SECTION 16400

SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.01 CONDITIONS

A. The Requirements of the General Conditions and Special Conditions apply to the Work of this Section as if fully repeated herein.

1.02 WORK INCLUDED

A. Provide electrical service and distribution systems as shown and specified.

1.03 RELATED WORK SPECIFIED ELSEWHERE:

A. Service transformer supplied by Utility Company.

B. Primary and (secondary service) conductors provided by Utility Company.

C. Switchboard under Section 16415.

D. Conduit under Sections 16021.

E. Conductors under Section 16070.

1.04 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Comply with requirements of serving Utility Company.

2. Make arrangement with Utility Company to provide electric service to premises. Notify Utility Company in advance with approximate date power connection is required so that power company may schedule Work to meet connection date.

B. Reference Standards:

1. CCR - California Code of Regulations.

2. NEMA - National Electrical Manufacturer's Association.

3. UL - Underwriter's Laboratories, Inc.

4. WUESSC - Western Utilities Electric Service Standardization Committee.

1.05 DESCRIPTION

A. Description of System:

1. Provide secondary distribution systems consisting of conduit, wire, and appurtenances as shown and specified.

2. Secondary distribution system to building will be 480/277 volts, 3 phase, 4 wire, grounded neutral.

3. Main service shall consist of empty conduits run three feet (3') (minimum) underground from Utility Company service point to transformer pad and bank. Terminate conduits as directed by Utility Company.

4. Utility Company will provide necessary primary and secondary service entrance electrical conductors and make necessary electrical connections in accordance with their Rule No. 16.

5. Secondary service shall consist of bus duct and/or empty conduit run two feet (2') underground from transformer secondary to switchboard.

6. Furnish and install three-sixteenths inch (3/16") approved fire retardant rope as "sleepers" in service conduits.

7. Provide ground rods and grounding busses as shown and as directed by Utility Company.

8. Contractor shall be responsible to contact the Utility Company and include in the bid proposal, and in accordance with the Utility Company specifications, whether shown or not shown on the Contract Documents, the following:

   a. Furnish and install the required underground duct system including necessary conduits, ducts, manholes, vaults, concrete encasement and concrete pads as required by the Utility Company.

   b. The contractor shall be responsible to pay one hundred percent (100%) of all engineering fees including deposit required by the Utility Company.

   c. Arrange for installation of the utility transformer, all conductors and all necessary connections by the Utility Company and pay any charges incurred including excess service charges if any.

   d. The Utility Company will own and maintain all primary and secondary conductors, transformers, utility compartment of the switchgear and related equipment for the secondary and primary distribution system. Transfer ownership of such facilities to the Utility Company upon acceptance of the Utility Company.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS OF SWITCHBOARD

A. Switchboard shall conform to latest applicable Requirements of IEEE, NEMA, UL, CCR Title 8, and WUESSC, and shall be of standard design.

B. For specific requirements of switchboard, refer to Section 16415, LOW VOLTAGE SWITCHBOARD.

C. Ground rods: Five-eighths inch (5/8") diameter minimum by ten feet (10') long, copper-clad steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Workmanship and Installation: Neat, clean, and properly laid out.

B. Installation shall be in accordance with Requirements of 2001 California Electrical Code.

C. Service and distribution feeders shall be provided and tested as specified under Section 16021 entitled CONDUIT, FITTINGS, AND SUPPORTS, and Section 16070 entitled INSULATED CONDUCTORS.

1. Provide test equipment and perform megger tests of installed feeder conductors. Record results of tests. Test will be witnessed by Project Coordinator.

D. Grounding: Ground neutral conductors, metallic conduits and other non-current carrying metallic parts of equipment.

1. General Requirements: Provide a ground resistance of five (5) ohms maximum. Measure ground resistance in normally dry conditions not less than forty-eight (48) hours after rainfall.

a. Where the specified ground resistance cannot be met, install additional ground electrodes and connect until specified resistance is obtained. Space ground electrodes as evenly as possible at least ten feet (10') apart and connect two feet (2') below ground.

b. Make connections above grade with bolted solderless connectors and make those below grade by a fusion-welding process. Use bare copper conductors to connect ground electrodes together.

END OF SECTION

SECTION 16415

LOW VOLTAGE SWITCHBOARD

PART 1 - GENERAL

1.01 CONDITIONS

A. The Requirements of the General Conditions and Special Conditions apply to the Work of this Section as if fully repeated herein.

1.02 WORK INCLUDED

A. Furnish all labor, materials, and equipment and perform operation required for complete installation of switchboard as indicated and specified herein.

