SUPPLY CHAIN MANAGEMENT

THIRUVANANTHAPURAM

SPECIFICATION

110V 15A. 30A. 60A BATTERY CHARGER

APPLICABLE TO KSEBL	**Rev#1.0**	DOC. NO.: **SCM-SPEC/XT/110V 15A, 30A, 60A Battery Charger**
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	Compiled by	Verified by	Approved by
Name	**Smt.Anitha.A.S**	**Smt.Sajithakumari.T.S**	**Mr. Sanal Kumar.K**
Position	Assistant Executive Engineer (Supply Chain Management)	Executive Engineer (Supply Chain Management)	Chief Engineer (Supply Chain Management)
Date	09/04/2021	23/04/2021	03/05/2021
Signature	Sd/-	Sd/-	Sd/-

(ii) Amendments and History

Sec. #	*Rev. #*	*Date*	*History of Change*
	1.0		Adopted – IEC 60146
	1.0		Incorporated changes for providing independent DCDB for 60A Battery Charger.

iii) Technical Specification and Evaluation Committee for Transmission Material

1) Sri.Sunil.K, Deputy Chief Engineer (SCM), Vydyuthi Bhavanam, Thiruvananthapuram Sd/-

2) Sri.Pradeep Kumar.S, Deputy Chief Engineer, System Operation Circle, Kalamassery Sd/-

3) Sri.Nandakumar.K, Executive Engineer, APTS Northern Region, Vydyuthi Bhavanam, Gandhi Road, Kozhikode Sd/-

4) Sri.Venugopal.V.P, Assistant Executive Engineer, Transgrid TC Subdivision, Kaloor. Sd/-

5) Sri.Sivaprasad.R, Assistant Executive Engineer, Electrical Subdivision, Thiruvambadi. Sd/-

6) Sri.Dony.C.S, Assistant Engineer, 220kV Substation, Kundara. Sd/-

(iv) Document Approval & Control Status: (R1)

	Compiled by	Verified by	Approved by
Name	**Smt.Anitha.A.S**	**Smt.Anitha Sugathan**	**Sri.Surendra.P**
Position	Assistant Executive Engineer (Supply Chain Management)	Executive Engineer (Supply Chain Management)	Chief Engineer (Supply Chain Management & Chief Safety Commissioner)
Date	20/12/2022	20/12/2022	20/12/2022
Signature	Sd/-	Sd/-	Sd/-

1. PURPOSE:

Purpose of this document is to document updates & history, upkeep and publish the specifications related to **110 V 15A, 30A, 60A Battery Charger** in a professional manner

2. SCOPE:

The Scope of this document is to inform and alert all relevant stakeholders including KSEBL. Public, KSERC etc regarding the current specifications and historical changes adopted in specifications of **110 V 15A, 30A, 60A Battery Charger** used in field by KSEBL

3. RESPONSIBILITY:

The Executive Engineer (T), Office of Chief Engineer, Supply Chain Management shall compile and take necessary steps to publish the specification in KSEBL website and shall inform relevant stakeholders regarding updates and revisions

4. PROCEDURE FOR REVISION:

Modifications if any, in the technical specification will be incorporated as **Revisions.** Any changes in values, minor corrections in pages, incorporation of small details etc. will be considered as Minor Modification. **The Revisions due to minor modifications will be assigned as Rev. No.0.1, 0.2 etc.**

A complete updation of the technical specification will be considered as Major modification. **The Revisions due to major modifications will be assigned as Rev. No.1.0, 2.0 etc.**

All the details regarding the revisions (both minor and major) will be incorporated in **"(ii)-Amendments and history"** above.

The concerned officers, in consultation with the Technical Committee will review and suggest changes required and the revision suggestion will be approved by **Chief Engineer (SCM & CSC).** Those who notice any discrepancy or have any suggestion regarding revision, may bring the matter to the attention of Chief Engineer (SCM & CSC) in writing or through e-mail id:**cescm@kseb.in**

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TECHNICAL SPECIFICATION AND CONSTRUCTIONAL FEATURES FOR BATTERY CHARGER

1.0) General: -

1.0.1) The specification covers the design, manufacture, factory testing, marking, packing, shipping, transportation, installation, site testing and commissioning of 110 V 15 A, 30 A & 60 A Battery Chargers.

