Engineering Standard

SAES-T-151 15 June 2018

Telecommunications D.C. Power Systems

Document Responsibility: Communications Standards Committee

Contents

Previous Issue: 20 April 2014 Next Planned Update: 15 June 2021

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1 Scope

This standard provides the minimum mandatory requirements of Communications Power Systems for the use in Saudi Aramco telecommunications facilities.

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Coordinator.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-302	*Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-B-069	*Emergency Eyewash and Showers*
SAES-K-002	*Air Conditioning Systems for Essential Operating Buildings*
SAES-K-003	*HVAC Systems for Communications Facilities and Data Centers*
SAES-P-100	*Basic Power System Design Criteria*
SAES-P-103	*UPS and DC Systems*
SAES-P-104	*Wiring Methods and Materials*
SAES-P-123	*Lighting*
SAES-S-060	*Saudi Aramco Plumbing Code*
SAES-T-795	*Communications Facility Grounding Systems*

Saudi Aramco Materials System Specifications

17-SAMSS-511 *Stationary Storage Batteries*

17-SAMSS-514 *Rectifier/Charger*

General Instruction

GI-0355.003 *Disposing of Hazardous Material*

3.2 Industry Codes and Standards

Institute of Electrical and Electronics Engineers, Inc.

IEEE 485 *Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations, Rev 2010*

National Electrical Manufacturers Association

NEMA PE-7 *Communications Type Battery Chargers*

National Fire Protection Association

NFPA 70 *National Electrical Code*

Underwriters Laboratories, Inc.

UL 924 *Emergency Lighting and Power Equipment*

4 Design

4.1 Battery Installation

4.1.1 Working space of at least 1 meter shall be provided in front of each battery rack or enclosure.

4.1.2 Batteries shall be supplied with covers for all inter-cell connecters and terminals or insulated copper busbars to enhance safety.

4.1.3 Battery enclosure requirements shall comply with SAES-P-103 standard.

4.2 Battery Rooms

4.2.1 Typical battery room design requirements shall comply with SAES-P-103 standard.

4.2.2 Battery room location shall comply with SAES-P-103 standard.

4.2.3 Battery room electrical area of classification shall comply with SAES-P-103 standard.

4.2.4 Battery room lighting requirements shall comply with SAES-P-103 and SAES-P-123 standards.

4.2.5 Battery Rooms – Ventilated

4.2.5.1 The battery rooms shall be ventilated to the outside air by forced ventilation to prevent accumulation of hydrogen and to maintain design temperature.

4.2.5.2 The ventilation system designed for hydrogen concentration shall comply with SAES-P-103 standard.

4.2.5.3 The maximum hydrogen evolution rate shall comply with SAES-P-103 standard.

4.2.5.4 Each vented cell shall be equipped with a flame arrester that is designed to prevent destruction of the cell due to ignition of gases within the cell by an external spark or flame under normal operating conditions", see NFPA 70 as reference.

4.2.5.5 Battery rooms shall be vented to the outside air. Ventilation shall provide at least one complete air change every three hours as a minimum. Return air ducts of air conditioning systems from a battery room are prohibited. Refer toSAES-K-002 or SAES-K-003 standards.

4.2.5.6 A battery room which meets the ventilation requirements of sections 4.2.5.1 and 4.2.5.2 at all times is considered to be a non-classified area. Therefore, special electrical equipment enclosures to prevent fire or explosions shall not be required.

4.2.5.7 Emergency eyewash facilities shall be provided as required by SAES-B-069, see SAES-P-103 standard for additional requirements.

4.2.5.8 Interlock between the High-Rate Charge and Ventilation Operation requirements shall with SAES-P-103 standard.

4.2.6 Battery Rooms – Non-ventilated

4.2.6.1 If sealed batteries are used in a sealed battery room (such as a passively cooled communication shelter) the individual cells shall be permitted to contain a venting arrangement or pressurerelease vent to prevent excessive accumulation of gas pressure, or the battery/cell shall be designed to prevent scatter of cell parts in event of a cell explosion.