1.03 QUALITY ASSURANCE

A. Source Quality Control.

1. Factory Tests for Switchboard.

a. Provide three (3) certified copies of test reports for the following:

1) "Megger" tests on all bussing with circuit breakers in place.

B. Reference Standards:

1. ANSI - American National Standards Institute.
2. ASTM - American Society for Testing and Materials.
3. IEEE - Institute of Electrical and Electronics Engineers.
4. NEMA - National Electrical Manufacturer's Association.
5. EUSERC - Electric Utility Service Equipment Requirements Committee.
6. UL - Underwriter's Laboratories, Inc.

1.04 SUBMITTALS

A. Refer to Division 1 and Section 16000.

B. Shop Drawings:

1. Switchboard showing size of all busses, arrangement of component units, overall dimensions and any details required for installation.
2. Overall dimensions of the switchboard shall not exceed the maximum dimensions noted on the Drawing.
3. Furnish complete Wiring Diagram of switchboard.

4. Number, type and size of spaces with provisions for installation of future circuit breakers.

5. System voltage, continuous current rating and short circuit current bracing for main bus.

C. Test Reports:

1. Submit certified test reports proving that bus structure have successfully withstood specified short circuit current and that maximum temperature rise at rated current does not exceed U.L. requirements.

PART 2 - PRODUCTS

2.01 REQUIREMENTS OF SWITCHBOARD

A. Switchboard shall be fully rated, designed, built, and tested in accordance with latest applicable requirements of IEEE, ANSI C37.20, NEMA PB-2 1978, U.L. 891, 1983 State of California Industrial Safety Title 8, and EUSERC; and low voltage power circuit breakers to ANSI C37.17 and U.L. 489. Switchboard shall be of standard design, manufactured by Square D, General Electric, Industrial Electric Manufacturing.

B. Provide engraved laminated plastic nameplates for switchboard showing switchboard designation and supply voltage, and for individual breakers, indicating feeder or equipment being served and trip size. Provide nameplate for all relays, timers, control transformers, and similar items mounted adjacent to equipment.

C. Switchboard shall be dead front, dead rear, safety type, completely enclosed with sheet steel.

D. Switchboard shall be rated 480/277 (208/120) volts, 3 phase, 4 wire. NEMA Class 1 * construction in a NEMA-3R enclosure.

E. Construct framework of structural or formed steel, built into a rigid structure capable of maintaining alignment during shipping, erection, and short circuits.

F. Where fittings, bolts, nuts, or washers may be ferrous material as allowed by NEMA Standards, use cadmium-plated steel conforming to applicable ASTM Standards.

G. Use silverplated copper bus of sufficient size based on 1,000 amperes per square inch and to carry continuously full-rated current at temperature rise not exceeding U.L. requirements. All busses shall be braced to withstand short-circuit current of 50,000 amperes RMS symmetrical. Current density at bolted connections shall not exceed 200 amperes per square inch of contact area.

H. A-B-C type bus arrangement, left-to-right, top-to-bottom, and front-to-rear, as viewed from the front, shall be used throughout.

I. Provide removable plates for access to all equipment and bus connections.

J. Arrange bus in clean and neat fashion for the type of service required.

K. Where neutral bus is required, provide full capacity bus, unless smaller bus is shown.

L. Use bus supports designed to withstand maximum short-circuit stresses to which they may be subjected. Supports shall be track resistant and flame retardant. Board shall carry the U.L. bus withstand rating.

M. Isolate main bus from all other conductors by barriers of metal or insulated material. Isolate incoming line bus from main bus.

N. Do not use cabling inside switchboard or substitute for bus bar conductors, unless otherwise indicated.

O. Use lugs designed to restrict turning when bolts are tightened so that required separation between phases and ground is maintained. Use multiple lugs for parellel feeder conductors.

P. Bolt switchboard sections together to provide suitable bonding, alignment, and rigidity. The switchboard may be shipped in sections for assembly on the project.

Q. Bond entire switchboard with copper ground bus, complete with lug. Use one-piece bus, except for splices necessitated by shipping requirements. Ground bus current rating shall be same size as grounding conductor on same basis as load busses.

R. Thoroughly clean each steel structure after fabrication, pretreat by approved phosphatizing process, prime with rust-inhibitive primer, and finish exterior with two (2) coats of ANSI Z55.1, color chip No. 61 (light grey) enamel or lacquer. Provide spare touch-up paint in unused aerosol painting cans.

S. The distribution branch protective devices shall be removable from the front and shall be group mounted with the necessary line and load connections accessible.

