

SECTION 26 33 01
DC BATTERY SYSTEM

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Batteries.
- B. Battery Rectifier/Chargers.
- C. Disconnect switch and circuit breaker.
- D. DC Distribution panel.

1.02 RELATED SECTIONS

- A. Section 20 70 26, Common Materials and Methods for Electrical Systems
- B. Section 22 40 00, Plumbing Fixtures
- C. Section 26 05 24, Low Voltage Wires and Cables
- D. Section 26 05 26, Grounding and Bonding for Electrical Systems
- E. Section 26 05 70, Electrical Cabinets and Enclosures
- F. Section 26 24 24, Circuit Breakers and Panelboards

1.03 MEASUREMENT AND PAYMENT

- A. General: DC battery system, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump-sum price for the related electrical or electronic systems work as indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B187/ B187M Standard Specifications for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bart, and Shapes
- B. California Code of Regulations (CCR):
 - 1. Title 24, Part 2 California Building Code (CBC)
 - 2. Title 24, Part 3 California Electrical Code (CEC)
 - 3. Title 24, Part 9 California Fire Code (CFC)

- C. Code of Federal Regulations (CFR):
1. Title 40 - Protection of Environment
 - a. Part 261.3 Identification and Listing of Hazardous Waste
 - b. Part 273.1 Standards for Universal Waste Management
 2. Title 49 - Transportation
 - a. Part 105 Hazardous Materials Program Definitions and General Procedures
- D. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 450 IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
 2. IEEE 484 IEEE Recommended Practice for Installation Design and Implementation of Vented Lead-Acid Batteries for Stationary Applications
 3. IEEE 485 IEEE Recommended Practice for Sizing Lead Acid Batteries for Stationary Applications
 4. IEEE 1184 IEEE Guide for Batteries for Uninterruptible Power Systems
 5. IEEE 1187 IEEE Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications
 6. IEEE 1188 IEEE Recommended Practice for Maintenance, Testing, and Replacement of Value-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
 7. IEEE 1189 IEEE Guide for Selection of Value-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
 8. IEEE 1375 IEEE Guide for Protection of Stationary Battery Systems.
 9. IEEE 1491 IEEE Guide for Selection and Use of Battery Monitoring Equipment in Stationary Applications.
- E. National Electric Manufacturing Agency (NEMA):
1. NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum)
 2. NEMA PB 1 Panelboards
 3. NEMA PB 1.1 General Instructions for Proper Handling, Installations, Operation and Maintenance of Panelboards Rated 600 Volts or less

- 4. NEMA PE 5 Utility Type Battery Chargers
- F. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code (NEC)
 - 2. NFPA 1 Fire Code
- G. Underwriters Laboratories (UL):
 - 1. UL 67 Standards for Safety Panelboards
 - 2. UL 1642 Standard for Lithium Batteries
 - 3. UL 1973 Standard for Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications
 - 4. UL 1989 Standard for Standby Batteries
 - 5. UL 489 Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures
- H. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- I. International Code Council Evaluation Service (ICC-ES):
 - 1. AC 156 Acceptance for Seismic Certification by Shake-table Testing of Nonstructural Components

1.05 SUBMITTALS

- A. General: Refer to Specification Section 01 33 00, Submittal Procedures, Specification Section 01 33 23, Shop Drawings, Product Data, and Samples, and Specification Section 01 78 23, Operation and Maintenance Data for submittal requirements and procedures.
- B. Manufacturer's product description, catalog data and information.
- C. Manufacturer's arrangement, wiring and detail drawing.
- D. Power consumption calculations. Estimated average power and peak power demand shall be provided.
- E. Battery and battery charger sizing calculations.
- F. Product data and catalog cuts for battery, battery racks/cabinets, battery chargers and disconnect switches.

