SECTION 34 21 05

PREFABRICATED AC AND DC EQUIPMENT HOUSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Prefabricated AC and DC equipment houses

1.02 MEASUREMENT AND PAYMENT

Not used

1.03 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C12.1 — For Electric Meters – Code for Electricity Metering

B. American Society for Testing and Materials (ASTM):

1. ASTM E84 — Standard Test for Surface Burning Characteristics of Building Materials
2. ASTM B187 — Standard Specification for Copper Bus Bar, Rod, and Shapes

C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

1. ASHRAE Handbook of Fundamentals, Chapter 26
2. ASHRAE Publication SPCDX (Climate Data for Region X)
3. Gdl 16 — Specifying Outside, Return, and Relief Dampers for Variable Air Volume Systems
4. Gld 19P — Ventilation and Indoor Air Quality

D. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE C37.20.1 — Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
2. IEEE C37.20.2 — Metal-Clad and Station-Type Cubicle Switchgear (above 1000V)

E. Illuminating Engineering Society of North America (IES):

1. RP-7 Practice for Industrial Lighting

F. National Electrical Manufacturers Association (NEMA):

1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches

2. NEMA PB 1 Panelboards

G. National Fire Protection Agency (NFPA):

1. NFPA 70 National Electric Code

2. NFPA 72E Standard on Automatic Detectors

3. NFPA 101 Life Safety Code

4. NFPA 130 Fixed Guideway Transit Systems

H. Sheet Metal and Air Conditioning Contractor's National Association

1. Architectural Sheet Metal Manual – SMACNA

I. Underwriters Laboratories Inc. (UL):

1. UL 50 Safety Enclosures for Electrical Equipment

2. UL 67 Panelboards

1.04 CODES AND REGULATORY REQUIREMENTS

Comply with the following codes and regulatory requirements:

A. California Building Code, Title 24, Part 2.

B. California Electrical Code (CEC), Title 24, Part 3.

C. Cal/OSHA Standards and California Public Utilities Commission, Rapid Transit District Safety Branch

D. National Electrical Safety Code (NESC)

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples for submittal requirements and procedures.

B. Submit samples of the equipment electrical insulation materials, their physical and electrical properties, and proposed methods of installation.

C. Submit heat load and heat exchange calculations showing that HVAC equipment is able to maintain house ambient temperatures within specified limits.

D. Submit certification that exterior powder coating system is a two-stem process that provides 5 mils minimum thick weather-resistant finish.

E. Submit samples for indoor and outdoor finishes, including certification that exterior finish is graffiti and ultra-violet (UV) resistant.

F. Submit samples for weatherstripping, including certification that exterior finish is graffiti and ultra-violet (UV) resistant.

F. Submit calculations, approved by a California Registered Professional Structural Engineer, showing that equipment house design meets Seismic Zone 4 structural requirements.

1.05 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be weatherproofed for shipment. Connection openings shall be closed to prevent entrance of foreign material during shipment and storage.

B. Equipment shall be handled and stored in conformance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.06 WARRANTY

A. Warrant ac and dc houses to be free from defective materials and workmanship, water leakage and seepage, and condensation for a five-year period commencing with the Guaranty of the Work in accordance with the General Conditions.

PART 2 - PRODUCTS

2.01 GENERAL

A. AC and DC equipment houses and their associated equipment shall be in separate houses

B. AC and DC equipment houses shall be prefabricated, climatized, self-supporting and transportable. The houses shall be weathertight and be free from defective materials and workmanship, water leakage and seepage, and condensation.

C. The maximum outside height of the switchgear houses shall be 12 feet. The maximum headroom shall be 10 feet.

2.02 HOUSE ASSEMBLY

A. General:

1. The house frame shall utilize steel post-and-beam framing with roof purlins.

2. Houses shall be designed for the applicable building code live loads and lateral loads and the following additional design requirements:

   a. In addition to roof live load, design roof-supporting members to support cable trays and any other equipment that is hanging from the roof. As a minimum, this load shall be considered to be 15 pounds per square foot.

   b. In addition to the supported equipment, design floor for a uniform live load of 100 pounds per square foot or a concentrated load of 1000 pounds, applied anywhere and distributed over an area of one foot square.

   c. Provide additional structural supports and roof beams at the shipping splits such that each shipping section is a self-supporting structure.

3. Form joints, locks and seams, interior and exterior, between panels of wall, floor and roof in accordance with the SMACNA Architectural Sheet Metal Manual, Plates 99 and 100 or equivalent water-tight joints as approved. Seal joints with non-hardening compound suitable for indoor and outdoor applications to be compatible with metal finish as recommended by sealant manufacturer.

