

## SECTION 34 21 40

### DC CONTROL POWER SYSTEM

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. General
- B. Batteries
- C. Battery Chargers
- D. Battery racks and ventilation system
- E. DC Distribution Panelboards
- F. Fused disconnect switches
- G. Finishes
- H. Emergency eyewash
- I. Miscellaneous devices
- J. Accessories
- K. Factory testing

##### 1.02 MEASUREMENT AND PAYMENT

Not used

##### 1.03 REFERENCES

- A. American National Standards Institute (ANSI)
  - 1. ANSI Z358.1 Emergency Eye Wash and Shower Equipment
- B. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA 250 Enclosure for Electrical Equipment (1,000 Volts Maximum)
  - 2. NEMA AB1 Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

3. NEMA FU 1 Low-Voltage Cartridge Fuses.
  4. NEMA PB 1 Panelboards
  5. NEMA PE 5 Utility Type Battery Chargers
- C. National Fire Protection Association (NFPA)
1. NFPA 70 National Electrical Code
- D. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE 450 IEEE Recommended Practice for Maintenance, Testing and Replacement of Ventilated Lead-Acid Batteries for Stationary Applications
  2. IEEE 484 IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
  3. IEEE 485 IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
- E. Underwriters' Laboratories, Inc (UL)
1. UL 67 Panelboards

#### **1.04 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 the following:
1. Manufacturer's product description, catalog data and information.
  2. Manufacturer's arrangement, wiring, and detail drawings.
  3. Design calculations for battery and battery charger sizing for the largest load of a traction power substation.
  4. Calculation and/or certification by California Registered Professional Mechanical Engineer that battery rack assembly meets Seismic Zone 4 requirements.
  5. Operating and maintenance manual including recommended spare parts list.
  6. Factory-trained manufacturer's representative(s) written certification that the equipment has been installed, adjusted and tested in accordance with the

manufacturer's recommendations. Submit three (3) copies of the manufacturer's representative's certification.

### **1.05 QUALITY ASSURANCE AND SUPPLIER QUALIFICATIONS**

- A. Battery and Charger components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100. The system and components shall conform to IEEE 485, NEMA 250, NEMA AB1, NEMA PB1 and UL 67.
- B. The manufacturer of the batteries and battery chargers shall have a minimum of 5 years manufacturing experience.
- C. Batteries and battery chargers shall be proven standard products, or equivalent to the standard products of manufacturers engaged in the production of such equipment for at least the past 5 years.

### **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Batteries shall be delivered dry charged. Accessories including electrolyte, shall be packed in separate shipping cartons.
- 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.

### **1.07 WARRANTY**

- A. Warranty for the batteries and battery chargers shall be provided and signed by the manufacturer and installer agreeing to correct system deficiencies and replace components that fail in materials or workmanship.
- B. Batteries shall have a warranty of one year from the date the battery is placed in service and an additional warranty of 19 years, pro rata, to deliver not less than 80 percent of its rated capacity. The battery chargers shall have a warranty of one year from the date the battery charger is placed in service.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. The dc control power system shall provide 125V dc power to all traction power facility equipment auxiliary control, monitoring and protection devices, as required.
- B. Each system shall consist of a battery charger, bank of batteries, battery rack, eye wash fountain, insulating mat, fused disconnect switch, DC distribution panelboard, and all equipment and materials necessary for a complete operating system.

- C. One manufacturer shall supply all components of the dc control power system. Battery components shall be manufactured by C and D Power Systems, Yuasa-Exide Power Inc., or approved equal
- D. Environmental Conditions: The batteries and battery chargers shall be suitable for operation under the following ambient temperature ranges:
  - 1. Minimum temperature  $-7^{\circ}\text{C}$
  - 2. Maximum daily temperature  $+40^{\circ}\text{C}$
  - 3. Maximum daily average temperature  $+30^{\circ}\text{C}$
- E. The input voltage to the dc control power system shall be 120 volts, single phase, 60 Hz; the output voltage shall be 125 V DC.

## **2.02 BATTERIES**

- A. The battery and its associated charger shall be connected in parallel. The charger, in addition to charging the battery, shall carry the continuous connected load. The battery shall supply the remainder of the heavy short-time current demands. When the ac supply to the charger is interrupted, the battery shall supply the required power for the specified load duty cycle.
- B. Batteries shall be of the valve-regulated lead-acid type with a minimum of 20 years design life under normal usage for the intended duty. Batteries shall be designed for float service.
- C. Batteries shall consist of a sufficient number of cells to provide a nominal output floating voltage of 130 V.
- D. The battery capacity shall be sized in accordance with IEEE 485. Contractor shall establish the required capacity in rated ampere-hours for an 8-hour discharge rate to 1.75 V per cell at 77 degrees F.
- E. Battery capacities shall be adequate for the following load duty cycle over a period of 8 hours from a fully charged state with the battery charger out of service:
  - 1. Normal continuous demand of station ancillary loads including relays, indicating lamps, control and annunciator panel, and supervisory control circuits.
  - 2. After 8 hours, close and trip of one high-voltage ac power circuit breaker.
- F. Each positive and negative cell assembly shall be designed for the required battery duty and a long life cycle. Cell elements shall be supported from projections in the bottom of the cell container or from the cover.