T. Switchboard main circuit breaker shall be 100 percent rated with solid-state trip units. Trip unit functions shall consist of adjustable long time ampere rating, adjustable long time delay, adjustable short time pickup, adjustable short time delay, and adjustable * instantaneous pickup. Main breaker shall be provided with integral adjustable ground fault protection, test button, and indicator. Distribution circuit breakers shall be molded case type with trip rating as shown. Circuit breakers with frame sizes greater than 100 amperes shall have adjustable magnetic trip elements which are set by a single adjustment. Equip handles with padlocking "lock-off" devices.

U. Equip switchboard enclosure with heater(s) and thermostat. Heater(s) shall prevent condensation from forming in the inside of switchboard. Set thermostat of fifty-five degrees (55°) F.

2.02 INSTRUMENTS AND SENSORS

A. Ammeters: ANSI C28,1; indicating ammeter with four and one-half inches (4.5") square black recessed case and two hundred fifty degree (250°) scale, white dial with black figures and pointer, 5 ampere, 60 hertz movement, one percent (1%) accuracy.

B. Voltmeters: ANSI C39.1; indicating voltmeter with four and one-half inches (4.5") square recessed case and two hundred fifty degree (250°) scale, white dial with black figures and pointer, 120 volt, 60 hertz movement, one percent (1%) accuracy.

C. Ammeter Transfer Switch: Rotary multistage snap-action type with 600 volt AC-DC silver plated contacts, engraved escutcheon plate, oval type handle, and four (4) positions including OFF.

D. Voltmeter Transfer Switch: Rotary multistage snap-action type with 600 volt AC-DC silver plated contacts, engraved escutcheon plate, oval type hand, and seven (7) positions including OFF.

E. Current Transformers: ANSI C57.13; 5 ampere secondary, bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

F. Potential Transformers: ANSI C57.13; 120 volt single tapped secondary, disconnecting type with integral; fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 hertz.

2.03 COORDINATION STUDY

A. Prior to inspection and testing as specified in Section 16415, Part 6, 3.2 and 3.3, submit copies of the coordination study to the Engineer and the testing company.

B. Switchboard manufacturer shall make system protection coordination study of the total distribution system for equipment proposed for this project. The manufacturer shall submit to Architect for approval, all data information, logged on One Line Diagram and plot time - current curves with protective device settings showing degree of coordination achieved. In developing the time-current curves the following shall be included in the submittal:

1. On a log-log grid paper identify the circuit and device function, phase and/or ground, for which the plots will apply.

2. Identify the current scale magnitude and voltage base.

3. Draw a One Line Diagram for that part of the system to be considered in the time-current curve plot.

4. Identify, by letter or number, the specific protective devices, whose characteristics will be plotted, on the One Line Diagram. Utilize this identification to identify the characteristic curve as developed and documentation of the final settings.

5. List only the pertinent data required for the specific time-current curve plot being prepared.

6. Initially plot the downstream protector and then proceed to plot successive series upstream protector characteristics.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1. Anchor to resist seismic forces.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

C. Prior to energizing all equipment, the conditions outlined in Section 16415, Article 3.2, A and B, must be met.

3.02 FIELD QUALITY CONTROL

A. The Contractor shall provide the following tests and services:

1. Check tightness of accessible bolted bus joints using a calilbrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.

2. Inspect completed installation for physical damage, proper alignment, anchorage, and ground.

3. Apply megger tests. Supply labor, materials, and test equipment required to perform continuity checks and megger tests. Submit test data for approval.

B. Obtain the services of an independent testing company who shall provide quality control and adjustments as well as the following tests:

1. Provide ground resistance tests.

2. Check and set, where required, all protective device settings in accordance with approved coordination study settings, and conduct ground fault acceptance tests.

3. Provide a visual inspection of all equipment for physical damage, proper alignment, anchorage, and grounding.

4. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for ten minutes for each configuration. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance is 2 megohms.

3.03 ADJUSTING, CLEANING AND TESTING

A. Adjust all operating mechanisms for free mechanical movement.

B. Touch up scratched or marred surfaces to match original finish.

C. Arrange test date and schedule time in advance with Project Coordinator.

1. Check each circuit breaker above 100 amperes, long-time and short-time delay pickup and instantaneous pickup. Instantaneous pickup current shall be determined by run-up or pulse method. Clearing time should be within four (4) cycles or less. Perform timing test with three hundred percent (300%) of breaker trip unit rated current. Adjust unit if required so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.

2. Main circuit breaker ground fault setting shall be per 1995 CEC Article 230-95 (a). *

D. A notice of this inspection with five (5) copies of performance test of circuit protective devices shall be filed with the Architect, including procedures used, conditions found prior to adjustment, and adjustment or repairs made. Final project acceptance will not be considered until after this notice is filed.