- G. Submit factory test data.
- H. Available short circuit current, maximum continuous current and maximum voltage ratings of the battery system.
- I. The voltage, current and fault current interrupting ratings of the protective devices rated for use in a DC circuit.
- J. Certificates:
 - 1. Factory trained manufacturer's representative(s) shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. The contractor shall provide three (3) copies of manufacturer's representative's certification.
- K. Supplier Qualifications:
 - 1. The manufacture of the batteries and battery charger must have a minimum of five (5) years of manufacturing experience.
 - 2. Battery and battery chargers shall be proven standard products, or equivalent to the standard products of manufacturer's engaged in the production of such equipment for at least the past five (5) years.
- L. Test procedures shall be provided to BART engineer for approval.
- M. Seismic Qualification Certification:
 - 1. Submit a "Functional Seismic Qualification" certificate of compliance for critical equipment components and systems and their support structures showing that they meet the requirements of CBC and ASCE 7 for equipment that must remain operable following the design earthquake. Qualification shall be in accordance with CBC for designated seismic systems, including ASCE 7 Section 13.2.1 and Section 13.2.2 subparagraph 1, and requirements specified in Article 1.08, herein.
 - 2. The critical equipment in the DC Battery System is the battery assembly which consists of batteries, battery racks, or battery cabinets.
 - 3. The design earthquake parameters for the equipment seismic qualification at the site locations are specified in Article 1.08, herein. Unless equipment is rigidly mounted, dynamic amplification shall be taken into account per the CBC and ASCE 7 in determining the design seismic demands, including consideration of mounting location and supporting structure response.
 - 4. Certifications shall be prepared and sealed by a professional civil or structural engineer registered in the State of California.
 - 5. Submit supporting documentation including, but not limited to, shake table test report, structural analysis report, and experience data report used as the basis for the seismic qualification certificates of compliance.

- N. Structural Calculations: Submit structural design calculations of the equipment support components and their anchorage not included in the seismic qualification certification as defined in Article 1.05M, herein, to demonstrate adequacy of the system under the design loads specified in the CBC and Article 1.08, herein. Calculations shall be prepared and sealed by a professional civil or structural engineer registered in the State of California. The special inspection and test requirement of the equipment support including its anchorage shall be specified in the structural design calculations.
- O. Special Inspection Report: Submit special inspections report performed by independent testing agency for equipment seismic qualification inspection and support anchorage installations specified in Article 1.08, herein.

1.06 QUALITY ASSURANCE

- A. Battery and charger components, devices and accessories shall be listed and labeled as defined in NFPA 70. The system and component shall conform to IEEE 485, IEEE 1184, NEMA 250, UL 489, NEMA PB1, and UL 67. Batteries shall be new and manufactured no more than six months prior to installation.

1.07 DELIVERY, STORAGE AND HANDLING, DISPOSAL, RECYCLE

- A. Batteries shall be delivered in secured moisture proof package and per manufacture’s shipping requirements.
- 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 the time of shipment.
- C. Receipt of proper disposal of hazardous waste material and waste recycle, such as recycle evidence, shall be submitted to the Engineer.
- D. Place batteries on charger for storage times exceeding one month.

1.08 SEISMIC REQUIREMENTS FOR EQUIPMENT

- A. Seismic Design Parameters based on California Building Code:
 1. Seismic Design Category D,
 2. Component Importance Factor, $I_p= 1.5$,
 3. Design earthquake spectral response acceleration parameter at short period, Short Period Design Spectral Response Acceleration (S_{DS}) shall be determined based on procedures defined in latest CBC.

B. Certification Requirement

1. Active or energized equipment shall be certified exclusively on the basis of shake table testing in accordance with ICC-ES AC 156, performed by an independent laboratory having accreditation to ISO 17025. Use of experience data is not an acceptable alternative to shake table testing. The following components may be exempt from shake table testing, provided their supports and attachments can be demonstrated to be in accordance with ASCE 7-10 and CBC using the seismic design parameters specified above: pipes, ducts, conduits, cables, cable trays, and raceways, excluding in-line equipment and components.
2. As required by ICC-ES AC 156, the configuration of mounting to the shake-table shall simulate the actual service mounting conditions for the product. For a multicomponent system, where individual components are certified by tests, connecting elements, attachments, and supports can be justified by supporting analysis by a California registered professional engineer. The flexibility of the supporting structure in the component to point of anchorage shall be replicated in the test setup; alternatively, the input motions for the test setup may be modified to account for this flexibility using a rational analytical method. See Section 4.5.2 of AC 156.
3. In accordance with AC 156, shake-table tests of representative specimens of a product line may be used in lieu of testing the specific model of equipment to be used in service. A minimum of two representative equipment/components shall have been tested for a product line with similar structural configuration, provided the mounting configurations simulate the actual service mounting conditions for the product.
4. Functionality testing: The equipment shall be functionally tested pre- and post-seismic testing, to demonstrate that the essential operational and control features of the equipment that are needed to maintain post-earthquake functionality. The essential operational and control features of the equipment shall be identified in advance of the shake-table testing, including the functionality testing methods and functionality acceptance criteria.
5. The shake table test input shall be based on the following parameters as defined in AC 156:
 - a. $A_{FLX-H} = S_{DS}$
 - b. $A_{RIG-H} = 0.4 S_{DS}$
 - c. $A_{FLX-V} = 0.67 S_{DS}$
 - d. $A_{RIG-V} = 0.27 S_{DS}$
6. Inspection: The following inspections related to the seismic qualification of equipment, and installation thereof, shall be performed by an independent inspection and testing service:
 - a. Verify that the label and anchorage or mounting conforms to the certificate of compliance.