1.0.2) The detailed and specific data are specified in the Drawings, Guaranteed Technical Particulars (GTP) and other documents that form part of this Specification.

1.0.3) Installation, site testing and commissioning of the Battery Chargers supplied is the responsibility of the supplier and shall be done on intimation from various field offices of KSEBL.

1.0.4) The required Charger shall conform in every respect to recognized standards for engineering design and workmanship and shall be capable of performing continuous commercial operation within the parameters guaranteed by the manufacturers and in accordance with the specifications.

1.0.5) The Chargers, to be offered, shall be complete in all respects necessary for their effective and trouble free operation as far as possible.

1.0.6) The Charger shall be connected with Lead acid type battery.

1.0.7) For 60 A Battery Charger, the Battery Chargers and DC Distribution Board shall be provided separately. The Battery Chargers and DC Distribution Board shall be provided in separate self contained units housed in separate cubicles. It shall be possible to fully isolate the Charger unit from the DCDB and Battery.

1.0.8) The Battery Charger must have certification from the OEM of Plante/Tubular/VRLA battery for the compatibility. The Battery manufacturer's recommendations for float/trickle, equalizing and boost charging shall be taken into consideration.

1.1) Drawings:- Typical drawings for Substation Supply Systems shall be provided.

1.2) **Standard to be followed:-** The Battery Chargers shall conform to the latest edition of IEC 60146 (1963) Reaffirmed in: 2016 with its latest amendments. The components of the

charger shall comply with existing IS/IEC standards specification, including as amended from time to time.

ANSI-C37.90A	Surge withstand capability Tests
EEUA-45D	Performance Requirement for Alarm Annunciation System
IS:1248	Indicating Analogue Electrical Measuring Instruments
IS:13703	LV Fuse for Voltages Below 1000V AC or 1500V DC
IS/IEC:60947	Specification for LV Switchgear and Control Gear
IS:13947	Air Break Switch/ Contactor
IS:2026	Power Transformers
IS/IEC:60529	Degree of Protection for cubicle
IS:13947 PartIV Section IV	AC Contactors for voltage not exceeding 1000 Volt
IEC:60529	Electrical Relays for Power System Protection
IS:5578, 11353	Specification for wiring
IS:3842	Application Guide for Electrical Relays for AC System
IEC:60146(1963) Reaffirmed in: 2016	Semiconductor Converters – General requirement and line commutated converters
IS:5/1978	Colour for ready mix paint
IS:5421/1981	Printed Circuit Board
IS:6005	Code of Practice for Phosphating of Iron & Steel
IS:6619	Safety Code for Semiconductor Rectifier Equipment

IS:13947/2004 Reaffirmed: 2019	Control Switches (Switching Devices for Control and Auxiliary Circuits including Contractor Relays) for Voltage upto 1000V AC or 1200V DC
IS:694	PVC Insulated Cable for Working Voltage 1100V
IS/IEC:60898	Miniature Circuit Breaker
IS/IEC:60068	Environmental Testing for Electronic & Electrical items

In case of conflict between the applicable reference standard and this specification, this specification shall govern.

Equipment complying with other internationally accepted standards such as IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the bidder shall clearly indicate the standards adopted, furnish a copy in English of the latest revision of the standards along with copy of all official amendments and revisions and shall clearly bring out the salient features for comparison.

2.0) **Technical Description:-**

2.1) **General Requirements:-**

2.1.1) The 110 V DC Charger systems shall be used in various Generating Stations/ Substations to provide the required DC supply for the protection relays, tripping circuit of all feeders & subsequent restoration, closing circuit of all feeders, local indication, control equipment and fire fighting (if available). Generally 55 Cells Lead acid Battery will be used.

2.1.2) The required Charger/ Distribution Board systems shall be designed with following functional blocks integrated in a single unit for 15/30A Battery Charger and separate units for 60 A Battery Charger.

1) One Float cum Boost Charger
2) One Distribution Board for distributing power to the various loads

2.1.3) Each system shall be rated to feed 100% of the entire calculated DC load. The Supplier/ manufacturer shall provide a comprehensive calculation for the charger capacities considering the worst loading conditions, for KSEB approval.

2.1.4) The nominal rating of the DC Supply shall be 110 V at DC Distribution Board Busbar. The voltage at load terminal will not exceed the limits of +10% to -15% of 110V.

2.1.5) The chargers shall be fed through 415 V AC, 3 –phase, 50 Hz 4 wire system. The charger offered shall be designed to work as indoor equipment (unless otherwise specified). Chargers will be suitable for continuous operation at AC voltage variation of ±10%, frequency variation of +3% to –5% and combined voltage and frequency variation of 10% (absolute).

2.1.6) Chargers shall be self-regulating, silicon-controlled full wave rectifier, fully controlled, bridge configuration, auto and manual control type designed for single and parallel operation with battery and shall be provided with static automatic voltage regulator for a close voltage stability even when AC supply voltage and DC load fluctuates.

2.1.7) Application of Chargers will be as follows: The Float-cum-Booster charger section shall be operated either in float mode or in boost-cum-standby float charger mode with facility to supply the DC continuous load of 15/30/60 Amp. During normal operation, the Battery is floated across the Battery charger at 118-126V (2.16 V / 2.3 V per cell) and should be compatible for battery as per specification and also supplies the Battery current 15/30/60 Amps into batteries for higher voltage upto 130-152V (2.35 V / 2.75 V per cell). Also system shall provide momentary current of 100 Amps for one second.

2.1.8) In all cases output voltage at DC distribution shall be within safe range specified elsewhere in this document. For initial charging, only battery load to be considered.

2.1.9) Battery current limit shall be adjustable to connect 100 AH and 200 AH also for 60 A Battery Charger.

2.1.10) Electronic circuits shall be preferably of conventional analog and digital mixed circuits but not limited to the same. Various limits and configuration settings shall be accessible to user through trim potentiometers.

2.1.11) Where numerical circuits using microcontrollers were used as controllers, manufacturer shall provide sufficient proof and guarantee regarding reliability of programmed memories/circuits in case of faults/ Earth potential Rises and severe EMI conditions. Circuits shall be designed as immune to all such external interferences. Spares of these microcontrollers cards should be provided and be made available by the firm.

2.1.12) Where numerical circuits are used in configuration, all software /tools shall be provided for configuration of chargers such as voltage and current limits, program for automatic modes etc along with each equipment or shall be integrated with the equipment.

2.2) **Charger & Distribution Board**

2.2.1) **General: -**

2.2.1.1) The Battery Charger and DC Distribution Board shall be integrated in a single unit for 15/30A Battery Charger and separate units for 60 A Battery Chargers. It should have 2 incomers having the same rating, one for connecting the battery system and another for paralleling with a second distribution board for taking/giving backup DC. The first incomer should have a normal DC ammeter and second incomer should have a central zero DC ammeter. The bidder/supplier shall submit GA drawing along with the tender.

2.2.1.2) The Battery Charger shall be designed for float mode and boost mode. It shall be suitable for initial charging of Lead Acid, Plante type, Tubular Type and VRLA Type Battery. The Battery Charger shall be capable of continuous operation to feed the 100% load including charging the corresponding battery bank, either on float or on boost charging modes. The cubicle shall be an indoor, floor-mounted, self-supporting sheet metal enclosed cubicle.

2.2.1.3) All necessary base frames, anchor bolts and hardware shall be part of cubicle fixing. 3.0mm thick sheet shall be used for load bearing parts and 2.0mm thick sheet shall be used for other parts of the charger. Type of cooling shall be natural air cooled/forced air cooled as per the design requirement. Heat dissipation and temperature rise calculation inside the cubicle of the charger shall be submitted for the approval of the KSEB Limited. For forced air cooling system, suitable louvers with filters shall be provided.

2.2.1.4) Removable gland plates shall be provided in the cubicle. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be defined based on calculation for the voltage drop over each stage and accordingly the suitable cable lugs and drilling of gland plates shall be defined.

2.2.1.5) The cubicle shall be vermin proof. Ventilation louvers shall be backed with air filter. Cooling fans shall be provided as specified above. Fan failure alarms shall be provided, wherever applicable. All doors and covers shall be fitted with synthetic rubber gaskets of good quality.