4.2.6.2 The room for storage batteries (either sealed or non-sealed) shall be provided with ventilation openings located so as to permit the circulation of air for dispersion of hydrogen gas that may be generated under abnormal battery or charging conditions. Openings at seams, joints, and splices in typical fabrication processes plus the use of porous building materials normally will be considered to provide required ventilation for dispersion of battery gases. The use of a manifold system or recombinators may be utilized to reduce the emission of hydrogen. Whenever the adequacy of ventilation is in question, a determination shall be made by measurement of gas concentration as described under Testing and Inspection.

4.2.6.3 The battery room shall be equipped with a hydrogen detection system, smoke and fire detector systems that are having a noticeable alarm. This alarm detection system shall alert personnel of the presence of hydrogen prior to entry into the battery room. The hydrogen sensor shall be installed on the battery room ceiling or located within 155 mm of the ceiling. Placed on the battery room door the following permanent indelible sign shall be provided in both English and Arabic: "Keep Door Open for Five Minutes before Entering". Provide a Multi-purpose Dry-Type Chemical Fire Extinguishers to combat Class A (ordinary combustibles), B (flammable liquids, including oils), and C (electrical fires) events.

4.2.6.4 A battery room which is sealed and does not meet the ventilation criterion of Section 4.2.5 is considered to be a classified area. The battery room shall be considered Class 1, Division 1, Group B, and explosion proof enclosures shall be installed for all appliances in these rooms.

4.2.6.5 Battery room doors shall open outward away from the room. No hasp, padlock or other device shall be installed which will hinder operation of the emergency door.

4.3 Batteries

4.3.1 Batteries selection shall comply with 17-SAMSS-511 standard.

4.3.2 Battery selection shall depend on the type of application.

4.3.2.1 For communication building offices and locations where environment can be controlled by air conditioning systems, batteries such as lead calcium pasted plate batteries are most suitable.

4.3.2.2 For remote locations where air conditioning systems are not adequate and deep cycling is anticipated, batteries such as multitublar lead-antimony or nickel cadmium batteries are most suitable.

4.3.2.3 For special applications, such as passive cooling shelters where ventilation is limited or where a separate battery room or closet is not practical sealed batteries are most suitable. The sealed batteries shall not contain free-liquid electrolyte. The electrolyte shall be in the form of a gel or absorbed within a microporous matrix. Sealed batteries shall comply with testing and construction requirements of UL 924.

4.3.2.4 Additional factors shall be considered in selecting the design life of the battery shall comply with SAES-P103 standard.

4.3.3 Battery Sizing

4.3.3.1 The battery reserve shall be large enough to sustain operation of the communications load under busy hour conditions (hereinafter called “full DC load”).

Battery Sizing		
Full DC load	8 hours	Standby AC power is available
Full DC load	12 hours	Unattended remote offices

The full DC load can be derived from actual measurements of a system if in service, or from estimates based on calculated loads as an alternative. Batteries are sized based on maximum system voltage required, the minimum allowable voltage, and the duty cycle. (Reference: IEEE 485).

Note: *Refer to SAES-P-100 for sizing of the electrical system which will be based upon using 110% of the sum of the operating load plus all known future loads.*

4.3.3.2 Final battery cell voltages shall not be less than 1.75 volts per cell for lead-acid, or 1.1 volts per cell for Nickel Cadmium.

4.3.3.3 The battery reserve shall be sized as determined by the following equation:

$$AH = L \times BT \times TC \times AC \times DF \quad (1)$$

where:

AH - Ampere-hour capacity of battery

L - Full DC load, continuous amperes

BT - Backup time (specified battery reserve, 8 or 12 hours)

TC - Temperature compensation factor , refer to SAES-P-103

AC - Age compensation factor (1.25)

DF - Design factor (1.10)

4.3.3.4 The minimum number of series-connected cells and the end-of-discharge voltage per cell shall be in accordance with SAES-P-103 standard.

4.3.4 Battery Racks - Liquid Cells

4.3.4.1 Configuration of the battery rack is determined by the cell dimension, the number of cells, the dimensions of the battery room, the maximum weight allowance per square foot of floor, and the cell access requirements for periodic maintenance such as adding water to the electrolyte. No compromise shall be made that affects the accessibility of the cells.