- G. Cell containers shall be of transparent styrene acrylonitrile. Each cell shall be provided with a filler opening fitted with an explosion resistant vent. Polarity of cell terminal posts shall be clearly and permanently identified. Electrolyte level lines shall be marked on all four sides of each container.
- H. Cells shall have a specific gravity between 1.210 and 1.220 at 77 degrees F, when fully charged.
- I. Cells shall be provided with intercell connectors. Batteries shall be provided with terminal plates and lugs as required. Connectors, plates, and lugs shall be lead-plated solid copper.
- J. As an alternative, maintenance free batteries shall be acceptable if it meets the technical requirements as specified in this specification section.

### **2.03 BATTERY CHARGERS**

- A. Battery chargers shall be completely automatic, silicon-controlled rectifier, convection cooled, and constant voltage, complying with NEMA PE 5.
- B. Battery charger enclosure shall be NEMA 250, Type 1. Enclosure shall be provided with a hinged front panel complete with lockable handle and two-point latches, minimum.
- C. Battery chargers shall be rated as follows:
  - 1. Capacity - In accordance with its associated battery size and continuous dc load.
  - 2. Recharging - Shall be able to recharge the battery from 1.75 V per cell to 85 percent of the battery capacity in 8 hours, maximum.
  - 3. Output Current - In accordance with its battery size and continuous dc load.
  - 4. Regulation -  $\pm 1$  percent of output dc voltage over its complete load range with  $\pm 10$  percent variation of input ac voltage.
  - 5. Current Limiting - Adjustable from 90 to 115 percent; factory set at 110 percent of output nominal current rating.
- D. Each battery charger shall be furnished with the following accessories:
  - 1. One dc voltmeter, 0 to 200 V
  - 2. One dc ammeter, range as applicable
  - 3. One ac input pilot light marked AC POWER ON

4. One selector switch two positions marked FLOAT and EQUALIZE
5. Two ground detection alarm relays, positive and negative, for local and remote supervisory annunciation
6. One ac input molded-case circuit breaker, NEMA AB 1
7. One dc output molded-case circuit breaker, NEMA AB 1
8. One equalizing time charger, 0 to 72 hours, to terminate a manually set adjustable equalizing charge of 2.33 V per cell
9. One dc failure alarm relay for local and remote supervisory annunciation
10. One ac failure alarm relay for local and remote supervisory annunciation
11. Space heaters, as indicated

### **2.03 BATTERY RACKS AND VENTILATION SYSTEM**

- A. Batteries shall be provided with two-tier two-step structural steel support racks. Battery racks shall be provided with insulating plastic strips to cover all supports, hold-downs, and restraining rails that are in contact with the battery cells. The exposed perimeter of the battery racks shall be covered with removable non-metallic acid-resistant barriers to preclude storage of foreign metallic objects.
- B. Battery racks shall be designed to Seismic Zone 4 requirements.
- C. A forced air ventilation system composed of fan, ducting and a hood properly sized, shall be provided to remove all potentially explosive gases from the station batteries and vent it directly to the outside.
- D. Provide an airflow switch in the ventilation duct to disable the battery charger upon loss of ventilation and to provide remote annunciation via SCADA.

### **2.04 DC DISTRIBUTION PANELBOARDS**

- A. DC panelboards shall comply with the requirements of NEMA PB 1, certified to UL 67, and shall be suitable for 2-wire, 125 V dc ungrounded power distribution service. Panelboard shall be equipped with main and branch circuit breaker type disconnects complying with NEMA AB 1 as indicated.
- B. Panelboards shall be surface mounted, dead-front type, housed in a NEMA Type 1 steel enclosure with hinged front cover, lockable handle, and two-point latch, minimum.