2.2.1.6) The cubicle shall have hinged double leaf doors at the backside and hinged single leaf front door i.e, cubicle shall have both front and rear end openings for adequate access to the inside components. The cubicle doors shall be properly earthed. The degree of protection of charger cubicle shall be at least IP-42.

2.2.1.7) The control wiring shall be PVC insulated, fire retardant (1.1kV) of at least 2.5mm^2 stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5mm^2 stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 10% spare terminals shall be provided for control circuits.

2.2.1.8) The insulation of all circuits except the low voltage electronic circuits shall withstand test voltage of 2 kV AC for one minute.

2.2.1.9) The Battery Chargers shall be self-regulating, natural air cooled, static type, composed of silicon controlled rectifiers (SCRs) connected in three phase full wave full control bridge circuit.

2.2.1.10) Each charger circuit shall be provided with its own AC input voltmeter with voltmeter selector switch, DC voltmeter & ammeter, battery DC output ammeter & voltmeter, battery charging current ammeter, control switches, rectifiers, Auto/ Manual voltage regulators, load limiting device, etc. as required for the successful operation of the DC system.

2.2.1.11) The charger shall have auto voltage regulators to enable stepless, smooth and continuous voltage control. The chargers shall have the effective current limiting feature and smoothing filters on both input and output to minimise harmonics, radio frequency transients, electromagnetic transients, etc.

2.2.1.12) The battery chargers as well as their automatic regulators shall be of static type. The battery chargers shall be capable of continuous operation at the respective rated load in float charging mode i.e. trickle charging the associated DC batteries while supplying the DC loads. The Batteries shall be Trickle charged at 2.25 Volts per cell. All chargers shall be capable of Boost charging the associated D.C. Battery at 2.3 to 2.7 Volts per cell at the desired rate.

2.2.1.13) The battery chargers shall have a selector switch for selecting the battery-charging mode i.e. float or boost charging.

2.2.1.14) The battery chargers shall be provided with facility for both automatic and manual control of output voltage and current. The selector switch will select the mode of output voltage/current control, whether automatic or manual. Necessary provisions shall be provided to avoid current/voltage surges of harmful magnitude/nature, which may arise during change over from auto to manual mode or vice versa under normal operating condition.

2.2.1.15) Soft start feature shall be provided to build up the voltage to the set value slowly within 15 seconds. The chargers shall have load limiters, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall not damage the charger nor shall it cause blowing of any of the charger fuses. The charger shall not trip on overload or external short circuit. After clearance of fault, the charger voltage shall build-up automatically when working in automatic mode.

2.2.1.16) When on automatic control mode during float charging, the charger output voltage shall remain within ±1% of the set value for AC input voltage variation of ±10%, frequency variation of +3% to –5%, a combined voltage & frequency (absolute sum) variation of 10% and a continuous DC load variation from zero to full load. Uniform and step less adjustment of voltage setting (in both auto/manual modes) shall be provided on the front of the charger panel covering the entire float charging output range specified. Step less adjustment of the load limiter setting shall also be provided from 80% to 100% of the rated output current for float charging mode.

2.2.1.17) During boost charging, the battery chargers shall operate on constant current mode (when automatic regulator is in service). The boost charging current can be adjusted continuously over a range of 50% to 100% of the rated output current for boost charging mode. The charger output voltage shall automatically go on rising, when operating in boost mode, as the battery charges up. For limiting the output voltage of charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be Vernier type.

2.2.1.18) Equalizing charging of batteries: The battery shall be given an equalizing charge at regular intervals during its life span at constant voltage to correct any inequalities among cells of the battery that may develop during its service. The BCs shall provide equalising charging to the batteries in the following modes:

a) Automatic mode: In the automatic equalising charging mode the charger shall have provision for charging at constant potential mode. The current limit shall be set at 5% of battery Ah. A facility for equalising charging with preset timer shall be provided with adjustable duration of 2hrs/4hrs/8hrs/12hrs. After the preset time the charger shall change over to float mode and equalising charging shall be stopped automatically.

b) Manual mode: In the manual equalising charging mode provision for equalizing for lead acid batteries shall be made but without a preset timer. The equalising charging shall be stopped manually after the required duration as per battery manufacturer's recommendation.

