment shall meet NEMA and UL standards.
5. Main circuit breaker or main fusible switch shall be as follows:
   1. Main circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic with solid state trips, bolted to bus with frame size and trip ratings as indicated on drawings. Voltage, amperage ratings and number of poles shall be as indicated on breakers. Main breaker shall provide a minimum short-circuit interrupting capacity as determined by utility company. Provide shunt-trip and integral ground fault devices, as indicated on drawings. Breakers shall be furnished with lockout provisions.
   2. Main fusible switch 800 amps or larger ampacity shall be high pressure contact, stored energy, quick-make/quick-break operation, with current limiting fuses, as indicated on Drawings. Provide shunt-trip, and integral ground fault devices, as indicated on Drawings. Were required, switches shall be motor operated and be furnished with an electrical trip mechanism piloted by output of ground fault sensing circuitry. Switch shall be furnished with lockout provisions.
6. Feeder circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic or solid-state type bolted to bus, with handles clearly indicating tripped position. Breakers shall be furnished with a single handle with no tie-bar. Voltage, amperage, and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle or label. Breakers shall be furnished with lockout provisions approved by the State of California for padlocking and shall provide a minimum symmetrical short-circuit interrupting rating, as indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
7. Fusible feeder switches shall be quick-make, quick-break, voltage rating and number of poles as indicated on Drawings, with visible blades and dual horsepower ratings. Switch handles shall physically indicate on and off positions. Switches shall be lockable only in off position and accept three industrial type heavy-duty padlocks master lock pro series 6121 keyed to 3221. Switch covers and handles shall be interlocked to prevent opening in on position. Provide means to permit authorized personnel to release interlock for inspection purposes. Switches shall be equipped with Class R current limiting fuses or dual element fuse of size and capacity indicated on Drawings.
8. Utility metering provisions shall meet requirements of serving utility and shall be furnished with necessary fittings.
9. Provide switchboard silver-plated copper bus bars of same capacity as main breaker, or as indicated on Drawings, between current transformer and main section and distribution sections; also, full height of breaker space in distribution portions. Copper bus shall have current density of 1000A per square inch of cross section. Bus structure shall be free-fitted and shall have sufficient strength to withstand short-circuit as indicated on drawings. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices. Bus bar bracing shall be designed to withstand maximum available short-circuit current. Connections for cables to circuit breakers, switches and motor control devices shall be heavy-duty mechanical pressure type terminal lugs. Provide service cable lugs as required by utility company. Cables and internal wiring shall be supported with suitable cleats.
10. Switchboard distribution sections shall be furnished with full height bussing. Unused spaces shall be provided with blank covers. Switchboards, as complete units, shall be given single short-circuit current ratings by manufacturer. Such ratings shall be established by actual tests by manufacturer, in accordance with UL specifications, on equipment constructed similarly to the furnished switchboard.
11. Provide a large nameplate identifying switchboard, indicating service voltage, originating power source, function and current rating. Nameplate shall be furnished with 3/16-inch engraved black letters on white background. Name plate shall be mechanically fastened to switchboard.
12. Provide labels for circuit breakers, disconnect switches, and or other disconnecting means in switchboards. Labels shall be a P-Touch type or equal, with a minimum width of 3/8 inch with black letters on white background. Label shall indicate name of load served, name or room number and if in different building, name of building. If equipment is installed in same room as source, label should indicate source name and “in this room”.
13. Paint cabinets, framework and plates inside and out with one coat of rust-resistant metal primer and one coat of gray enamel, baked on, or lacquer sprayed on.
14. Manufacture boards according to reviewed Shop Drawings. Switchboard shall meet requirements of legally constituted authorities having jurisdiction, and respective serving utility.
15. Switchboards installed outdoors shall be weatherproof NEMA Type 3R enclosure. Enclosure construction shall be formed of code gage galvanized steel with ANSI No. 61 gray enamel finish. Heavy-duty, three-point latching, vault type door handles with padlocking provisions shall be furnished on doors. Padlocks shall be furnished keyed to master lock pro series 6121 and keyed 3221. Switchboards installed outdoors shall be specifically required to maintain service during extreme outdoor ambient temperatures of a minimum of 150 degrees Fahrenheit in NEMA Type 3R enclosures.
16. For grounded wye electrical service switchboards rated more than 150 volts, to ground and 1,000 amperes or more, provide ground fault protection for main protective device. Ground fault protection shall be UL listed, with ground sensor encircling phase conductors and neutral conductors integral with the main protective device. Provide testing of ground fault protection system by an independent recognized testing laboratory. Testing lab shall provide necessary testing equipment at the Project site and perform a certified test on ground protection system in presence of the Project Inspector. The ground fault setting shall be selected to coordinate with downstream circuit protective devices. Verify that the system neutral is grounded at the service entrance switchboard only, except neutrals of step-down distribution transformers. For branch circuit protective devices, rated 800 amps or more, provide ground fault protection where shown on the drawings, or as described above, for main protective device. Coordinate settings with main protective device ground fault protection.
17. In main and distribution switchboards provide a multifunctional digital meter with true RMS measured Amperes (each phase and neutral) Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, VAR, Watts, KWH, KVARH, KVAH, voltage/current unbalance, and demand metering: W, VAR, Amperes, VA. Meter to have a front mounted RS232 port to allow programming and meter values via laptop computer and supplied software. The meter shall be GE Multiline PQMII with BACnet translator capabilities; equal or better meters will be acceptable with District’s approval only. Contractor shall supply the metering software and electronic key to owner.

