Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	46-SDMS-02 Rev. 00
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46-SDMS-02

REV. 00

SPECIFICATIONS

FOR

BATTERY CHARGERS
FOR
PRIMARY DISTRIBUTION SUBSTATAIONS

TABLE OF CONTTS

1.0 SCOPE

This SEC Distribution Material Standard Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance of indoor battery chargers intended to be used in the Primary Distribution Substations for Distribution Sector of Saudi Electricity Company, Saudi Arabia.

2.0 CROSS REFERENCES

This Material Standard Specification shall always be read in conjunction with SEC General Specification No. 01-SDMS-01, titled "General Requirements for All Equipment/Materials", which shall be considered as an integral part of this SDMS.

This SDMS shall also be read in conjunction with SEC Purchase Order or Contract Schedules for project, as applicable.

3.0 APPLICABLE CODES AND STANDARDS

The latest revision/amendments of the following Codes and Standards shall be applicable for the equipment/material covered in this SDMS. In case of conflict, the vendor/manufacturer may propose equipment/material conforming to one group of Industry Codes and Standards quoted hereunder without jeopardizing the requirements of this SDMS.

3.1	IEC 60146 -1-1	Semi-Conductor Converters- General Requirements and line commutated Converters-Part-1-1. Specification of basic requirements.
3.2	IEC 60146 -1-1	Transformers and Reactors.
3.3	IEC 60529	Classification of Degrees of Protection Provided by Enclosure.
3.4	IEEE C57.12.01	Standard General Requirements for Dry-Type Distribution and Power Transformers.
3.5	ANSI C63.4	Measurement of Radio Noise Emission From low Voltage Electrical and Electronic Equipment in the Range of 9 KHZ to 40 GHZ.
3.6	IEEE 446	Recommended Practice for Emergency and Standby Power System for Industrial and Commercial Application.

3.7	ANSI/ NEMA ICS6	Enclosures for Industrial Controls and Systems
3.8	NEMA PE5	Constant-Potential-Type Electric Utility (Semi-Conductor Static Converter) Battery Chargers
3.9	NFPA 70	National Electric Code (NEC)
3.10	NEMA 250	Enclosures for Electrical Equipment (1000 V maximum)

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 General

4.1.1 The battery charger shall be constant voltage type solid state (Silicon) controlled rectifier equipment, designed to provide fully automatic voltage stabilization and current limitation for charging vented Nickel Cadmium batteries in DC Systems. It shall also be capable of simultaneously supplying varying load permanently connected in parallel with the battery. Typical applications are emergency lighting, UPS, switchgear, controls, instrumentation and other stationary applications.

4.1.2 The charger circuitry shall be of modular design and the printed circuit cards shall be plug-in or slide-in type. The silicon rectifier diode and thyristors shall be assembled to one sub-assembly, which can be easily exchanged.

4.1.3 It shall be ensured that harmonics due to SCR (Silicon Controlled Rectifier) commutations are not reflected back into the AC power mains.

4.1.4 Disconnection of DC load from the supply during boost charging is not permitted. It may, therefore, be necessary to install voltage-dropping diodes in the load circuit to ensure that the load voltage does not rise above its permissible upper limit. This requirement of dropping diodes is more considerate with the Nickel Cadmium batteries. The diodes shall be automatically switched in and out by means of voltage sensing relay and contactor on a fail-safe basis. This means that on failure of the switching relay and contactor the diodes shall be in circuit.

4.2 Performance Characteristics and Ratings

4.2.1 The charger shall be either single phase or three-phase, as specified in the Data Schedule.

4.2.2 The rated output voltage of the charger shall be l25 Vdc unless specified otherwise in the Data Schedule.

4.2.3 The design of the charger shall be current-limiting adjustable up to 110% of the rated output current with rated input voltage.

4.2.4 The battery charger shall be designed for three charging modes that is, float charging for normal use, boost (equalize) charging under discharged battery conditions and pre-commissioning battery charging**.**

4.2.5 The steady state output voltage shall be automatically and continuously held constant to within $\pm$0.5% of the voltage setting at any load from no-load to full rated load (0 to 100%), with simultaneous AC input voltage variations of $\pm$10% and with input frequency variations of $\pm$5% under the specified ambient temperature conditions per 01-SDMS-01. This regulation shall be maintained under both float and boost operations.

4.2.6 The maximum voltage transient shall remain within $\pm$5% of initial steady state voltage with battery connected and $\pm$15% of initial steady state voltage with battery disconnected for sudden load changes (application or removal) from 10% to 100% of the rated output. Recovery to steady state regulation range shall take place in less than 300 milliseconds and all transient behavior shall disappear within 500 milliseconds.

4.2.7 The ripple voltage shall not exceed 2% peak-to-peak of the nominal DC voltage over the specified input voltage range with battery disconnected.

4.2.8 The power factor shall be better than 0.8 lagging at full load and minimum efficiency at half-load is not less than 85% at rated line voltage.

4.2.9 The charger shall be suitable for operation in parallel with other chargers having similar output voltage and regulation characteristics, and shall share load to within $\pm$10% of the output current of each charger. A blocking diode shall be provided on the DC side of the chargers to prevent any reverse flow of power.

4.2.10 The battery charger shall be suitable for parallel or independent or master/standby operation with an ungrounded battery bank as specified in the Data Schedule.

4.2.11 Audible noise of the charger unit shall not exceed 65 dB (A-weighting) measured at any point 150 centimeters from any vertical surface of the rectifier.

4.2.12 The charger specific ratings shall be as specified in Data Schedule.

4.3 Controls and Protection

4.3.1 The charger shall be adequately protected against short circuits by automatic circuit breakers provided at both input and output circuits. An electronically controlled current limiting device per clause 4.3.3 shall also protect the output circuit.

4.3.2 The charger shall be protected against voltage or current transients by use of appropriate surge suppression techniques to be installed across the secondary's of the input transformer.

4.3.3 An automatic and adjustable current limiting device shall be provided to protect the charger against direct short circuits and continuous overloads without tripping it out of circuit. The setting range shall be up to 100% of the rated current of the charger. Normal function of the charger shall be restored automatically at the end of overloads/short circuits.

4.3.4 The charger shall have independent individual adjustable float and equalize charge circuits. These circuits shall have adjustable manual devices. The minimum range of adjustment for float and equalizing/pre-commissioning voltage shall be 90% to 110% (± 10%) and 90% to 130% (-10%, +30%) of the DC system voltage respectively. Once the desired float and equalize voltages are selected these shall be automatically and continuously maintained/regulated at the preset level within the specified limits per clause 4.2.5. The output voltage control shall have locking device in order to avoid any accidental change of voltage setting.

4.3.5 Provisions shall be made to initiate equalization both via a manual float-equalization switch and a 0-48 hour adjustable timer.

4.3.6 The equalize charging mode, shall automatically return to float mode upon expiry of the equalization time.

4.3.7 The charger shall be furnished with a soft start (current "walk-in" control) to limit the inrush current upon application of input voltage. The control circuitry shall gradually ramp up the output current within 15 seconds to allow gradual loading of the input AC power source.

4.3.8 The charger shall be designed to automatically shut down in the event of high output voltage. The set point shall be selectable and consistent with the maximum recharging voltage of the particular type of battery as well as the maximum allowable voltage of the load.

4.4 Status Indications, Alarms and Instrumentations

4.4.1 General

a. The alarm signals shall be triggered via dry contacts, which shall be used to light LED indicators on the charger panel, give a remote alarm indication and/or operate an audible alarm as applicable.

b. All the status and alarm indicators mentioned hereunder shall be high intensity LEDs.

c. All alarm relays shall be auto-reset.

4.4.2 Status Indications

The following status indicators shall be provided:

a. AC Power ON (Green)

b. Float Mode (Green)

c. Boost / Equalize Mode (Red)

d. Pre-commissioning Mode (Red)

e. Dropping Diodes in circuit (Red), if applicable.

4.4.3 Alarm Indications

a. The following alarm indicators shall be provided. All alarms shall be connected to a separate relay card with an individual relay for each alarm. All indications shall be in red.

i. AC power fail alarm
ii. Low DC voltage alarm
iii. High DC voltage instantaneous shutdown alarm
iv. Cooling system fail alarm, if applicable
v. Master charger fail alarm, if applicable
vi. Standby charger out of regulation alarm, if applicable
vii. Diode failure alarm
viii. DC Earth fault alarm
xi. MCCB/MCB trip/ Fuse failure alarm

b. Low DC voltage alarm relays shall be provided with an adjustable time delay of 0-30 seconds to allow for any short-term voltage fluctuations.

4.4.4 Panel Mounted Equipment/Instruments

The charger shall have the following components mounted on the front panel. Each component shall be labeled for identification:

a. An AC Circuit Breaker for charger input with pilot lamp (green).

b. A selector switch for Float/Equalize/pre-commissioning

c. A selector switch for Master/Standby, if applicable

d. An AC Digital Voltmeter with ± 1 % or better accuracy for input AC supply and a selector switch for three (3) phase units only.

e. An AC Digital Ammeter with ± 1 % or better accuracy for input AC supply.

f. A DC Digital ammeter with ± 1 % or better accuracy ranging from 0-150% of maximum output rated current.

g. A DC Digital voltmeter with ± 1% or better accuracy ranging from 0-120% rated output voltage along with ground detection momentary switch which will disconnect DC voltmeter from output circuit and measure voltage to common ground.

h. One 0-48 hour equalize timer per clause 4.3.6.

i. Programmable Controls for the following functions:

i) Float voltage adjust
ii) Equalize voltage adjust
iii) Current limit adjust
iv) Over-voltage trip adjust
v) Low voltage alarm adjust
vi) Low voltage alarm delay select
vii) Ground alarm adjust

j. Charger output MCB

k. Status indicators per clause 4.4.2

l. Alarm indicators per clause 4.4.3

m. A lamp test push-button to test all lamps

n. For any additional accessory requirements, see Data Schedule.

Note: Precise digital meters with functional select switch may be provided for fast and accurate measurement of the charger and battery parameters.

Items 'h' and 'i' may be located inside the charger provided they are easily accessible.

4.5 Construction

4.5.1 The battery charger shall be designed for indoor free standing or wall mounted equipment as specified in Data Schedule. All components shall be integrally designed to complete control and monitoring as required.

4.5.2 The charger enclosure shall be classified as either NEMA Type 3 (per NEMA 250) or IP41 (per IEC-60529). The cabinet shall be constructed of welded sheet steel material, which shall be suitably stiffened for load bearing components. All bolted parts shall use suitable washers to ensure electrical continuity of the structure.

The panel shall be made completely vermin proof.

4.5.3 Access to the equipment shall be from the front. The door shall have a handle with provision for locking.

4.5.4 Besides AC terminals the chargers shall have a DC positive and one negative terminal on the output side. The positive terminal shall be marked "+" and colored red. The negative terminal shall be marked "-" and colored black. AC terminals shall be marked "AC" with proper phase markings for three (3) phase chargers. AC/DC terminals shall be mounted on separate terminal blocks. All the markings shall be permanent. The marking shall be per applicable industry standards.

4.5.5 The charger shall be adequately ventilated for self-cooling by natural air convection. A forced air-cooling may be used if specified by SEC per Data Schedule. The loss of forced cooling when applied shall be detected by an alarm activated by either a thermostat or airflow switch.

4.5.6 An approved schematic diagram of the charger identifying various components and referring to the appropriate drawings and erection instructions shall be affixed to the inside of the cubicle access door. The diagram shall be marked on durable non-fading material suitable for the specified climatic conditions per 01-SDMS-01.

4.5.8 A thermostatically controlled anti-condensation space heater with overriding manual control shall be provided in each charger to maintain the internal temperature above the dew point.

4.6 Wiring and Terminal Blocks

4.6.1 All wiring within the panel shall be installed and tested at the factory unless otherwise specified. All wiring shall be heat and flame retardant rated 90ºC maximum conductor operating temperature, type SIS as listed in NFPA 70 or approved equivalent, rated 600/1000 V, with insulated, tinned, stranded, annealed copper conductor, and shall not be smaller than 2.5 mm². Sharp edges and burs shall be eliminated before the commencement of the wiring. An additional length of cables shall be allowed to permit removal of a termination and re-termination at least twice.

For the wiring of solid-state devices, smaller size wires may be acceptable only if the associated device cannot accommodate larger wire sizes.

All wires shall be adequately rated for thermal withstand of short circuit currents, in accordance with back-up tripping time.

4.6.2 Wiring shall be made without splices. The control wires shall have solder less insulated ring type terminals, tin-plated copper crimp type. Spade type wire lugs shall not be used. The color of insulation of positive and negative conductors shall be red and black respectively.

4.6.3 All Terminal blocks except electronic system internal terminal blocks shall be of non-captive pan head screw type, having material which is dimensionally stable, resistant to cracking and not subject to moisture absorption and shall be mounted on grounded rails. No more than two conductors shall be terminated at any one terminal point. If additional terminations are needed, flat preformed jumpers shall be provided.

4.6.4 Wiring shall be carried in troughs or in neatly formed packs, which shall be tied or otherwise secured at frequent intervals to prevent undue stress on equipment or connections. Bends in the wiring shall be carefully made in such a manner that the insulation is not damaged. Connections across portions, which are movable, shall be made with flexible wire formed to distribute the bending motion. Wiring of meters/relays mounted on doors shall be mechanically protected.

4.6.5 The AC and DC circuit terminals shall be fitted with non-flammable, transparent plastic covers to prevent accidental short circuit/contact with live parts or earthing of the battery.

4.6.6 All printed circuit boards shall be coated with a solder able polyurethane varnish.

4.6.7 All internal wiring terminations shall be identified by legible markings at the device terminals. Each end of every wire leaving a terminal block shall be identified indicating local termination point and destination as per Figure 1. All internal wiring shall have identification showing both locations of termination at each end of the wire. Markers shall be of ferrule type, permanently marked and shall be made of material that will not deform or deteriorate and shall withstand a temperature of 90°C. Adhesive type terminal markers are not acceptable.

4.7 External Cabling

4.7.1 All external cabling or wiring will be brought to the panel from bottom, unless otherwise specified.

4.7.2 Removable gland plates underneath the terminal blocks shall be punched for installation of incoming conduits or control cables.

4.7.3 Cabling shall enter the panel through suitable cable glands to prevent contact with sharp metal edges.

4.8 Grounding

4.8.1 Provision shall be made for grounding of the panel and a bolted connector shall be provided to accommodate 95 mm^2 earthing conductor.

4.8.2 All hinged doors and panels shall be properly grounded by un-spliced flexible ground wires.

4.9 Nameplates

4.9.1 The charger shall bear a nameplate fixed on the front side of the panel. The plate shall be marked in English with the following minimum information:

a. The words "BATTERY CHARGER"

b. Model Number and Type

c. Manufacturer's Name/Country and Trade Mark

d. Year of Manufacture (month and year)

e. Manufacturer's Serial Number

f. Rated AC Input Voltage

g. Rated AC Input Current

h. Frequency

i. Number of Phases

j. Rated DC Output Voltage

k. Rated DC Full Load Output current

l. Range of adjustments for:

   i. Float charging
   ii. Boost/Equalizing charging
   iii. Pre-commissioning charging
   iv. Current limiter.

m. SEC Purchase Order Number/Contract No. /Job Order No.

n. 46-SDMS-02, Rev.0

o. SEC ITEM NO.

4.9.2 The nameplate material shall be stainless steel or other non-corrodible material, but shall not include plastic and shall be fastened to the equipment by stainless steel screws or rivets. The markings shall be imprinted or etched in black, and shall be non-fading.

4.9.3 Device Identification

a. Appropriate identification in the form of engraved or embossed nameplate shall be provided for each charger component**.** These nameplates shall be made of non-corrodible material and shall be of appropriate size.

b. Each component shall be permanently identified to correspond to the device identification symbol utilized on the wiring diagrams. This identification shall be adjacent to the terminals of the device. Standard relay device numbers shall be provided for protective relays

c. The rating plates for each component shall bear the following minimum indications:

   i. Identification reference/manufacturer's type designation.
   ii. Serial Number
   iii. Rated Voltage & Current.

5.0 TESTS

All test results shall be provided for review and acceptance by SEC.

5.1 Type (Design) Tests

All type (design) tests prescribed in the relevant IEC or equivalent ANSI/IEEE standard shall be performed on the representative unit or on the first unit of every new design or rating to be supplied to SEC.

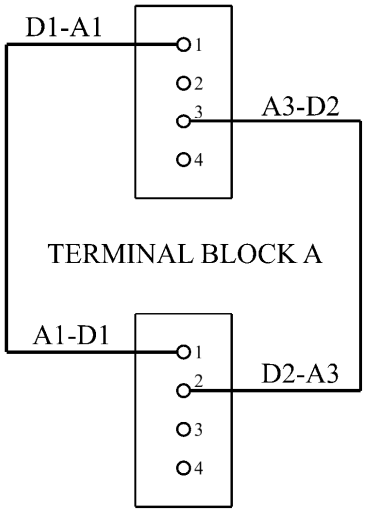
In lieu of the actual type (design) tests, certified test reports of type (design) tests performed on an identical unit may be submitted to SEC for review and approval during bidding stage.

5.2 Routine (Production) Tests

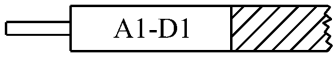
All routine (production) tests prescribed in the relevant IEC or equivalent ANSI/IEEE standard shall be performed on all the equipment covered by this TMSS. Manufacturer shall furnish a list of such tests for review and approval by SEC.

5.3 Special Tests

Any special tests specified in Data Schedule shall be performed per the applicable standards.



TERMINAL BLOCK D



WIRE END MARKING

Fig: 01 INTERNAL WIRE IDENTIFICATION

DWG No: SEC-Battery Charger - 01

6.0 TECHNICAL DATA SCHEDULE

(BATTERY CHARGERS)
(Page 1 of 5)

SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Proposed Values
3.0	**APPLICABLE CODES AND STANDARDS**			
	Applicable Industry Standards		x	
4.0	**DESIGN AND CONSTRUCTION REQUIREMENTS**			
4.1	**General**			
	Charging Characteristics			
	Type of charger and designation Number			
	Charging Installation within Air Conditioned/non air conditioned area			
	Application (Substation)			
4.2	**Performance Characteristics and ratings**			
	Rated Output voltage of the Charger (V AC)			
	Rated Input Voltage (V AC)			
	No. of phases and wires of input supply			
	Charging output current rating (A)			
	Continuous DC load to be catered to by the charger per load profile (A)			
	Float Charging Current to be catered to by this charger (A)	x		
	Battery Recharging time (max.) (Hrs.)			

6.0 TECHNICAL DATA SCHEDULE

(BATTERY CHARGERS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
	Type of Battery (Ni-Cad)			
	No. Of Cells			
	AH capacity • 8 hour discharge rate • 10 hour discharge rate			
	Type of operation between chargers between chargers (Parallel/ Independent/ Master-standby			
	Adjustable charging range for float and equalize mode (%)			
	Steady state Voltage regulation under specified conditions (%)		x	
	Maximum Voltage transients (%) • with battery connected • with battery disconnected		x	
	Maximum transient recovery time to (ms) • Steady State Condition • Full Recovery		x	

6.0 TECHNICAL DATA SCHEDULE

(BATTERY CHARGERS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Proposed Values
	Internal resistance of battery bank including inter cell and inter tier connection in fully charged condition(mΩ)		x	
	Internal resistance of individual cell in fully charged condition(mΩ)		x	
	Cross section of inter- cell connector (mm^2)		x	
	Battery terminal short circuit current (A)		x	
	Time for total discharge during short circuit (sec)		x	
	Maximum permitted ripple voltage content for float and equalizing charges		x	
	Maximum discharge rate Discharge duration (minutes /seconds) Discharge current (A)		x	
	Recommended maximum recharge current following discharge (A)		x	
	Float Charging Current at the recommended float voltage setting (mA/AH)		x	
	Maximum self discharge rate per month at 25 ◦C		x	
	Guaranteed service life (minimum) under operating conditions (years)		25	
	Cycle life at 80% DOD (cycles)		x	
	Maximum capacity loss (% per year)		x	
	Maximum allowable deep discharge/ percentage of		x	
	Specific gravity at 25 ◦C		x	

6.0 TECHNICAL DATA SCHEDULE

(BATTERY CHARGERS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
4.5	**CONSTRUCTION**			
	Type of mounting, Floor/wall			
	Conduit Cable Entry (top /bottom)		bottom	
	Any Forced cooling required ?	Yes/No		
	Total Weight of panel (kg.)	x		
	Degree of protection		IP41	
	Overall dimensions of charger panel (mm) • Width • Height • length		x	
5.0	**TESTS**			
	Special tests			
	Special tests that shall be required (please mention)			

X : values to be offered by vendors

6.0 TECHNICAL DATA SCHEDULE

(BATTERY CHARGERS)

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SEC Enquiry No: _____ Item No: _____

A) Additional technical information or features specified by SEC.

B) Additional supplementary data or features proposed by Vendor/Supplier.

C) Other particulars to be filled up by Vendor/Supplier.
(Use separate sheet if needed).

Address	Manufacturer	Vendor/Supplier
Name of the Company		
Location & Office Address		
Authorized Name & Signature		
Date		
Official Seal / Stamp		