2.2.1.19) Energising the charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of voltage setting. The time taken to stabilise within specified limits shall be less than 15 seconds.

2.2.1.20) In case of float-cum-boost charger, manufacturer shall offer an arrangement in which the voltage setting device for float charging mode is also used as output voltage limit setting device for boost charging mode, and the load limiter of the float charging mode is also used as boost charging current setting device.

2.2.1.21) Suitable filter circuits shall be provided in all the chargers to limit the ripple content (peak to peak) in the output voltage to 1%, irrespective of the DC load fluctuation even when they are not connected to a battery.

2.2.1.22) Momentary output voltage of the Charger, without the Battery connected shall be within 94% to 106% of the voltage setting during sudden load Change from 100% to 20% of full load or vice-versa. Output voltage shall return to, and remain, within the limits (+/- 1% of the set value) in less than 2 seconds after the above mentioned change.

2.2.1.23) The battery charger shall be provided with facility for both automatic and manual control of output voltage and current.

i) The Battery Charger shall be provided with facility for both automatic and manual control–which shall control both Float & Boost functions.

ii) It shall have current limiting facility, if the voltage control is in an automatic mode and shall cause a gradual lowering of the output voltage when the DC load current exceeds the load limiting setting.

iii) The charger shall have an adjustable current limiting facility-brought about by changing the charging voltage in gradual manner, also for safe guarding the Battery.

iv) Uniform and smooth adjustments of voltage setting (in both manual and automatic modes) shall be provided.

v) The current limiting characteristics shall be such that any overload or short circuit in the DC system shall not damage the charger, and will lower the output voltage immediately to avoid blowing of any of the charger fuses. To prevent any failures of the automation platform creating hazards in the field, it is recommended that fuses blow rather than risk life and high voltage output.

vi) A lead acid battery charger should switch to float charge when fully saturated when operating in automatic mode.

vii) Soft start feature should be invariably provided to minimize the in-rush current.

2.2.1.24) The Charger shall not trip for overload or external short circuit.

2.2.1.25) During boost charging, the battery charger shall operate on constant current mode. It shall be possible to adjust the boost charging current continuously over a range of 20 to 100% of the rated output current for boost mode. During float mode, the charger shall be on constant voltage mode with battery current limiter. During boost charging, DC output from charger shall be within specified limit. For achieving this, suitable battery tap selection/dropper diode with adequate contactors and blocking diode shall be provided.

2.2.1.26) For limiting the output voltage of the charger, a potentiometer shall be provided, whereby it shall be possible to set the upper limit of the boost voltage as per specified value.

2.2.1.27) The charger shall be able to recharge the battery after a complete discharge cycle, i.e., to 95% of its capacity within a time interval of not more than 10 hrs and in the mean time supply the entire equipment design load.

2.2.1.28) Suitable filter circuits with fuse failure alarms shall be provided in the charger to reduce as much as possible the ripple content and also to suppress noise in the output voltage irrespective of the DC load, especially when the battery is not connected to the charger.

2.2.1.29) The charger output voltage (battery disconnected from the charger) shall be free of noise by providing noise filters.

2.2.1.30) The input of the charger shall be equipped with a device, which shall cause the charger to switch off in the event of DC output over voltage; short circuit at the charger shall not cause any damage to the charger from the battery side.

2.2.1.31) The detailed technical specifications are to be filled up in the GTP, Annexure II that form part of this specification.

2.2.1.32) AC and DC switches shall be provided at the input and output respectively with adequate rating. The operating handle of the switch shall be fully insulated.

2.2.1.33) The charger failure device shall detect the AC supply voltage failure. The detecting device shall not operate on switching surges or transient loss of voltage due to faults on the power system. In addition, the charger shall be equipped with a 4 pole MCB and contactor at the input and fuses and an off load isolator at the DC output. A suitable single phasing detection shall be provided for the AC input. The relay shall initiate necessary alarms for single phasing.

2.2.1.34) The voltage at load terminal shall not exceed the limits of +10% and -15% of nominal system voltage for DC system.

2.2.1.35) Effective current (load) limiting feature and filters on both input and output to minimise harmonics shall be provided.