- b. Inspection and testing of the anchorage installation as required in the certificate of compliance and/or structural design calculations of mechanical and electrical equipment.

1.09 PROJECT/SITE CONDITIONS

- A. The batteries and battery charger shall be suitable for the operation under the following conditions:

Ambient Temperature Ranges:

- 1. Minimum temperature 19.4 degrees Fahrenheit
- 2. Maximum daily temperature 104 degrees Fahrenheit
- 3. Maximum daily average temperature 86 degrees Fahrenheit

1.10 WARRANTY

- A. A warranty for the batteries and the battery charger shall be provided and signed by the manufacturer and installer agreeing to correct the deficiencies and replace components fail in materials or workmanship.
- B. Batteries shall have full warranty of three (3) years from the date of the battery is placed in service and additional warranty of seven (7) years, pro rata, to deliver not less than 90 percent of its rated capacity.

PART 2 – PRODUCTS

2.01 SYSTEM REQUIREMENTS

- A. General:
 - 1. The battery systems shall include batteries, battery charger, battery racks, disconnect switch, dc distribution panel, and related accessories as specified herein.
 - 2. Refer to Specification Section 26 34 37, Uninterruptable Power Supply (UPS) for Battery Rectifier/Charger specifications.
 - 3. Battery system shall be installed in a ventilated room. An exhaust ventilation system composed of fan, ducting and a hood properly sized, shall be provided to remove all potentially hazardous gases from the battery racks in compliance with the National Electrical Code (NEC) and National Fire Code (NFC) and vent it directly to the outdoors.
 - 4. A battery containment system with neutralizing pads shall be installed in compliance with the National Electrical Code (NEC) and the National Fire Code (NFC).

5. Provide the air flow sensors and associated electronics and monitoring circuits which will provide local alarming and remote alarming to Operation Control Center (OCC) via Supervisory Control And Data Acquisition (SCADA).
6. Battery system shall be sized to provide additional 20 percent capacity over the calculated equipment power.
7. The battery system shall be installed for ease of maintainability. All interface cables and accessories for batteries and battery cabinets shall be provided for installation as a complete system. If slide tray is used, each battery slide tray shall be automatically disabled from the system when slide tray is pulled for service.
8. Batteries shall be designed to comply with UL standards. Battery selection, sizing, installation, maintenance, testing, and replacement shall be performed per relevant IEEE guidelines and recommended practices. If an IEEE guideline or recommended practice does not exist for a particular battery type, written approval from the Engineer shall be required.

B. Manufacturers:

All components of each system shall be supplied by one manufacturer. Battery components shall be manufactured by following:

Lead Acid Batteries:

1. Eastpenn
2. C and D Power System
3. Yuasa-Exide Power Inc
4. Or Approved Equal

Lithium Ferrophosphate Batteries (LFP, also known as LiFePO₄)

1. Ampetus
2. Valence
3. BYD
4. Or Approved Equal

C. Lead Acid Batteries:

1. The batteries shall be of heavy-duty, sealed, and maintenance-free design with solid copper, lead-plated posts in individual cells. The batteries shall have the following:

- a. The battery cells shall be sealed valve regulated lead acid type (VRLA) (Gel or AGM (Absorbent Glass Mat)) with a minimum of ten (10) years of life under normal usage.
- b. The battery consists of individual cells. The case of each individual cell shall be molded, flame-retardant, durable and impact resistant.
- c. The battery cell posts shall be bolted with lead plated copper bars using stainless steel hex-head nuts.
- d. The batteries shall consist of sufficient number of cells to provide nominal floating voltage as specified in the Contract.
- e. The battery capacity shall be sized in accordance with IEEE 485. Establish the required capacity in rated ampere-hours (as specified for that location) discharge voltage 1.75 V per cell at 77 degrees Fahrenheit.
- f. No venting of any gas under normal operation.
- g. Each individual battery cell shall be equipped with self-resealing flame arresting safety vents.
- h. Batteries shall be fully charged upon arriving to the project location.
- i. Batteries shall be stored in a temperature controlled area of 65 degrees Fahrenheit plus or minus 5 degrees Fahrenheit, and on trickle charge when not in service.

D. Lithium Iron Phosphate (LFP, also known as LiFeP04)

1. The battery modules shall be of heavy-duty, maintenance free design with solid copper or solid brass terminals in individual modules. The batteries shall have the following:
 - a. The battery cells shall be LFP type with a minimum of fifteen (15) years of life under normal usage.
 - b. The battery consists of individual cells in molded, flame-retardant, durable and impact resistant modules. Battery modules shall have integrated, micro-processor based cell balancing and protection against thermal runaway.
 - c. The battery cell posts shall be connected with bolted copper bars or bolted copper battery cables using stainless steel hex-head nuts. Other locking connectors may be used with Engineer approval.
 - d. The batteries shall consist of sufficient number of cells to provide nominal floating voltage as indicated.
 - e. Establish the required capacity in ampere-hours (as specified for that location) considering the corresponding rated capacity of the battery modules at 105 degrees Fahrenheit. Battery system capacity calculations shall be completed in accordance with the battery manufacturer's recommendations.
 - f. Batteries shall be fully charged upon arriving to the project location.

- g. Batteries shall be stored in a temperature controlled area of 65 plus or minus 5 degrees Fahrenheit, and held at 40 percent State of Charge when not in service.
- h. Receipt of proper disposal of batteries and recycle certificate shall be submitted to the Engineer.

E. Ratings:

- 1. The battery voltage rating shall be as indicated with a tolerance of plus 15 percent or minus 10 percent. Battery shall have ampere-hour capacity to provide rated power to all connected equipment and devices for as specified hours.
- 2. The battery shall be able to retain full capacity during long term float service without maintenance.
- 3. The battery shall be sized to provide full operation as specified in the Contract at 122 degrees Fahrenheit ambient without charger.
- 4. Complete battery system dimensions as specified in the Contract.

F. Cell Containment:

- 1. The individual cell housing shall be heat-resistant and shall not deteriorate or become cloudy upon exposure to the electrolyte.
- 2. The covers shall be cemented in place to provide a permanent leak-proof seal.
- 3. Cell terminal posts shall be clearly and permanently identified.

G. Name Plate:

- 1. Each battery shall be legibly and permanently marked with the following:
 - a. Manufacturer's name
 - b. Battery and cell type
 - c. One-minute, one-hour, and eight-hour ampere ratings
 - d. Month and year of manufacture
 - e. Ampere-hour capacity for as specified hours

H. Accessories:

- 1. Any manufacturer's special tools for removal and replacement of batteries shall be provided.
- 2. Each battery slot shall have identification number for its position in the string.
- 3. Battery log-book.
- 4. One (1) rack mounted thermometer for battery ambient temperature.

5. Each battery module shall have identification label for each corresponding location and date of installation.

I. Battery Charger:

1. Battery chargers shall be fully regulated with power semiconductor devices, convection-cooled, constant-voltage type complying with NEMA PE 5. The charger shall be rated for operation in the voltage level, number of phases, and designed consistent with its voltage and current rating.
2. 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.
3. Battery charger shall be rated as follows:

a. Capacity	In accordance with its associated battery size and continuous DC load
b. Recharging	Shall be able to recharge the fully discharge battery capacity as soon as safely possible without compromising the battery life. The rate of charging current to the battery module shall be such that it will not overheat the batteries and consistent with battery manufacture's specifications for its safe operation.
c. Output current	In accordance with its battery size and continuous DC load.
d. Regulation	+ 1 percent of output DC voltage over its complete load range with + 10 percent variation of input AC voltage.
e. Current limiting	For trickle chargers: adjustable from 90 to 115 percent, factory set at 110 percent of output normal current rating.
f. Voltage Regulating	For float chargers: adjustable from 90 to 115 percent factory set at 110 percent of output normal voltage rating.
4. The battery chargers shall be equipped with the following features:
 - a. One DC voltmeter (voltage as specified in the contract)
 - b. One DC ammeter, range as applicable
 - c. One AC input pilot light marked AC POWER ON.
 - d. Float-equalize switch
 - e. Float and equalizing voltage adjusting potentiometer

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- f. Two ground detection alarm relays, positive and negative, for local and remote supervisory annunciation.
 - g. Output AC ripple shall be limited to 2 percent at max charging current at battery charger.
 - h. AC input molded case circuit breaker, UL 489
 - i. DC output molded case circuit breaker, UL 489
 - j. Output DC failure alarm relay, for local and remote supervisory annunciation (SCADA)
 - k. AC failure alarm relay, for local and remote supervisory annunciation
 - l. Surge and transient protection
 - m. DC high-low voltage alarm relay
 - n. DC output thermal-magnetic circuit breaker
 - o. Battery monitoring system shall provide early warning of battery failure and equalization of charge current to each battery cell
 - p. Space heaters, as required
- J. Trickle Battery Charger (Constant Current Charger):
- 1. Trickle charger shall only be provided with lead acid batteries.
 - 2. Trickle charger shall be provided to charge the battery when main charger is not available. When a battery string is integrated with a UPS system then the trickle charger shall be disconnected.
 - 3. Trickle battery charger shall be provided for each battery string.
 - 4. The trickle battery charger shall stop the charging automatically after the batteries are fully charged.
 - 5. The trickle charger shall be 120 V AC or 208 V AC, 60 Hz single phase input. The output shall be consistent with the battery string voltage.
- K. Float Battery Charger (Constant Voltage Charger):
- 1. Float charger shall only be provided with lithium batteries.
 - 2. Float charger shall be provided to charge the battery when main charger is not available. When a battery string is integrated with a UPS System, then the float charger shall be disconnected.
 - 3. Float battery charger shall be provided for each battery string.
 - 4. The float battery charger shall stop charging automatically after the batteries are fully charged.

5. The float charger shall be 120 V AC or 208 V AC, 60 Hz single phase input. The output shall be consistent with the battery string voltage.

L. Emergency Eye Wash:

1. Provide an eye wash in accordance with Contract Specifications Section 22 40 00, Plumbing Fixtures.

M. Disconnect Switch and Circuit Breaker:

1. A two-pole hand-operated disconnect switch shall be provided between the battery and the battery charger.
 - a. The rating of switch shall be coordinated with the dc output circuit breaker of battery charger.
 - b. The disconnect switch shall be mounted in a surface mounted NEMA Type 12 enclosure.
 - c. The disconnect switch shall be provided with two normally open (NO) and two normally closed (NC) contacts for monitoring and interlocks.
2. Circuit breakers shall be UL 489 molded case, quick-break, bolt on type, with thermal-magnetic type overload trip, suitable for AC/DC operations.

N. DC Distribution Panelboards:

1. General:
 - a. The DC distribution panel boards (if required) shall comply with the requirements of UL 67, NEMA 250, UL 489 and NEMA PB 1.
 - b. Each distribution panel board shall contain a main power circuit breaker and branch circuit breaker with spacer blanks and bus provision for future branch circuit breaker installation, as shown on Contract drawing.
 - c. The panel board shall be in NEMA Type 1 door-in-door enclosure made of galvanized steel, for surface mounting with multiple knockouts and wiring gutters.
 - d. Each distribution panel board shall be provided with a swinging door with full length piano hinge and a flush spring latch.
 - e. The open door shall expose the dead front circuit breaker handle and circuit breaker card directory.
 - f. Interior component shall be mounted on back plate of reinforce steel for rigid support and accurate alignment.
 - g. A moisture resistance circuit identification chart shall be furnished and attached to the inside face of the cover.
 - h. Fuses: If DC loads are used from the battery system, such loads shall have a fuse to protect the battery system and load.

2. Electrical Requirements:

- a. The panel boards shall be rated for short circuit of 10,000 amperes interrupting rating minimum and be equipped with two pole molded case circuit breakers and positive and negative bus bars.
- b. Bus bars shall be ASTM B187/B187M, 98 percent conductive copper, with silver plated contact surface.

O. Finishes:

1. The battery racks shall be treated with at least two coats of alkaline gray paint.
2. The distribution panel shall be cleaned, primed and finish painted in accordance with the manufacture's standard specifications, suitable for indoor service. The color of exterior finish paint shall be ANSI 61 gray polyester powder finish or equal unless otherwise directed by District.

P. Source Quality Control:

1. General

- a. Notification of Test: The District shall be notified not less than 30 Days in advance of scheduled test dates. Test procedure shall be approved by the District prior to the dates of schedule tests.
 - b. Test Program Plan: Submit a plan identifying the approach to be used for accomplishing the required shop tests. The projected schedule for the test and test execution, and submittal of the test results shall be included.
 - c. The test procedures shall include as a minimum:
 - 1) Objective and scope
 - 2) Test set up
 - 3) Test equipment to be used
 - 4) Personnel required for the test
 - 5) Estimated duration of the test
 - 6) Pass/fail criteria
 - 7) Samples of data sheets to be used.
 - 8) Test procedures shall be submitted not less than 30 Days prior to test.
2. Test Results: Test results will be reviewed and accepted by the District representative as submittal or additional tests are required. If additional tests are required because the test results submitted do not comply with the requirements of the specifications, the retesting is to be documented and submitted to the District as a part of the work.
3. Test Reports: Test reports shall document the results obtained and be certified by manufacturer. Report shall include the following:

- a. Equipment tested including model and serial numbers
 - b. Title of the test
 - c. Objective of the test and pass/fail criteria
 - d. Summary and conclusion
 - e. Location and date of test
 - f. Test methods and equipment used for the test
 - g. Results including calculations and other supporting data
 - h. Abbreviations and references
 - i. Signature of the test supervisor and witnesses.
4. Test Witnessing: The District reserve the right to witness all tests including factory tests conducted elsewhere by Contactor, its suppliers, or by an independent agency. If District determines not to witness a test or tests, test report shall be submitted to District for review. Test reports shall be signed by all witnessing parties.
5. Test Equipment: Provide annually certified calibrated test equipment, instruments, tools and other required items necessary to perform the test indicated.

Q. Replacement Materials:

1. Replace or repair equipment, parts and materials that are rejected, damaged, lost, or consumed during performance of shop tests. Replacement materials shall be new and warranted.

R. Factory Tests:

1. Factory test shall include design and production tests performed by the Contractor, its supplier, or a testing agency prior to the 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 design tests which are to be waived.
2. Factory test shall be performed to include the following tests for the DC control power supply.
 - a. Temperature rise test
 - b. Power loading at 100 percent capacity for 24 hours at 89.6 degrees Fahrenheit and 90 percent humidity.

S. Acceptance Tests:

1. The Contractor shall perform minimum one hour load testing to verify the battery discharge rate is consistent with the specified battery run time.

PART 3 – EXECUTION

3.01 INSTALLERS

- A. The Contractor shall install the battery and battery charger including the associated devices in the train control battery rooms or other BART facilities with the manufacturer's recommendations and as indicated.

3.02 INSTALLATION

- A. The installation of DC distribution panelboards shall comply with the requirements of NEMA PB 1.1
- B. Battery and Battery Charger:
1. The battery and rack assembly shall be arranged to provide easy access to each battery cell or module for maintenance and replacement.
 2. The cables or the bus bars between battery cell or module shall be securely connected.
 3. The battery charger shall be installed as indicated on the Contract Drawings.

3.03 FIELD QUALITY CONTROL

- A. Power distribution test shall verify that the energy at all level is available and is properly distributed to the equipment requiring power in the train control rooms and other BART facilities. The test shall include verification:
1. No grounds, short circuits, open circuits, or misplaced wiring exists in the power distribution system.
 2. Standby, reserve and battery power circuitry are complete and operate properly.
 3. Output AC power supplies, provide the correct voltage levels and phasing where required, record voltages.
 4. Output DC power supplies, provide the correct voltage levels and correct polarity, record voltage and loads.
 5. Adjustable transformer or voltage regulators are adjusted correctly.
 6. Ground fault detectors are operating correctly.

3.04 CLEANING

On completion of installation, the Contractor shall inspect the battery and battery charger and ancillary equipment. The contractor shall remove paint splatter and other spots. The Contractor shall remove excess materials, vacuum dirt and debris. The Contractor shall repair any damage or scratches to exposed surfaces to match original finish.

3.05 DEMONSTRATION

A factory authorized service representative shall demonstrate operation of equipment for the District's maintenance personnel to adjust, operate and maintain DC power system controls, protective devices, instrumentation and accessories.

END OF SECTION 26 33 01