3.04 RECORD DRAWING

A. Post Record Drawing copy of the power distribution riser diagram in the vicinity of the main switchboards, framed and mounted under glass or plexiglass. Submit to Architect for approval before fabrication.

END OF SECTION

Power Systems Testing Company, Inc.
2267 Claremont Court
Hayward, California 94545
(510) 783-5096

Apparatus Unlimited
8516 Fruitridge Road
Sacramento, California 95826
(916) 383-4986

Electro Test, Inc.
3470 Fostoria Way, Suite B
San Ramon, California 94583
(925) 244-2025

SECTION 16435

PANELBOARDS, INDIVIDUAL MOUNTED CIRCUIT BREAKERS AND SAFETY SWITCHES

PART 1 - GENERAL

1.01 CONDITIONS

A. The Requirements of the General Conditions and Special Conditions apply to the Work of this Section as if fully repeated herein.

1.02 WORK INCLUDED

A. Furnish all labor, materials, and equipment and perform operation required for complete installation of panelboards, individual mounted circuit breakers, and safety switches as indicated on Drawings and/or specified herein. Such Work includes, but is not limited to, furnishing and installation of power and lighting panelboards and fused safety switches.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. FS - Federal Specification

a. W-C-375 Circuit Breakers, Molded Case: Branch Circuit and Service.

2. CEC - 1998 California Electrical Code:

a. Art. 384 Switchboards and Panelboards.

3. NEMA - National Electrical Manufacturer's Association

a. PB1 Panelboards.

b. AB Molded Case Circuit Breakers.

4. UL - Underwriter's Laboratories, Inc. Standards

a. 489 Molded Case Circuit Breakers and Circuit Breaker Enclosures.

b. 67 Electric Panelboards.

1.04 SUBMITTALS

A. Refer to Division 1 and Section 16000.

B. Test Reports: Production tests of circuit breakers when requested.

C. Show:

1. Circuit breaker numbering.

2. Circuit breaker type and short circuit rating.

3. Provisions for future addition of circuit breakers.

4. Bussing and rating of, including neutral and ground.

5. Enclosures:

   a. Dimension.

   b. Trim.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Panelboards: Square D, General Electric, Industrial Electric Manufacturing.

1. Panelboards: Factory-assembled, dead-front, metal encased safety type; construction consisting of structural or formed steel frame carefully braced and welded into rigid structure which shall maintain its alignment and not be damaged in shipment or erection, or by stresses resulting from short circuits. Bolted housing construction with tack-welded joints will be acceptable. Frame: Completely enclosed on rear, top and sides with sheet steel covers, doors and panels, accessible from front. Cabinet: Of sufficient size to conform to both minimum dimensional requirements and minimum wiring gutter requirements of Article 373 CEC (1998). Minimum Cabinet Size: twenty inches (20") wide by five and three-quarters inches (5 3/4") deep. Stationary Portions of Steel Frame and Covers: 12-gauge minimum with concealed trim clamps. Old style screw fastener type not acceptable. Doors: Sheet metal construction with concealed hinges and equipped with flush type lock and catch. All panels shall be keyed alike. Supply two (2) keys with each lock. Distribution panels installed in outdoor locations shall be free standing in NEMA 3R enclosure. Equipped with heater(s) and thermostat. Heater(s) shall prevent condensation from forming in the inside of the panel. Set thermostat at fifty-five degrees (55°) F.

2. Busses: Hard-drawn copper, ninety-eight percent (98%) conductivity, Grade ED, ASTM B230, (tin plated aluminum) in accordance with NEMA Standards and as * hereinafter specified.

3. Connectors: Silver plated copper.

4. Structure Housing, Bus, and Connections; Construct brace to safely * withstand rated short circuit currents in conformance with UL Standard UI-67. Connections shall be bolted or welded and laminations arranged to provide adequate contact area. All contact surfaces of copper (aluminum) shall be silver-plated (tin-plated). Copper sizes and arrangement shall be such that temperature rise of bus shall not exceed fifty degrees (50°) C. with a forty degrees (40°) C. ambient outside enclosure.

5. Provide a bare copper neutral bus on insulated bus supports and an uninsulated copper equipment ground bus bar secured to each unit frame, to provide separate, integrated, continuous, neutral and equipment ground buses. Neutral Bus: Same size as associated phase buses for 480/277 volt panels, 200% rated for * 208/120 volt panels. Ground Bus: Arranged to ground panelboard's non-

current-carrying parts, provided with brazed or approved pressure connector terminations for feeder ground conductors.

6. Panelboard Main and Branch Circuit Protection: Bolt-on type, molded case circuit breakers with sizes as shown. Individual panelboards shall be constructed to have short circuit rating consistent with circuit breaker being installed.