2.2.1.36) The DC system shall be ungrounded and shall float with respect to ground potential when healthy. In other words, 110V DC systems shall be IT systems (I=Isolated, T=Earth) as described in BS 7671.

2.2.1.37) 110 V DC systems shall not be directly connected to earth, but earthed via the high impedance for insulation monitoring (i.e. earth leakage) device. Suitable ground fault detection system shall be provided in the battery charger panel to detect ground fault on either polarity for annunciation in charger panel.

2.2.1.38) The battery charger shall be designed to limit fault level on DCDB to 25 kA.

2.2.1.39) The design of the charger shall not allow any reverse current flow from the DC battery into the charger.

2.2.1.40) The battery charger shall have all the necessary built-in protections such as those against input over/ under voltages, phase failures, over load, output over / under voltages, battery over / under voltages, surges, short circuits, earth faults, etc.

2.2.1.41) The charger shall be designed to operate at an ambient air temperature of 50°C. It will be located indoor but in a hot, humid and tropical atmosphere.

2.2.1.42) The heat dissipation and power control system should be designed with a factor of safety of 8.

2.2.1.43) All semiconductor devices shall be adequately derated to prolong the life of devices, but shall not be derated below 0.7 of normal voltage and current or 0.5 of the normal rated power.

2.2.1.44) Transistors: The transistors are to be derated to as follows:

- Collector current: 80%
- Any other Voltage: 70%

2.2.1.45) Diode: The diodes are to be derated to as follows:

- Forward current: 50%
- Peak reverse voltage: 50%

2.2.1.46) Capacitors: The use of electrolytic capacitors shall be kept to an absolute minimum and wherever possible tantalum capacitors shall be used. Capacitor voltage shall be derated to 50%.

2.2.1.47) Resistors: All resistors shall be preferably metal oxide type and in general shall not be rated more than 50% of the manufacturer's rating. Preset Potentiometer shall be used instead of fixed resistors wherever wide range voltage and current adjustments are necessary and shall be provided with locking devices. Wire wound resistors shall be used in snubber circuits and as bleeder resistors. Power of resistors shall be derated to 50%.

2.2.1.48) The complete battery charger and distribution board system shall be designed to enable a complete charger to be removed and replaced with ease and without disturbance to the reminder of the equipment and wiring for 60A battery charger. Facility shall be provided for testing batteries and chargers without load disconnections.

2.2.1.49) **Application of chargers will be as follows:-** The float cum boost charger is to be designed to charge the battery after drainage as well as supply to the load simultaneously.

Sl No	Rating of Charger	Max Battery Current from charger	Battery to be used	Remarks
1)	15 A	10 A	100 AH Lead Acid plante/tubular /VRLA	Shall be suitable for all batteries, but in case of VRLA we will use only float

			in 0.1C10 curve100AH Lead Acid Plante/ Tubular/ VRLA in 0.1 C10 curve	mode
2)	30 A	20 A	200AH, lead acid plante/ tubular/ VRLA in 01 C10 curve	Shall be suitable for all batteries, but in case of VRLA we will use only float mode.
3)	60 A	40 A	300AH or 400AH, lead acid plante/ tubular/ VRLA in 01 C10 curve	Battery current limit shall be adjustable to connect 100AH and 200AH also.

2.2.1.50) Chargers shall be equipped with following modes manually selectable via multiple position switches.

Sl. No.	Mode	Controller characteristics	Range
1)	FLOAT	Constant voltage controller with adjustable battery current limit	90V to 127V at Battery terminals Voltage variation and battery current limit shall be possible through input Potentiometers
2)	Manual boost	Constant current controller with adjustable voltage limit	20% to 10% Battery current (in 0.1 C10 curve) shall be adjustable through potentiometer.
3)	Automatic boost	Constant voltage controller or constant current controller	Boost initiation shall be depending on discharge condition and stop shall be depending on voltage attainment during charging. Change over shall be fully automatic.
4)	Initial Charging	Constant current controller with adjustable voltage limit	20% to 100% battery current (in 0.1 C10 curve), shall be adjustable through potentiometer. Voltage range from 90 to 150V

2.2.1.51) During changing of Charger from float to boost and vice versa, should be with uninterrupted DC output. The battery tapping connected to output for boost charging should have the full DC current output rating. In all cases output voltage at DC distribution shall be within safe range specified elsewhere in this document.