4. Provide closure plates to seal between the foundation slab and the house wall assembly. The closure plates shall be of compatible finish with the walls.

B. Base Structure:

1. The base of the house shall be structural steel:

   a. The main, cross, and longitudinal tie members shall consist of structural steel channels, angles and beams sized as required and braced and joined between shipping splits to provide adequate strength for installation and for operation.

   b. The base channels shall be suitable for welding to leveling channels embedded in concrete.

2. Provide lifting lugs on the base of each complete shipping section. Design base structure for each shipping section to provide adequate strength for lifting. Other components of the house shall not be permitted for lifting.

C. Floor Plate:

1. Floor: Wall-to-wall steel plate, designed to accommodate the layout as indicated and welded to the main, cross and tie channels. Determine thickness of the steel plate based on the floor loading. Minimum plate thickness shall be 1/4-inch.

2. Dielectric insulating floor for DC houses: The floor for dc houses shall be covered with dielectric insulating material (flooring) complying with the following requirements. Install in accordance with insulating material manufacturer's written instructions.

a. Material: Pourable non-hygroscopic insulating material, based on epoxy compound with a non-asbestos filler, Amazite or equal. Thickness shall not be less than ¼ inch. Final floor surface shall be slip-resistant.

b. The floor insulation shall not crack under the anticipated mechanical and thermal stresses during the life cycle of the house.

c. Minimum dielectric strength of the insulating material shall not be less than 200 volts/mil. Surface resistance measured with a megger with electrodes spaced three inches apart shall exceed 500 megohms.

d. DC equipment enclosures shall be mounted on the floor through insulating fasteners of sufficient dielectric and mechanical strength.

3. Provide floor openings as required. Design floor openings to provide access to cable trenches below, as indicated. Provide exposed floor openings with electrically insulated covers to withstand equipment weight and traffic. Furnish covers with lifting handles.

4. Provide floor for battery area with a containment to retain any electrolyte spill. Place a durable electrolyte-resistant plastic mat on the floor to protect the floor and the curb from electrolyte. Containment area shall be able to hold electrolyte from two battery cells.

5. For AC houses, the covers for the floor opening to the 34.5 kV trench below shall be non-ferrous. The covers for the floor opening in the 34.5 kV switchgear cable compartment shall have holes, number and location of holes shall be determined and oriented according to the required cable training and termination. The covers shall be split with the split running through the centerline of the holes. After cable and cover installation, the split and holes shall be vermin-proofed.

D. Wall Assembly:

1. Walls shall be of double panel construction. Fabricate wall panels from cold-rolled or formed sheet steel as follows:

a. Outer wall panels: No. 14 gage minimum

b. Inner wall panels: No. 16 gage minimum

2. Wall panels shall be 24-inch modules, or manufacturer's standard and shall be bolted at mating flanges to maintain even tension on the panel skin, adding strength, and providing a smooth appearance.

3. Provide wall openings as required. Locate cross and longitudinal tie channels such that no loss of structural integrity is caused by these openings.

4. The design shall permit removal of major equipment such as switchgear cubicles and rectifiers from the houses. Removable wall panels are acceptable for this purpose.

E. Roof Assembly:

1. The roof shall be of the gable type with a slope of one inch in 12 inches, and with rain caps over adjacent panels to provide adequate water drainage. Rain caps shall be overlapping inverted V, large enough to divert heavy rain run-off.

2. Roof assembly shall consist of exterior load-carrying panel members and a false interior ceiling. Assembly shall allow for expansion and contraction and be watertight:

3. The outer roof panels shall be a flat seam or standing seam design, fabricated from the same material as the outer wall panels. Form and flash seams, splices and roof penetrations in accordance with the SMACNA Manual. Specific applications and Reference Plates from the Architectural Sheet Metal Manual are as follows:

   a. Provide expansion batten seams perpendicular to the roof ridge and at connections of shipping splits. Sections between seams shall not exceed 30 feet in any direction. Form expansion batten seams as shown in Plate 119, Detail 20.

   b. Form eaves at expansion batten seams as shown in Plate 103.

   c. Flash seams parallel to the roof ridge as shown in Plate 105, Figure B.

   d. Flash ridge as shown in Plate 105, Figure C.

   e. Flash roof penetrations as shown in Plate 112.

4. Fabricate inner ceiling panels from the same material as the inner wall panels, and shall be installed to the underside of the roof assembly.