|  |
| --- |
| **EDIT NOTE: THE EQUIPMENT METERS SHALL BE CAPABLE OF COMMUNICATING VIA THE PROTOCOL USED BY THE EMS SYSTEM IN THE SITE. MODIFY PARAGRAPH 2.01-A.15 ACCORDINGLY.** |

1. Connections to bussing shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

* + 1. Switchboards shall be located so that they are readily accessible and not exposed to physical damage.

1. Switchboard locations shall provide sufficient working space around the switchboard to comply with the California Electrical Code.
2. Switchboards shall be securely fastened to the mounting surface.
3. Switchboard cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
4. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
5. Lugs shall be suitable and as required for installation with the conductor being connected.
6. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
7. Maintain the required bending radius of conductors inside the cabinet.
8. Distribute and arrange conductors neatly in the wiring gutters.
9. Tightening the wire lugs or conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.
10. Remove shipping blocks from component devices.
11. Manually exercise circuit breakers to verify they operate freely.
12. Remove debris from switchboard interior.
13. Follow manufacturer's instructions for installation.
14. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rated as those installed.
15. Do not install in highly corrosive environments such as pool equipment, boiler, chemical and corrosive materials storage rooms, and similar areas. When equipment is installed in such areas, it shall be labeled and listed for the application.
16. Switchboard equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, and perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:
    1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the switchgear during testing.
17. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
18. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
19. Test reports shall include the following:
    * 1. Identification of the testing organization.
      2. Equipment identification.
      3. Ambient conditions.
      4. Identification of the testing technician.
      5. Summary of project.
      6. Description of equipment being tested.
      7. Description of tests.
      8. Test results.
      9. Analysis, interpretation and recommendations.
20. Perform tests in the presence of the Project Inspector.
21. During testing, provisions shall be made to prevent damage to solid state components, or electronic equipment such as TVSS equipment that may be tied onto switchboard bussing.
22. Test results shall meet manufacturer’s recommendations or NETA ATS- 2007 recommendations, whichever is more stringent.

**3.02 PADS AND ANCHORING**

1. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as specified in Section 03 3000: Cast-In-Place Concrete.
2. Where a utility meter is installed in a switchboard, concrete pad shall extend three feet from face of switchboard door or board, whichever is greater. Concrete pad installation shall comply with electric utility company requirements.
3. Anchor bolts for freestanding equipment shall meet CBC Seismic Zone 4 design requirements, and manufacturer’s installation recommendations. The more stringent requirements will be enforced.
4. Project Record Documents: Provide project record drawings of switchboards as installed, indicating main and branch circuit ratings, circuit numbers and part numbers.
5. For ground fault relays and sensors, the following information shall be provided:
   1. Certified Calibration and Acceptance Test.
   2. Installation Instructions.
   3. Operating Instructions.
   4. Maintenance Instructions.
   5. Replacement Parts List.

6. Final Test Report.

1. Test information shall be submitted to the Architect. Nameplates may be fabricated of engraved laminated plastic or etched metal and shall be permanently attached with escutcheon pins or screws.

**3.03 PROTECTION**

* + 1. Protect the Work of this section until Substantial Completion.

**3.04 CLEANUP**

* + 1. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION