Section 16: STORAGE BATTERY

16.0 SCOPE

16.0.1 General

16.0.1.1 This specification covers the technical and associated requirements for a storage battery or storage batteries for use in electric power generating stations, switchyard and substations.

16.0.1.2 It is not Owner's intent to specify all technical requirements nor to set forth those requirements adequately covered by applicable codes and standards. Contractor shall furnish a high quality storage battery or batteries meeting the requirements of these specification and industry standards.

16.0.1.3 The Contractor shall bear the full responsibility that the equipment has been designed and fabricated in accordance with all codes, standards, and applicable governmental regulations and performs under the conditions and to the standards specified herein.

16.0.1.4 No departure shall be made from these specification and standards unless waived or modified in writing by the Owner. The Contractor shall obtain from its subcontractors a statement as to compliance with this specification without exception and/or if there are any exceptions, these shall be described in detail and included in Contractor's proposal. The Contractor shall add a statement that no other exceptions are taken to this specification.

16.0.2 Works to be Provided by the Contractor

16.0.2.1 The Contractor shall provide the equipment, accessories and services delineated in Paragraph A.2, Section 1 of the Technical Data Sheets.

16.0.3 Works to be Provided by Owner

16.0.3.1 Owner shall provide the materials and services listed in Paragraph A.2, Section 1 of the Technical Data Sheets.

16.1 CODES AND STANDARDS

16.1.1 General

16.1.1.1 The equipment furnished shall be in accordance with, but not limited to, the latest issues of the following codes and standards, including all addenda, in effect at time of purchase order unless otherwise stated in this specification:

ANSI/IEEE American National Standards Institute and/or Institute of Electrical & Electronic Engineers

C18.1	Specification for Dry Cells and Batteries
Z55.1	Gray Finishes for Industrial Apparatus and Equipment (NO. 61 Light Gray and No. 24 Dark Gray)
450	Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations

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NGCP Standard SpecificationPart 1: Substation Equipment & MaterialsStorage BatterySB-2			
	484	Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations	
	485	Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations	
IEC	International I	Electrotechnical Commission (all parts of listed Standards apply)	
	60623 60896	Nickel Cadmium Batteries Stationary Lead Acid Batteries, General Requirements and Methods of Test	
ISO	International	Standards Organization	
	9001	Quality System Model for Quality Assurance in Design/Development, Manufacture and Testing	
	9002	Quality System Model for Quality Assurance in Production, Installation and Servicing	
NEMA	A National Electrical Manufacturer's Association		
	IB 1	Definitions for Lead Acid Storage Batteries	
NEPA	National Fire Protection Association		
	70	National Electrical Code - Article No. 480	
UL	Underwriters Laboratories Incorporated		
	486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors	
UBC	Uniform Buil	ding Code of the International Conference of Building Officials, Earthquake Regulations	

16.1.1.2 These codes and standards set forth minimum requirements which may be exceeded by Contractor if, in Contractor's judgment and with Owner's acceptance, superior or more economic design or materials are available for successful and continuous operation of Contractor's equipment as required by this specification.

16.2 TECHNICAL REQUIREMENTS

16.2.1 Description of Services

16.2.1.1 The storage batteries covered by this specification will be used to supply dc power under continuous and emergency conditions for the dc power system listed in the Technical Data Sheets of Storage Battery. The batteries shall be complete in all respects and shall be furnished with all required accessories.

16.2.1.2 All materials and parts which are not specifically mentioned herein but are necessary for proper erection, assembly and safe operation of the battery system shall be identified and furnished by the Contractor and included in the price for the battery system.

16.2.2 Design Requirements

16.2.2.1 Service conditions under which each battery shall operate satisfactorily and deliver the specified capacity are listed in Section 1 of the Technical Data Sheets.

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16.2.2.2 The Contractor shall furnished batteries as described in the Technical Data Sheets of Storage Battery. The batteries shall comply with Article 480 of NEPA 70.

16.2.2.3 The batteries are required to supply power in case of emergency, the various substation equipment and auxiliaries as shown in the bid drawings. The batteries must have sufficient AH capacity to supply power to these equipment including future extensions and/or additions to the substations at an hour discharge rate described in the Technical Data Sheets of Storage Battery.

16.2.2.4 The batteries shall be fully charged and stabilized at the open circuit voltage just prior to the commencement of the duty cycle.

16.2.2.5 Each battery shall perform in accordance with the requirements of its respective duty cycle at any time including the end of its service life. In this context, end of service life is defined as the time at which the battery capacity is 80% of Contractor's initial rating.

16.2.2.6 De-rating factors for the specified service conditions shall be applied in addition to the aforementioned requirements.

16.2.2.7 The nominal system voltage for each battery is provided in the Technical Data Sheets of Storage Battery. Each battery is for use in an ungrounded system unless otherwise noted in the Technical Data Sheets.

16.2.3 Design and Construction Features

16.2.3.1 The cell jars shall be of transparent impact-resistant heavy duty SAN Plastic (polypropylene (PP)) material to allow check of electrolyte level through the cell wall.

16.2.3.2 High and low electrolyte level lines shall be permanently marked on all four sides of cell and/or monobloc (multicell) units.

16.2.3.3 Sediment space shall be adequate to permit unimpaired operation of the battery despite material accumulation throughout its guaranteed life. Cell design shall accommodate plate growth such that jar will not crack.

16.2.3.4 Cells shall be vented. The vent plugs shall form a tight seal within the vent opening and prevent electrolytic creepage or dust and foreign matter entrance. The vent plug shall be the explosion resistant type and shall have external gas recombinator plug. No top-up of electrolyte is required.

16.2.3.5 Plates shall be supported so that no undue stress is placed on the jar or cover during the life of the battery. Supports shall be bottom supports. Negative and positive plates shall be matched. The life of the negative plate shall be equal to or greater than that of the positive plate. The plates shall be reinforced as needed to retain their shape and shall have the necessary conducting material to maintain low internal resistance to carry the current to or from all parts of the plate under all operating conditions. Separators shall be impervious to the chemical action within the cell. They shall provide proper spacing and insulation between the plates and permit free circulation of electrolyte.

16.2.3.6 The battery whether wet or dry charged shall be furnished complete with electrolyte. The specific gravity of the electrolyte in the lead-acid batteries at 25 degree shall be as specified in the Technical Data Sheets of Storage Battery.

16.2.3.7 The Contractor shall furnished connectors for connecting the cells and tiers of the battery. The connectors and bolts shall be designed for a temperature rise not exceeding 30 degree above a rated ambient of 40 degrees when conducting a sustained one hour current equal to the battery one hour discharge rate and continuous current equal to the battery discharge rate described in the Technical Data Sheets of Storage Battery. Connectors shall be fully insulated, including bolt. The use of plastic or PVC covering for insulation is not allowed.

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16.2.3.8 All current-carrying parts, such as terminal bolts, links and connections shall be adequately protected to a degree of protection of at least IP20 (IEC 60529 or equivalent ANSI/IEEE Standard) to prevent personnel from coming into contact with the battery system. However, provision shall be made for measuring the cell voltages without removing such protection.

16.2.3.9 The voltage drop of all connectors in series shall be not be more than one volt while carrying the one hour discharge current.

16.2.3.10 Connectors shall meet the requirements of UL 486A or ASTM D.

16.2.3.11 Intercell connectors shall provide a sufficient spacing between cells for periodic cleaning of cell sidewalls to eliminate traces of acid spillage, etc. The inter-tier connections shall be properly insulated and the arrangement shall be subject to Owner's review. Inter-tier shall be fully insulated including bolt.

16.2.3.12 The terminal cells shall be provided with connectors (essentially, terminal plates, and terminal lugs) for copper cables as specified in the Technical Data Sheets for the Storage Battery. Appropriate size of terminal lugs for the power cable and ground cable for battery rack, shall be provided by the Contractor. Sample of terminal lugs, shall be furnished for approval by the Owner. Only female insert terminal pole is required.

16.2.3.13 Solid copper connectors, terminal plates, and terminal lugs shall be lead plated for leadacid batteries. They shall be insulated, rubber molded copper connector.

16.2.3.14 To allow easy monitoring of the battery cells electrolyte, the Contractor shall furnish staggered design battery racks made of corrosion resistant steel, properly insulated and painted. They shall consist of no more than two (2) steps or as specified in the Technical Data Sheets. The staggered racks shall be complete with all necessary steel frames, fittings, rails and braces, plastic insulating channels, plastic spacers and hardware. The paint shall resist the corrosive effects of the battery electrolyte. The racks shall be designed to permit the mounting of the batteries as easy as possible. The design shall also consider the easy maintenance of the batteries.

16.2.3.15 Each rack shall have a grounding pad and a lead plated terminal lug suitable for ground cable specified in the Technical Data Sheets for the Storage Battery.

16.2.3.16 If rack are shipped knocked down, all parts shall be numbered or match-marked to facilitate field assembly.

16.2.4 Accessories

16.2.4.1 The Contractor shall furnish and ship with each battery system any and all accessories which are essential for proper installation, operation and maintenance. The accessories shall include, but are not limited to the following:

- a. Vent-plug-mounted hydrometer syringe
- b. Portable hydrometer syringe
- c. Vent-plug-mounted thermometer
- d. Battery cell voltmeter with shunt load resistor (2 percent accuracy with +/-3 volt scale)
- e. Goggles
- f. Plastic face shield
- g. Acid proof gloves
- h. Apron
- i. Overshoes
- j. A quantity of bicarbonate of soda

16.2.4.2 Contractor shall furnish, as part of the whole supply for the battery system, <u>a wall mounted</u> storage cabinet for the accessories

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16.2.5 Other Technical Requirements for the Battery System

16.2.5.1 Other technical features for the battery system, if required by the Owner are stated in the Technical Data Sheets of Storage Battery.

16.3 INSTALLATION

16.3.1 Installation will be by Contractor unless specified otherwise in Paragraph A.2, Section 1 of the Technical Data Sheets.

16.3.2 The complete details of proper handling, transport and storage, installation, testing, commissioning, performances guarantees, etc. for the battery system shall be furnished by the Contractor for Owner's review and approval.

16.4 TESTS

16.4.1 Material Tests

16.4.1.1 All materials shall comply with test criteria, and Owner acceptance of the equipment shall not relieve Contractor of his responsibility for meeting all the requirements of this specification. The Contractor shall carry out at his own expense all tests necessary to ensure the satisfactory design and manufacture of storage battery in accordance with ANSI/IEEE or IEC equivalent.

16.4.2 Shop Test

16.4.2.1 The weight of each positive and negative plate shall be measured before assembly. The tolerance shall not exceed \pm 1.0 percent.

16.4.2.2 Contractor shall designate the permanent pilot cell on the basis of the test results for each battery's permanent record. If the battery is shipped wet, it shall be the cell with the lowest specific gravity after the battery is installed but not yet charged. If the battery is shipped dry, it shall be the cell indicating the lowest voltage while on charge. In addition, approximately 10 percent of the battery's cells shall be selected at random as permanent sample cells.

16.4.2.3 The following production tests shall be performed for batteries to be shipped wet:

- a. Cell voltage measurement. The tolerance shall not exceed ± 0.01 volts.
- b. Electrolyte gravity measurement simultaneously with a. The tolerance shall not exceed <u>+</u> 0.01.
- c. Cell jar leakage test. The cell shall be pressurized with air and for one hour the pressure shall remain constant.

16.4.2.4 If the battery is shipped dry, the battery test shall be made at the factory. For this test, the Contractor shall produce 5 percent extra cells in the same production run as for the battery and perform the tests on the extra cells.

16.5 DATA AND DOCUMENTATION REQUIREMENTS

16.5.1 General

16.5.1.1 Contractor furnished data and information shall be the guaranteed performance data,

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predicted performance, interface requirements and construction features of all Contractor's furnished equipment. The accuracy of such information and its compatibility with overall performance requirements specified by Owner are the sole responsibility of the Contractor.

16.5.1.2 All information submitted as part of Proposal Data will become part of contract data for successful bidder. Any deviation from such data requires Owner's approval.

16.5.2 Data and Information to be Submitted with the Proposal

16.5.2.1 In addition to other information requested, the Contractor shall furnish the following information as part of the proposal for the batteries:

- a. Filled-in Technical Data Sheets of Storage Battery;
- b. Sufficient illustrative and descriptive material (such as catalog, drawings, etc.) to allow a detailed evaluation of the Storage Battery being proposed;
- c. ISO 9001 Certification of the proposed manufacturer;

NOTE: If the manufacturer of the Storage Batteries is already in the accredited list of manufacturers, the Bidder does not need to submit Items (b) and (c).

16.5.3 Data and Information to be Submitted After Award of Contract

16.5.3.1 After award of the contract, the Contractor shall furnish drawings and data, in quality and quantity as specified herein and in purchase order, for Owner's review and acceptance as follows:

- a. Installation drawings showing batteries, interconnections, rack outline, dimensions required for mounting, weight of rack and filled cells, and description of rack finish for each battery system;
- b. Cell outline including connector and battery terminal details, electrolyte levels, weight of assembled cell, separate weights of electrolyte, plates and jar;
- c. Type, catalogue designation and description of major components furnished by Contractor;
- d. Battery arrangement;
- e. Complete design calculations;
- f. Discharge graph for assumed pre-defined emergency case;
- g. Length of time batteries can be stored if shipped dry charged and/or charged wet. Also, Contractor's storage recommendations.
- h. Recommendations for tests after delivery including field tests and performance;
- i. List of drawings and schedule of submittal;
- j. Instructions covering installation, operation and maintenance;
- k. Final Technical Data Sheets conforming to the specification;
- I. Final Drawings as approved.

16.5.3.2 The Contractor shall provide in the manner, number of copies, and within the time set forth in the purchase order, Instruction Manuals in accordance with Paragraph 1.8, Section 1 - General Administrative Requirements, Part 1 of the Technical Specifications.