7. Circuit Breakers:

   a. Circuit breakers shall be single pole and multi-pole. Single pole circuit breakers shall be full module size; two poles shall not be installed in a single module. Multi-pole circuit breakers shall be of the internally common trip type having a single operating handle. For sizes of 50 amperes of less, breakers may consist of a single pole factory assembled into a permanent multi-pole unit. Short circuit interrupting rating of circuit breakers shall be as indicated on Drawings.

   b. Circuit breakers: Thermal-magnetic type unit construction with manual operating handle indicating "ON-OFF" and "TRIPPED" positions.

   c. All circuit breakers shall be tested in accordance with NEMA STANDARDS Publication No. AB1.

   d. Circuit breakers used for switches in fluorescent lighting circuits shall be approved for switching duty and marked "SWD".

8. Provide panel matching full skirt to floor for surface mounted panelboards.

9. Finish:

   a. Panelboards: Epoxy electro-static dry paint. Interior metal surfaces, zinc plated. Equipment shall be cleaned, primed, and finish painted in accordance with the Standard Specifications.

   b. Finish Color: ANSI Z55.1, Color Chip No. 61 (light gray).

10. Circuit Identification: Inside door with framed-In holder behind protective covering for mounting circuit identification.

B. Safety Switches: Enclosed, FS W-S-865C, Type HD with externally operated handle. NEMA 3R enclosure for outdoor locations including under canopies. Enclosure: NEMA 1, unless specifically shown or specified otherwise.

C. Molded-Case Circuit Breaker: NEMA AB1, FS W-C-375. NEMA 3R enclosure for outdoor locations including under canopies. Enclosure: NEMA 1, unless specifically shown or specified otherwise.

D. Elevator Disconnecting Means:

1. Enclosed, FS W-S-865C, Type HD with externally operated handle arranged to be locked in the open position. Furnish dual-element Class J fuses.

2. The fuses shall be selectively coordinated with all other supply side over current protective devices.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Anchor panelboards, circuit breakers and safety switches to wall. Provide supports between studs as required. Anchor distribution panels to concrete pad.

B. Mount panelboards, circuit breakers and switches level and plumb.

C. Install flush mounted panel backbox front edges flush with finished wall. Where flush panel backbox is deeper than wall depth, install closing trim of wood or metal to provide a finished trim.

D. After installation, make all feeder connections to load side lugs of circuit breakers, disconnect switches and incoming secondary feeders.

E. Install in accordance with manufacturer's specifications and recommendations.

F. Fill out panelboard circuit identification card, typewritten, with list of circuits in use. Identification shall be specific with room designation and other information as necessary. For distribution panelboards, use engraved laminated phenolic plate showing load served and trip rating.

G. Where panelboard is flush in wall, provide one (1) three-quarters inch (3/4") conduit stub into accessible ceiling space for each five (5) spare circuit breaker spaces.

H. Provide identification for panelboard, individually mounted circuit breakers and switches as specified under Section 16000, Article 3.5 EQUIPMENT IDENTIFICATION.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 CONDITIONS

A. The Requirements of Division 1 Standard Provisions and Special Provisions apply to the Work of this Section as if fully repeated herein.

1.02 WORK INCLUDED

A. Provide all labor, materials and equipment necessary to complete the installation of:

1. Power System Grounding.
2. Communication System Grounding.
3. Electrical Equipment and Raceway Grounding and Bonding.
4. Signal Reference Grid Grounding System. *

1.03 RELATED WORK

A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

B. Section 16010: Basic Electrical Materials and Methods.

C. Section 16021: Conduit, Fittings, and Supports.

D. Section 16070: Insulated Conductors.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Division 5: Building Steel.

B. Division 15: Cold Water Lines.

1.05 DESCRIPTION OF SYSTEM

A. This Section provides for the grounding and bonding of all electrical and communication apparatus, machinery, appliances, building components, fittings and accessories where required to provide a permanent, continuous, low impedance, grounded electrical system.

B. Ground the electrical service system neutral at service entrance equipment on line side of neutral disconnect link.

C. Ground each separately derived system, as described in 1998 CEC Section 250-5(d) unless specifically noted otherwise.

D. Except as otherwise indicated, the complete electrical installation including the neutral conductor, metallic conduits and raceways, boxes, cabinets and equipment shall be

completely and effectively grounding in accordance with all code requirements, whether or not such connections are specifically shown or specified.

1.06 RESISTANCE

A. Resistance from the Main Switchboard Ground Bus to the ground electrode and to earth shall not exceed five (5) ohms unless otherwise noted.

B. Resistance from the farthest panelboard, switchboard or motor control center ground bus to the ground electrode and to earth shall not exceed twenty (20) ohms.