F. Entry Doors: Provide entry doors as indicated and as specified herein:

1. Door Size: 42 inches minimum by 96 inches. Size doors to allow removal of the largest breaker.

2. Door Construction: Fabricate doors and frames of formed sheet steel, 16 gauge minimum, galvanized and shop primed, reinforced to support door closer and panic hardware. Insulate doors as specified under Article entitled “Climatization”. Manufacturer’s standard thermal insulation may be acceptable in lieu of the specified insulation subject to District approval. Doors and frames exceeding 72 inches wide shall be 14-gauge minimum.

3. Entry doors shall be weatherproof.

4. Door hardware for each door shall consist of the following:

   a. Heavy-duty horizontal exit device, Von Duprin XP99 device, a Designated Matching Product, with AF trim exterior handle and RS-34 strike.

   b. Rim cylinder lock, Falcon #951, a Designated Matching Product, 7-pin standard cylinder, "G" keyway, "O" bitted, US32D finish, furnished with three keys.

c. Heavy duty door closer, LCN #4040, Norton E/F, or equal as approved.

d. Two pairs of 4-1/2 x 4-1/2 inches, 5-knuckle, concealed bearing, stainless steel hinges with non-removable pins.

e. Heavy duty door stop/hold unit to hold the door in a fully opened (180 degrees) position.

f. Braided ground strap, 1/2 inch x 14 inches tinned plated copper with 1/4 inch x 1/2 inch stainless steel bolts and nuts installed near the top door hinge for bonding the door to the house frame.

g. Provide weatherstripping and flashing. Weatherstipping shall be ultra-violet (UV) resistant.

F. Finishes

1. All exterior surfaces, including roof and ventilating domes, shall be finished using a two-step powder coating process with the following characteristics:

a. Thickness: 5 mils, minimum

b. Color: Medium beige

c. Weather-resistant

d. Graffiti-resistant

e. Ultra-violet (UV) resistant

2. Surfaces of equipment inside equipment houses shall have an ANSI 61 gray finish.

3. Following assembly, any areas exposed to outside atmosphere that have been affected by cutting or welding shall be spot galvanized with a primer that forms a dry film of no less than 90 percent pure zinc.

2.03 CLIMATIZATION

A. General: Construct and equip houses with the climatization features as indicated.

B. Weatherstripping: Provide weatherstripping and flashing for openings such as doors and removable panels to exclude water entry under all weather conditions.

C. Thermal Insulation:

1. Floor Insulation: Coated, glass-fiber insulation, one inch thick, three pcf minimum density, applied with adhesive and mechanical fasteners to underside of floor plate.

2. Wall, Roof and Access Door Insulation: Foil faced glass-fiber, two inches thick, three pcf minimum density with foil face facing interior, sandwiched between the inner and outer panels.

2.04 HEATING AND VENTILATING SYSTEM

A. General: The HVAC system shall conform to the design requirements of ASHRAE standards listed under article entitled "References" herein. Natural ventilation is the preferred method for prefabricated switchgear houses.

B. Design Criteria

1. Indoor and Outdoor Design Conditions

   a. Indoor temperature shall not exceed 86°F (30°C) with HVAC equipment operating at their design capacities. Summer outdoor temperature shall be as specified by ASHRAE Publication SPCDX, Climatic Data for the region in which the house is to be located.

   b. Indoor temperature shall not drop below 60°F (15°C). Winter outdoor temperature shall be as specified by ASHRAE Publication SPCDX, Climatic Data for the region in which the house is to be located.

   c. Space relative humidity shall not exceed 55 percent.

2. Indoor Heat Rate: Indoor heat rate gains shall include all heat-generating equipment and components based on their design loading. When equipment design is based on an in-line spare, one unit shall be assumed to be out of service.

3. Transmission/Solar Heat Gains: Transmission heat gains through sunlit walls and roof shall be based on CLTD method in accordance with ASHRAE Handbook of Fundamentals, Chapter 26. Assume medium color roof and walls, outdoor temperature as specified in Article 2.04-B.1.a herein, and long axis oriented in the East-West direction. No credit shall be taken for heat outflow from the enclosure.

4. Noise criteria: Noise generated by the operating HVAC equipment shall not exceed 55dB at any point along a perimeter 10 feet away from the exterior outline of the enclosure.

C. Louvers: Louvers shall be in accordance with Section 08 90 00, Louvers and Vents.

D. Heating and Ventilation Equipment: Refer to Section 23 34 00, HVAC Fans and Section 23 81 00, Unitary HVAC equipment for heating, cooling and ventilation equipment requirements.

E. Submit heat load and heat exchange calculations showing the HVAC system is capable of maintaining the required indoor climate conditions.

2.05 ELECTRICAL REQUIREMENTS

A. General:

1. Electrical materials, devices and installation shall be in accordance with Section 34 21 50 - Traction Power Materials and Devices, and Section 34 21 70 - Traction Power Facilities Installation Requirements.

2. Provide dry-type, general purpose, three-phase transformer, complying with the requirements of Section 26 05 17, Dry Type Transformers, to step the incoming service voltage down from 480 V ac to 208/120 V ac.

3. Provide one duplex, 20 ampere, 120 volt, 3-wire receptacle with integral ground fault protection inside the house near each entry door. The receptacle shall be a NEMA S-20R configuration.

4. Wiring devices shall be in accordance with Section 20 70 26, Common Materials and Methods for Electrical Systems.

B. Lighting:

1. Provide fluorescent lighting chain-suspended at nine feet above finished floor in each house:

   a. Fixtures shall be industrial porcelain enamel reflector type with 40-watt rapid start, cool white lamps.

   b. The average maintained lighting intensity shall not be less than 40 foot-candles at floor level. Uniformity ratio shall not exceed three to one.

   c. Control interior lighting by surface-mounted 3-way or 4-way switches of specification grade located near each entry door.

2. Provide emergency lighting with self-contained charger and battery sized for 90-minute operation. Emergency lighting shall be at least one foot-candle at any point at the floor level and shall conform to NFPA 101.

3. Exterior lighting shall consist of a weatherproof, wall mounted area lighting fixture above each doorway. Fixture shall be a one-piece housing/refractor of polycarbonate and be equipped with a 70-watt high-pressure sodium lamp and internal photoelectric control. Ballast shall be 120 volt, reactor, high power factor type. Photometrics shall provide a low glare, downward and outward light distribution. The exterior lighting shall be on a separate circuit, and shall be controlled by a switch with three-positions as follows: ON, OFF and AUTO. In the AUTO position, the exterior lighting shall be controlled by a photoelectric cell.

C. Equipment Electrical Insulation:

1. Furnish and install equipment insulation as indicated and as specified herein.

2. Submit samples of equipment insulating materials, their physical and electrical properties, and proposed methods of installation.

3. Insulating materials, when exposed to flames or electrical arcing, shall not give off toxic gases or products of combustion which are harmful to personnel or to the surrounding equipment or which will result in electrical arcing.

4. Minimum clearance between high-resistance ground equipment enclosures and solidly- grounded equipment enclosures shall be eight feet, unless indicated otherwise.

5. Where clearance from any parts of high-resistance ground equipment to walls, columns, doors, equipment or any grounded object is less than eight feet, the walls, columns, doors, equipment or grounded object shall be insulated to a height of eight feet with an insulation sheet of glastic-type material rated at 1500 volts DC minimum.

6. No gaps shall exist between electrical wall insulation and the floor or between adjacent insulation sheets. No non-insulated fittings or hardware shall protrude through or be unprotected by insulation.

7. Wall insulation protecting exposed structural wall sections shall extend at least 10 feet beyond the limits of the high-resistance ground equipment. High-resistance ground equipment may be placed directly against the house walls, provided such walls are insulated as indicated.

8. Floor insulation for the high resistance grounded equipment shall cover the entire floor.

9. Glastic-type insulation shall be provided between the rectifiers and the dc switchgear, between individual DC switchgear cubicles, and between the rectifier and the negative return cabinet.

D. Wiring:

1. Wiring shall be as specified in Section 34 21 50 - Traction Power Materials and Devices.

2. Provide terminal blocks at both sides of shipping splits to connect wiring between shipping sections.

3. Provide and tag all wires and cables required for connecting the terminal blocks of the shipping sections.

4. Provide dedicated conduits to segregate fire detection and alarm circuits.

E. Circuit Breakers and Panelboards: Refer to Section 26 24 24, Circuit Breakers and Panelboards for requirements.

1. Provide four spare circuit breakers, three 20-amps and one 30-amps, in each panelboard. In addition, provide spaces for future installation of a minimum of eight circuit breakers in the L01 panelboard and two circuit breakers in the L02 panelboard. The bus in each panelboard shall extend to cover the spaces for future circuit breakers.