4.3.4.2 Maintenance personnel shall be able to service any cell without being crowded by adjacent cabinets or other facilities. All battery racks shall have side and end rails to restrain the battery cells from sliding off the bottom rails.

4.3.4.3 Battery racks specifications, installation requirements and procedures shall comply with SAES-P-103 standard.

4.3.4.4 Grounding and bonding of battery rack shall comply with SAES-P-103 standard.

4.4 Battery Charger

4.4.1 Battery chargers shall comply with NEMA PE-7, Communication Type Battery Chargers, with the following additions:

4.4.1.1 The battery chargers shall have sufficient capacity to carry the full DC load as well as recharging the batteries to 90% capacity in 16 hour's time at locations having a back-up generator and 8 hours at locations without a backup generator.

4.4.1.2 The calculated station full load shall be increased by 10% to provide a nominal allowance for contingency at all locations.

4.4.1.3 A minimum of three (3) battery chargers shall be used at central switching offices (see Section 4.3.2).

4.4.1.4 A minimum of two (2) battery chargers shall be used for remote stations. Each charger shall be capable of carrying the full DC communications load plus 10%.

4.4.1.5 An equalizing timer shall be provided for automatic return to float charge mode.

4.4.2 The full load current rating of each battery charger shall be determined by the following equation:

$$\mathrm{FLC} = \left(\frac{\mathrm{S.F.xL}}{\mathrm{R}-1}\right) + \left(\frac{\mathrm{BIFxAH}}{\mathrm{RxH}}\right) \mathrm{x} \frac{1}{\mathrm{Ka}} \mathrm{x} \frac{1}{\mathrm{Kt}} \quad (2)$$

where:

FLC - Charger Full Load Current rating

S.F. - Service Factor (1.15)

L - Full DC load, continuous amperes

BIF - Battery Inefficiency Factor: 1.15 for lead acid and 1.4 For nickel- cadmium batteries

AH - Ampere-hour capacity of the battery

H - Specified recharge time, hours

R - Number of parallel chargers

Ka - Altitude derating factor:

to 1,000 m	Ka	=	1.00
to 1,500 m	Ka	=	.90
to 3,000 m	Ka	=	.60

Kt - Temperature derating factor:

to 50°C	Kt	=	1.00

to 55°C	Kt	=	.90
to 60°C	Kt	=	.60

Note: *If the charger is used in ambient temperatures higher than 50°C, the charger's DC ampere specification shall be increased using the Kt factor above.*

4.4.3 Battery chargers shall be provided with individual alarms with isolated contact closure for the following conditions:

a) AC failure

b) Charger failure

c) DC Output failure

d) High DC voltage

e) Low DC voltage

f) Breaker Trip (could be integrated with "b" above

g) Equalizer/float mode status

4.4.4 A low voltage disconnect device shall be provided to disconnect the load from a discharged battery and shall be set at 40.6 ± 2.5% volts DC (39-41.6 Vdc) with a 48-volt system and 20.3 ± 2.5% volts (19.8-20.8 Vdc) with a 24-volt system. Additionally, the maximum allowable depth of discharge shall not exceed the manufacturer's specifications.

4.5 Working Space about Batteries (Wet Cells)

4.5.1 The minimum headroom of working space about the battery room shall be 1.98 m from the floor or platform (raised floor) if utilized.

4.5.2 For battery plants enclosed in a battery room, there shall be provided one entrance with measurements not less than 610 mm wide and 1.98 m high.

If only one entrance is provided, the entrance provided shall be so located that the edge of the entrance nearest the battery equipment is a minimum of 914 mm.

4.5.3 Additional working spaces requirements shall comply with SAES-P-103 standard.

4.6 DC Power Distribution

The main control panel of the DC power distribution system shall incorporate a load ammeter, ammeter shunt, battery voltmeter, alarm circuits, voltage control circuits, alarm/status indicating lamps and control breakers and shall comply with 17-SAMSS-514.

4.7 Uninterruptible Power Supply (UPS)

4.7.1 Redundant system shall be used on critical communications facilities where operation damages can occur during the period of surges or power source failure.

4.7.2 Additional requirements for UPS system shall comply with SAES-P-103 standard.

5 Installation

Wiring and Grounding

5.1 Wiring shall be in accordance with NFPA 70 (National Electric Code), SAES-P-104 (Wiring Methods), and SAES-T-795 (Groundings). Connectors between cells and between rows of cells shall be corrosion resistant and resistant to fumes from the electrolyte.

5.2 The positive bus of the DC system shall be connected to the Master Ground Bar. See Figures 1 and 2 for typical DC power connections for central offices and remote locations, respectively.

5.3 Design the cable routes or bus ducts so that tight or excessive bends are avoided. The bending radius must not be less than eight times the overall diameter for unshielded power cable. Terminate the cables in the direction of the current flow.

6 Testing and Inspection

6.1 Safety Requirements

6.1.1 Safety Equipment requirements shall comply with SAES-P-103 standard.

6.1.2 Safety Signs requirements shall comply with SAES-P-103 standard.

Additional Requirement: Water facilities shall be provided for rinsing spilled electrolyte in the battery room.

6.1.3 Battery Disposal requirements shall comply with SAES-P-103 standard.

Additional Requirements:

6.1.3.1 Batteries, such as Lead Acid and Nickel-Cadmium cells, shall be considered as hazardous waste. Disposal of batteries shall be in accordance with GI-0355.003.

6.1.3.2 Neutralizing solutions are required in battery rooms where liquid electrolytes are in use or stored.

6.1.4 Drains shall comply with SAES-S-060 standard, “Chapter 8 – Indirect and Special Wastes.

Note: *Drains are not required for sealed battery installations.*

6.1.5 A Battery Operation and Maintenance Instruction Card provided by the battery manufacturer shall be kept in a prominent position close to the battery, where it can be read easily. This card shall contain condensed instructions and general information on care and maintenance of the battery system. This card shall include information on charge and discharge status, float charge, cell readings, and the location of battery maintenance records.

6.2 Battery Test

Comply with the requirements as per SAES-P-103 standard, “Battery Tests and Records”.

6.3 Charger Test

Chargers shall be tested per NEMA PE-7.

6.4 Ventilation Test for Sealed Battery Rooms

To determine if batteries and associated battery charging equipment complies with ventilation requirements of Section 4.1.4, the battery system shall be tested as follows:

6.4.1 A battery system shall be discharged for 24 hours while connected to maximum rated load. The automatic cutoff circuit for the discharge of the battery shall not be defeated. This will insure that the depth of discharge does not exceed the battery manufacture's recommendation (usually 75-80%) thus reducing the possibility of permanent damage to the batteries.

6.4.2 Following the discharge, the battery is to be recharged for the time specified by the manufacturer for maximum charge condition.

The maximum hydrogen gas concentration is to be no more than 2.0% by volume when measured during step (Section 6.4.2). Measurements are to be made by sampling the atmosphere inside the battery room (shelter) at 75 and 125% of the specified recharge time. Samples of the atmosphere within the battery room (shelter) are to be taken in the uppermost location in the battery compartment. The hydrogen concentration measurement shall be completed by the use of an aspirator bulb or similar device provided with gas detection equipment.

Revision Summary

5 June 2011	Revised the "Next Planned Update." Reaffirmed the content of the document, and reissued with editorial revision to change the Primary Contact Person.
22 April 2012	Editorial revision to change the primary contact.
20 April 2014	Editorial revision to change the primary contact.
15 June 2018	Major revision to align with SAES-P-103 standard and provide applicable changes to IT/Communications needs.

Summary of Change Form

No.	Paragraph No.	Change Type (New, Modification,..)	Technical Change(s)
1	G	Change standard title	To specify that this document intended for telecommunications applications.
2	G	Modify scope description	This is to provide more clarity.
3	3.2	Deletion of references which are not applicable to the standard.	Replaced with SAES-P-103 standard, this to ensure to aligned with SAES-P-103 standard.
4	4	Modifications	- Re-arrange the sequence for better understanding of the end users. - The arrangement was in alignment with SAES-P-103 standard. - All requirements stated in this standard which are duplicated or stated in SAES-P-103 were deleted.

**Figure 1 – Communication Standby Battery System
Central Office Typical One Line Diagram**

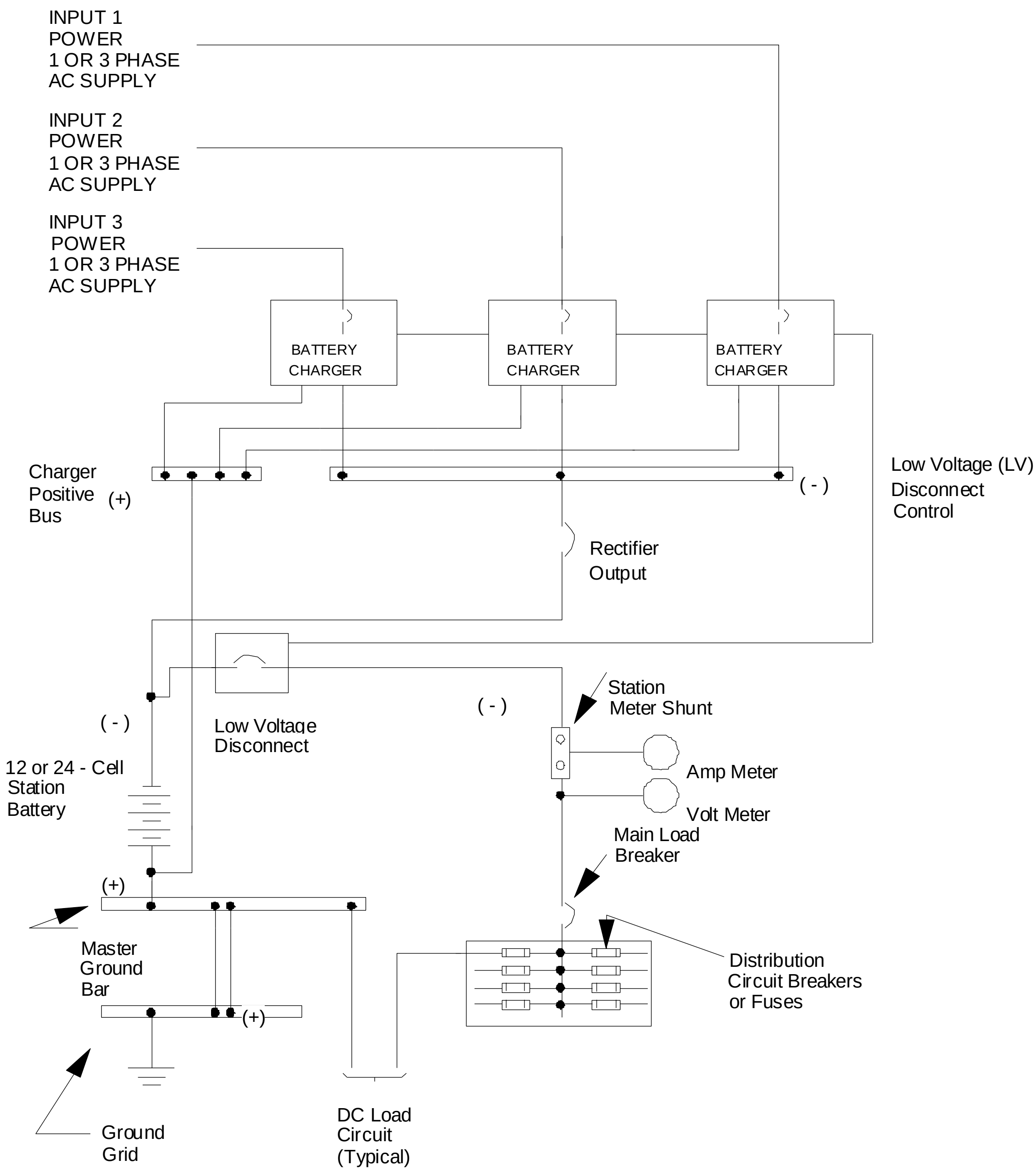

Figure 2 – Communication Standby Battery System Remote Typical One Line Diagram