1.07 SUBMITTALS

A. Submit, in accordance with Division 1 and Section 16000, manufacturer's data for grounding materials specified in this Section.

PART 2 - PRODUCTS

2.01 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND)

A. 4/0 AWG minimum bare copper conductor.

2.02 DRIVEN (GROUND) RODS

A. Copper clad steel, minimum 3/4-inch diameter by 10 feet long, sectional type with copper alloy couplings and carbon steel driving stud. Weaver, Cadweld or equal.

2.03 GROUND WELL BOXES FOR GROUND RODS

A. Precast concrete box 10-5/8 inches wide x 17-1/4 inches long x 24 inches deep with light duty concrete cover for non-traffic areas or steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "GROUND ROD". Christy, or equal.

2.04 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug. OZ/Gedney BLG, Thomas & Betts #TIGB series or equal.

2.05 CONNECTIONS TO PIPE

A. For cable to pipe, OZ/Gedney G-100B series, Thomas & Betts #390X series or equal.

2.06 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

A. Where required grounding conductors shall be spliced together or connected to round rods using exothermic welds or high pressure compression type connectors.

1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld or equal. Each particular type of weld shall use a kit unique to that type of weld.

2. High pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series or equal.

2.07 BONDING JUMPERS

A. OZ/Gadney Type BJ, Thomas & Betts #3840 series or equal.

2.08 GROUND CONDUCTOR

A. Ground conductor shall be code size Type THW/THWN insulated copper wire, green in color. Where continuous color coded conductors are not commercially available, provide a minimum four (4") inch long color band with green, non-aging, plastic tape in accordance with 1998 C.E.C.

2.09 MAIN BUILDING REFERENCE GROUND BUS *

A. Provide one 18 inches wide x 2 inches high x 1/4 inch TK copper bus bar, or size as noted on Drawings. Mount on walls in main electrical room, on insulating standoffs, 18 inches AFF. Furnish complete with cast copper alloy body Thomas & Betts Series 310 or equal lugs for connecting grounding system cables. Attach lugs to bus with appropriate size bronze bolt, flat washer and Belleville washer. All connection shall be torqued. All holes shall be drilled and tapped for single hole lugs. Provide six (6) spare lugs and lug spaces.

2.10 SIGNAL REFERENCE GRID *

A. The Signal Reference Grid (SRG) throughout the entire raised floor area shall be manufactured from 2 inch wide by 26 AWG gage thick copper strips on 2 foot centers, as manufactured by Cadweld®. All crossovers shall be joined by welding. The SRG shall be furnished in sections 4 to 16 feet wide. The sections shall be rolled on large, extra heavy duty tubes with the outside of the roll protected for shipment. Each section shall be clearly identified by part number.

B. Adjacent SRG sections shall be welded together at the jobsite using Cadweld(R) connections. To join sections together, overlap the outside strip of one section over the outside strip of the adjacent section, and weld together every two feet, approximately midpoint between factory welds.

C. Whenever an obstruction is encountered, it is acceptable to cut the SRG to go around the obstruction and splice connecting pieces of the SRG to suit.

D. SRG squares do not have to line up between adjacent sections in a room or between rooms (An offset of several inches often makes installation easier).

E. SRG does not have to be exactly centered between pedestals.

F. The SRG does not have to be bonded to the floor. If any section does not lay flat, pedestal mastic or other convenient means can be used to bond to the floor. Consider this step after all SRG mats are installed and welded together and all low impedance riser and pedestal connections have been made. SRG strips which may be vibrated by air blast from air handling units must be bonded to the floor.

G. It is permissible to splice sections of copper strip to lengthen SRG connectors so they clear preexisting objects on the floor.

H. Use Low Impedance Risers (LIR) in connect to each equipment enclosure to the SRG. Do not connect LIR risers to SRG strips closest to outside walls. Connect LIR no closer than the second SRG row away from the outside walls of room.

I. Every sixth steel pedestal in each direction shall be connected to the SRG, using #6 AWG 7 strand copper cable.

J. All columns within and at perimeter of the Computer Room shall be bonded to the SRG using #6 AWG 7 strand copper cable unless drawing indicates otherwise. Installer shall use the shortest path between the building steel and the Signal Reference Grid.

K. All conduits, water pipes, ducts, etc. the Computer Room which cross the SRG or lay within 3 feet of it shall be bonded to the SRG (at each end of the room if these are horizontal). Use #6 AWG 7 strand copper conductor.