F. Dry-Type Transformers:

1. Refer to Section 26 05 17, Dry-Type Transformers, for requirements, with the following exceptions:

   a. Housings shall be NEMA 1 with a ventilated screen.

   b. Transformer shall be sized to provide at least 30 percent spare capacity over the initial maximum demand load.

G. Grounding:

1. Ground test stations shall be provided, as indicated, along the bottom and inside wall of the house and shall be interconnected by an insulated copper cable sized at no less than 250 kcmil.

2. Each ground test station shall consist of a copper ground bus, ¼ x 2 x 12 inches, supported by a minimum of two standoff insulators.

3. Furnish ground test stations in the high-resistance grounded house with non-metallic enclosures and insulate the interconnecting ground cables between test stations.

4. Grounding shall conform to the requirements specified in Section 34 21 70 - Traction Power Facilities Installation Requirements.

2.06 FIRE DETECTION AND ALARM SYSTEM

A. General:

1. Refer to Section 28 31 00 - Fire Detection and Alarm System, for requirements.

2. Provide fire detection and alarm system conforming to NFPA 72E, complete with ionization detectors, dual ion zone module, control panel, end-of-line device, power supplies and all other items of material and equipment required for a complete installation.

3. Locate fire alarm control panel as indicated.

2.07 FIRE EXTINGUISHERS:

A. Provide fire extinguisher near each entry door, in accordance with the requirements of Section 10 40 00 - Safety Specialties. Fire extinguishers shall be of the carbon dioxide type, 20-pound capacity, and shall be wall-mounted.

2.08 FACTORY TESTING

A. General: Testing shall be performed in accordance with the requirements of Section 01 45 24, Testing Program Requirements.

B. Design Tests:

1. One empty house of each kind (AC and DC Equipment House), complete with throat connection assemblies in the case of the DC equipment house, shall be tested in accordance with the weatherproofing test for outdoor metal-enclosed switchgear of ANSI C37.20.1 and C37.20.2.

C. Production Tests:

1. General: Tests specified herein shall be performed on each fully assembled prefabricated ac and dc equipment house. Tests shall be performed with all equipment installed and wired inside the house, and that all equipment have successfully passed the specified design and production tests.

2. Dielectric Tests: These tests shall be performed using an insulation resistance tester (megger) with the appropriate voltage output to confirm the insulation integrity of all power, control power, and hard-wired control and indication circuits. Tests shall also confirm the isolation of the dc switchgear and rectifier enclosures from ground in the dc equipment houses.

   a. Insulation resistance test on the switchgear power buses to ensure there is no insulation breakdown along the main power path.

   b. Tests to verify the insulation integrity of control power buses, and low voltage power and control cables and wiring, with the end devices disconnected where appropriate.

   c. DC equipment house tests on the dc switchgear and rectifier enclosures (with Dev 164 disconnected), and on the insulated floor and wall surfaces, to confirm the integrity of the insulation from ground. The enclosures to ground insulation shall be tested with at least 4600 V dc applied for 1 minute.

3. Circuit Continuity Tests: Perform tests to verify the continuity of all control circuits, combined with inspection checks to confirm that all wiring is correctly terminated in accordance with approved control schematics and wiring diagrams. The wiring shall be checked completely, including terminations for equipment external to the houses where applicable, and at shipping splits, if required.

4. Functional Tests General Requirements: Perform functional tests on all equipment, devices and control circuits inside the houses to verify that they function in accordance with the final approved control schematics, and meet the requirements of these Specifications:

   a. Control and indication functions shall be tested for all circuits including relays, control panel, local and remote indications, local and remote control, and shutdown.

   b. Control and indication functions shall be checked for proper operation by actuating each contact that initiates a control operation or alarm indication, and then following the control sequence or signal propagation through the various associated devices to ascertain that the correct results and indications are obtained for each condition.

c. Actuation of contacts as required to initiate an operation and to set up the interlocking conditions, shall be performed in a manner that effectively simulates operating scenarios.

d. Control Parameters: Verify the control parameters, configuration and set points of all equipment with electronic (microprocessor-based) controls and solid state relays such as the NGD, MPR, and ETTS equipment in the DC houses.

e. Control and Annunciator Panel (CO2) and the SCADA RIO Cabinet (23G): Alarm and control functions shall be simulated in ac equipment houses designed to operate with the CO2 and SCADA cabinets located in an associated dc house. The following functional tests shall be performed:

1) Control and alarm functions shall be verified at the CO2 mimic panel and the SCADA RIO discrete input terminal strip by operating the appropriate device in the switchgear.