- C. A moisture resistant circuit identification chart shall be furnished and attached to the inside face of the cover.
- D. Establish the required current rating of the control power distribution panelboards for each dc control power system. Panelboards shall be furnished with main incoming terminals. Branch circuit breakers shall be 100 A. frame size with 10,000 A. interrupting rating, minimum.
- E. Panelboards shall be furnished with the required number of branch circuit disconnects based on the following control power distribution requirements:
  - 1. AC circuit breakers
  - 2. DC main and feeder breakers
  - 3. Rectifier-transformer and rectifier
  - 4. Control and annunciator panel
  - 5. Supervisory control and interface terminal cabinet
  - 6. 30% spares

**2.05 FUSED DISCONNECT SWITCHES**

- A. A two-pole hand-operated fused disconnect switch shall be provided between the set of batteries and the battery charger as indicated. Fuses shall comply with NEMA FU 1 and shall provide short circuit protection for the battery system and main cables to the dc distribution panelboard. The fuse rating and switch size shall be coordinated with the dc output circuit breaker of the battery charger. The disconnect switch and fuses shall be mounted in a NEMA Type 1 enclosure.

**2.06 FINISHES**

- A. Battery racks shall be treated with at least two coats of acid and alkaline resistant gray paint.
- B. Equipment shall be cleaned, primed and finish painted in accordance with the manufacturer's standard specifications, suitable for indoor service. The color of the exterior finish paint shall be light gray or equal unless otherwise directed by the Engineer.

**2.07 EMERGENCY EYE WASH**

- A. Provide a portable eye wash unit with twin spray heads, 10-gallon stainless steel tank, automatic pressure control, push-to-operate valve, and pressure gage. Product

shall be in conformance with CAL OSHA Industrial Safety Orders and ANSI Z358.1.

**2.08 MISCELLANEOUS DEVICES**

- A. Insulating Mat: Electrolyte resistant plastic mat shall be provided under each battery rack, extending not less than 12 inches outside the rack.
- B. Nameplates: Each battery cell container shall be marked with the following information:
  - 1. Manufacturer's name
  - 2. Month and year of manufacture
  - 3. Cell type
  - 4. Ampere-hour capacity

**2.09 ACCESSORIES**

- A. One set of the following accessories shall be provided for each set of batteries:
  - 1. Thermometer
  - 2. Hydrometer with holder
  - 3. Filling syringe
  - 4. Cell lifting sling, complete with strap and spreader
  - 5. Battery logbook
  - 6. Quart of terminal grease
  - 7. Set of special tools, if required
  - 8. Set of cell identification numbers

**2.10 FACTORY TESTING**

- A. General:

1. Notification of Tests: The Engineer shall be notified not less than 30 days in advance of dates scheduled for tests. Test procedures shall be approved by the Engineer prior to dates of scheduled tests.
2. Test Program Plan: Submit a test plan identifying the approach to be used for accomplishing the required factory tests. Test plan shall be prepared and submitted in accordance with Section 01 45 24, Testing Program Requirements. The projected schedule for test and test execution, and submittal of test results shall be included.
3. Test Procedures: Test procedures shall be submitted not less than 45 days prior to test, and shall include as a minimum, the following:
  - a. Objective and scope
  - b. Test set up
  - c. Test equipment to be used
  - d. Personnel required for the test
  - e. Estimated duration of test
  - f. Pass/fail criteria
  - g. Samples of data sheets to be used
4. Test results will be reviewed and accepted by the Engineer, as submitted or additional tests may be required. If additional tests are required due to failure of the dc control power system to meet specifications requirements, retesting is to be performed and results documented and resubmitted to the District as part of the Work.
5. Test Reports: Test reports shall document the results obtained and be certified by the manufacturer. Reports shall include the following:
  - a. Equipment tested, including model and serial numbers
  - b. Title of test
  - c. Objective of test and pass/fail criteria
  - d. Summary and conclusions
  - e. Location and date of test
  - f. Test method and equipment used for test
  - g. Results, including calculations and other supporting data
  - h. Abbreviations and references

- i. Signatures of test supervisor and witnesses
6. Test Witnessing: The District reserves the right to witness any and all tests, including those tests conducted elsewhere by the Contractor, its suppliers, or by an independent agency. If District determines not to witness a test or tests, test reports shall still be submitted to the District for review. All witnessing parties shall sign test reports.
7. Test Equipment: Provide calibrated test equipment, instruments, tools, and other required items necessary to perform the specified tests.
8. Replacement Materials: Replace or repair equipment, parts, and materials that are rejected, damaged, lost, or consumed during performance of factory tests. Replacement materials shall be new and warranted.

**B. Factory Tests:**

1. General: Factory tests shall include design and production tests performed by the Contractor, its supplier, or a testing agency prior to shipment of the equipment. Unless otherwise indicated, the District may waive the requirements for design tests upon review of test procedures, test results, and/or certified documentation of like equipment. Tests results on like equipment or materials shall be submitted for the design tests that are to be waived.
2. Factory tests for the DC control power systems shall include the following:
  - a. Temperature rise test.
  - b. Power loading at 100 percent capacity for 24 hours at 32 degrees C and 90 percent humidity.

**PART 3 - EXECUTION**

Not Used

**END OF SECTION 34 21 40**