L. Miscellaneous steel connections shall be #6 AWG 7 strand copper cable connected to the SRG.

M. Bond SRG to bus bar using #6 AWG 7 strand copper cable.

N. Each Transient Suppression Plate (TSP) shall be bonded to the SRG using #6 AWG 7 strand copper cable unless otherwise indicated. *

PART 3 - INSTALLATION

3.01 GROUNDING ELECTRODES

A. Concrete Encased Grounding Electrode (Ufer Ground): Provide, unless otherwise indicated, a #4/0 AWG minimum bare copper conductor encased along the bottom of concrete foundation or footings which are in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. The electrode shall extend through a horizontal length of 40 feet minimum and shall be encased in not less than two (2) nor more than five (5) inches of concrete separating it from surrounding soils. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to the main building reference ground bus.

B. Grounding Electrode (Ground Ring, Grid, and Driven Rods): Provide a driven ground rod installed in listed ground well box and filled with gravel after connection is made. Interconnect ground rod with structural steel and adjacent rods with minimum #4/0 AWG bare copper conductor. Ground rod shall not be less than 15 feet from any other electrode of another electrical system or from adjacent ground rod(s).

C. Separately Derived Electrical System Grounding Electrode: Grounding each separately derived system per requirements in 1998 C.E.C. Section 250-26 or as shown on Drawings, whichever is greater.

D. Metal Underground Water Pipe - Cold Water Metal Piping System: Contractor shall install a grounding electrode conductor from the main incoming cold water line to the main building reference ground bus in the electrical room as close as possible for incoming entry point. The electrode shall be sized per 1998 C.E.C. Table 250-94. Electrode connection should be accessible.

E. Inspection: The grounding electrode and connections thereto shall be inspected by the Electrical Inspection Authority prior to concrete encasement, burial, or concealment.

3.02 GROUNDING ELECTRODE CONDUCTOR

A. Provide grounding electrode conductor as indicated on the Drawings or sized per 1998 C.E.C. Table 250-94, whichever is greater.

3.03 POWER SYSTEM GROUNDING

A. Provide unless otherwise indicated, a Main Building Reference Ground Bus in the Main Electrical Room. Connect the following items using 1998 C.E.C. sized copper grounding conductors to lugs on the Main Building Ground Bus:

1. Grounding electrode conductor from concrete encased electrode.

2. Bond conductor to main incoming cold water piping system.

3. Bond conductor to building structural steel.

4. Grounding electrode conductor to transformer secondaries.

5. Bond conductors to Ground Bus and neutral bus in the Main Distribution Board.

3.04 EQUIPMENT BONDING/GROUNDING

A. Provide a 1998 C.E.C. sized copper ground conductor, whether indicated or not on the Drawings, in each of the following:

1. Non-metallic conduits and ducts.

2. Distribution feeders.

3. Motor and equipment branch circuits.

4. Device and lighting branch circuits.

B. Provide a separate grounding bus at distribution panelboards, switchboards, and motor control centers. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35 volts above ground.

C. Conduit terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.

D. Provide bonding jumpers across expansion and deflection couplings in conduit runs.

E. Provide ground wire in flexible conduit connected at each and via grounding bushing.

3.05 COMMUNICATION SYSTEM GROUNDING

A. In addition to grounds noted on the Drawings, provide on #6 THW or THWN in 3/4 inch conduit, from each Satellite Telephone/Communication Backboard to main ground bys on the Main Telephone/Communication Backboard.

B. Unless otherwise shown on the Drawings, provide on #1/0 THW or THWN in 3/4 inch conduit from the Main Telephone/Communication Backboard ground bus to the Main Building Reference Ground Bus.

3.06 SIGNAL REFERENCE GRID GROUNDING *

A. Install Signal Reference Grid as specified under the entire raised floor area before the raised floor is assembled. Mark the location of pedestals to prevent interference. As obstacles are

encountered such as columns, etc., the Signal Reference Grid shall be modified to form as closely as possible the desired two foot squares.

B. Install copper straps (LIR) as specified. The copper straps shall be installed on the basis of one for each piece of equipment on the raised floor including PUDs and panelboards, frequency changers, etc. The copper strap shall be exothermically welded to the Signal Reference Grid utilizing the shortest possible distance, but in no case shall any connections be made to the perimeter portion of the Signal Reference Grid. Use two LIR's for all electronic apparatus if the LIR's are no longer than 24 inches.

C. Bond each transient suppression plate to the Signal Reference Grid with a minimum of two exothermic welds unless otherwise indicated.

D. Install bonding conductors as specified as follows:

1. At each steel building column.

2. At every sixth raised floor pedestal in each direction.

3. At all under floor metallic piping.

4. Install bonding jumpers at all piping systems under floor between each fitting to insure a sufficiently low impedance path along the entire run.