2) Alarm functions at the switchgear shall be simulated at each device and the correct indication verified at the CO2 display panel and the SCADA RIO discrete input terminal strip located in the C03 panel.

3) Control circuit functional testing shall be performed by actuating control switches on the CO2 mimic panel, and observing the operation of the circuit breakers and associated status indications on the mimic panel.

4) The correct operation of selector and lockout switches shall be verified between the CO2 panel, the switchgear and the SCADA RIO discrete input terminal strip.

f. Support Systems and Devices: Check the required settings of thermostats and humidistats for the space heaters, and confirm the proper functioning of all support systems and devices, including those of the 125 V dc control power systems, where applicable.

g. Fire Alarm System Tests:

1) After the fire alarm and smoke detection system is completely installed, it shall be tested for continuity and correct operation.

2) The concealed calibrated test feature shall be used to check operational integrity of the detection chamber. Each ionization detector shall be operated to ensure that the indicating lamp at the annunciator panel is lit. After completion of the test, the ionization detectors shall be set for correct sensitivity.

5. Functional Tests for DC Houses: Functional tests on 1000 V dc circuit breaker controls shall include verification of the load measuring, auto-reclosing and non-reclosing sequences.

a. Emergency and Transfer Trip System (ETTS): The transfer trip cabinet (TTC) shall be installed and wired to other equipment in the DC house, as for the permanent installation. If the DC house is interfaced (in the field) with emergency

trip panels (ETPs), such panels shall be temporarily installed in the vicinity and connected via short fiber-optic cable to the TTC for the purposes of these tests. The following ETTS tests shall be performed:

1) Verify the proper operation of the emergency trip circuits and logic by shorting, one at a time, the monitored current loops of the ETP, simulating thereby emergency trip events. Verify that the correct DC circuit breakers are tripped by the ETTS in each case, without re-closing, and that the correct signals are sent out by the PLC in the TTS for tripping dc circuit breakers in other traction power facilities (not part of the system test configuration).

2) Verify the proper operation of protective relays and correct functioning of the transfer-tripping logic, by shorting field contacts, or by putting the DC MPR in fault simulation mode, as appropriate. Verify that the PLC in the TTC sends out the correct signals for transfer tripping of remote dc circuit breakers (that are not part of the test system configuration).

3) Verify that incoming transfer-tripping or emergency tripping signals to the local ETTS equipment, are properly decoded by the PLC in the TTC, and the correct dc circuit breaker is being tripped in the correct mode (with or without auto-reclosing).

b. Temperature Alarms and Devices: All high temperature alarms and devices shall be tested, their calibration and settings checked, and proper operation verified.

c. Reverse-Current Trip: The Contractor shall apply current in the reverse direction through each main DC circuit breaker, to verify that the reverse-current trip device trips the circuit breaker at the minimum current setting, as required.

d. DC Equipment Enclosure Protective Scheme: The proper operation of the high-resistance frame grounding scheme in all modes shall be verified by tests involving application of high potential to (enclosure ‘hot’), as well as grounding of (enclosure ‘grounded’), the DC equipment enclosures.

e. Undervoltage Relays: Tests to verify the pickup and dropout levels of the undervoltage relays shall be performed.

f. Door Interlocks: Tests to verify the proper functioning and operation of all door interlocks in the DC house, such as those on the rectifier doors and the doors to the dc circuit breaker compartments shall be performed.

6. Functional Tests for AC Houses: Functional tests on 34.5 kV ac circuit breaker controls shall include verification of control interlocking and automatic transfer functions, as follows:

a. Undervoltage tripping of switching station breakers.

b. Interlocking between switching station and sectionalizing station breakers.

c. Automatic closing operation of sectionalizing station breakers.

d. Automatic transfer between the two incoming breakers in traction power substations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall verify that foundation and anchor bolt locations are installed in accordance with the approved design before delivery or installation of the house.

B. Deliver and reassemble the shipping sections, and install the house on a foundation:

C. Apply waterproof, non-hardening sealing compound between the foundation and house base perimeter.

D. Installed prefabricated ac and dc equipment houses shall be made ready for energization by connecting shipping sections of the house, raceways and circuits between shipping split sections and all control circuits between AC and DC switchgear, transformers, and equipment inside the prefabricated house.

E. Install grounding connections to the underground ground grid system

F. Perform all field tests specified in Section 34 21 80, Traction Power System Field Acceptance Testing.

G. Clean, repair, and repaint house and floor to provide the appearance of a new installation prior to final acceptance.

END OF SECTION 34 21 05