E. All bonding conductors shall be exothermically welded at both ends except the suitable bolted connections shall be used to conduit, copper water pipe or equipment.

3.07 TESTS

A. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required to comply with resistance limits specified under this Section of the Specifications.

B. Typewritten records of measured resistance values shall be included with the Operation and Maintenance Manual furnished to the Owner at the time of project closeout and before certificate of final payment is issued.

C. All ground resistance tests shall be performed by an independent testing agency using test equipment expressly designed for that purpose. Submit name of testing agency for review and approval, in writing, by the Engineer prior to the performance of any testing.

D. Refer to Section 16415, Articles 3.1 and 3.2, for sequence of testing and installation.

END OF SECTION

Power Systems Testing Company, Inc.
2267 Claremont Court
Hayward, California 94545
(510) 783-5096

Electro Test, Inc.
3470 Fostoria Way, Suite B
San Ramon, California 94583
(925) 244-2025

Apparatus Unlimited
8516 Fruitridge Road
Sacramento, California 95826
(916) 383-4986

SECTION 16460

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 CONDITIONS

A. The Requirements of the General Conditions and Special Conditions apply to the Work of this Section as if fully repeated herein.

1.02 WORK INCLUDED

A. Provide dry type transformer and make connection where shown.

B. Reference Standards:

1. American National Standards Institute, Inc. (ANSI) Publications and National Electrical Manufacturer's Association (NEMA) Publications:

   a. ST-1 Specialty Transformers

   b. ST-20 Dry Type Transformers for General Applications

2. Underwriter's Laboratories, Inc. (UL) Publications:

   a. UL 506 Transformers, Specialty

1.03 SUBMITTALS

A. Submit product data under provisions of Division 1 and Section 16000.

B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA and impedance rating and characteristics, loss data, efficiency at twenty-five (25), fifty (50), seventy-five (75), and one hundred (100) percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.

B. Handle transformer using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Transformers: Square D, Westinghouse, General Electric:

1. Transformer: Dry type two (2) winding, not less than one (1) coil per phase and bearing required UL listing mark. "T" connected transformers may be provided for sizes 15 kVA and less. ANSI/NEMA ST-20 and UL 506.

a. Use following tap arrangement in high voltage winding:

1) Four (4) two and one-half percent (2-1/2%) FCBN; Two (2) two and one-half percent (2-1/2%) FCAN.

b. Utilize insulation system that has been properly temperature classified and approved by UL. Insulation temperature shall conform to the following:

Transformer Rating, kVA	Insulation Temp. Degrees C.	Temperature Rise Degrees C.
2 and less	150	80
3 - 30	185	115
37-1/2 & larger	220	150

c. Terminal straps in terminal compartment located below core and coil assembly. Maximum compartment temperature rise of five degrees (5°) C.

d. Capability of operating at one hundred percent (100%) of nameplate rating continuously while in an ambient temperature not exceeding forty degrees (40°) C.

e. Capability of meeting daily overload requirements of ANSI Standard C57.96.

f. Sound level equal to or lower than those established by ANSI Standard C89 and not to exceed the following:

Transformer Rating, kVA	Maximum Sound Level, Decibels
1 - 9	40
15 - 45	45
75 - 150	50
225 - 300	55

g. Basic Impulse Level: 10 KV for transformers less than 300 kVA, 30 KV for transformers 300 kVA or larger.

h. Subject to following production tests in accordance with Standards of NEMA PUB. No. ST 20 and TR 27 and UL-506:

1) Applied Potential

2) Induced Potential

3) No Load Losses

4) Voltage Ratio

5) Polarity

6) Continuity

Manufacturer shall have performed following additional tests on units identical to design type being supplied for this project. Provide proof of performance of these tests in form of test data sheets upon request.

7) Sound Level

8) Temperature Rise Tests

9) Full Load Losses

10) Regulation

11) Impedance

i. Enclosure and base of heavy gauge sheet steel, cleaned, phosphatized and finished with baked enamel. Indoor transformer shall include baffled vent louvers and rigid punched or ventilated bottom. Outdoor transformer shall be ventilated type with rain shields and screens.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Read and follow manufacturer's bulletin "Instructions for Receiving, Installing, Operating and Maintaining Dry Type Transformers" included with shipment before installation of unit.

B. Mount transformer on resilient material.

C. Mount transformer to resist seismic forces and brace to .56G.

D. Ground transformer neutral.

E. Bond from secondary neutral to case.

F. Use flexible conduit connection only to transformer enclosure.

G. Check for damage and tight connections prior to energizing transformer.

H. Measure primary and secondary voltage and make appropriate tap adjustments.

END OF SECTION