2.2.1.52) The Battery Charger shall be provided with facility for both automatic and manual control of output voltage and current. It shall have current limiting facility, if the voltage control is in an automatic mode and shall cause a gradual lowering of the output voltage when the DC load current exceeds the load limiting setting. The current limiting characteristics shall be such that any overload or short circuit in the DC system shall neither damage the charger, nor cause blowing of any of the charger fuses. The charger shall have an adjustable current limiting facility, also for safe guarding the Battery. The charger shall not trip for overload or external short circuit. Soft start feature should be invariably provided to minimize the in-rush current.

2.2.1.53) Uniform and smooth adjustments of voltage setting (in both manual and automatic modes) shall be provided. During boost charging, the battery charger shall operate on constant current mode. It shall be possible to adjust the boost charging current continuously over a range of 20 to 100% of the rated output current for boost mode. During float mode, the charger shall be on constant voltage mode with battery current limiter. During boost charging, DC output from charger shall be within specified limit. For achieving this, suitable battery tap selection with adequate contactors and blocking diode shall be provided.

2.2.1.54) For limiting the output voltage of the charger, a potentiometer shall be provided, whereby it shall be possible to set the upper limit of the boost voltage as per specified value.

2.2.1.55) The charger shall be able to recharge the battery after a complete discharge cycle, i.e, to 95% of its capacity within a time interval of not more than 10 hrs and in the mean time supply the entire equipment design load. Suitable filter circuits with fuse failure alarms shall be provided in the charger to reduce as much as possible the ripple content and also to suppress noise in the output voltage irrespective of the DC load, especially when the battery is not connected to the charger. The charger output voltage (battery disconnected from the charger) shall be free of noise by providing noise filters. The input of the charger shall be equipped with a device, which shall cause the charger to switch off in the event of DC output over voltage, short circuit at the charger and shall not cause any damage to the charger from the battery side.

2.2.1.56) The construction of the charger shall ensure easy access to all components for smooth and safe maintenance.

2.2.1.57) All bus bars and bus connections shall be of high conductivity copper and adequately sized to limit the maximum temperature rise to 40° C from ambient temp (50° C) under rated load condition. The maximum allowable temperature rise shall be 55° C from ambient temp (50° C) at joints. All bus connections shall be silver-plated joined with two bolt connection with plain and spring washes and locknuts. Heat–shrinkable insulating sleeves shall be provided for bus bars. All bus connections shall be color coded for easy identification. Bus bars shall be supported and braced to withstand the stress due to maximum short circuit current and also to take care of any thermal expansion. The clearances and creepage distances shall be in accordance with clause 4 of IS: 6619-1972.

2.2.1.58) AC and DC Voltmeters and ammeters (with shunt) shall be provided for the charger, at the input and output correspondingly. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. A low range Ammeter (0-5) A with push button shall be provided to measure trickle charging current in float operation. All fuses for the protection of outgoing DC circuits shall be HRC type. Rectifier unit shall be protected with semiconductor fuses in AC & DC side with fuse failure alarms. Fuses shall be mounted on fuse holders mounted on fuse bases. The design of the charger shall not allow any reverse current flow from the DC battery into the charger.

2.2.1.59) The rectifier shall be for three phase full wave thyristor controlled bridge circuit with LC ripple filters.

2.2.2) **DC Distribution Board**

2.2.2.1) **Distribution Board for 15/30 A Battery Charger: -** The incomers should have HRC fuses with on load 2 pole isolation switches with sufficient DC rating. At the output, the 110V DC distribution boards shall comprise DC MCBs at the output to feed all various equipment. All DC MCBs shall be connected to the DC Bus bar in the panel. The output of MCBs shall be terminated in suitable bolted type terminal connectors. The cables between MCBs and terminal block shall be selected at suitable rating.

2.2.2.2) Independent DCDB for 60A Battery Charger

2.2.2.2.1) The cubicle shall be constructed from good quality steel sheet. The cubicle shall be robust in construction. The cubicle shall be made of steel sheet of 3 mm size for front side & bottom and 2.5 mm size for other sides. It will be reinforced by steel frame and shall be mechanically strong. It will be indoor, floor mounting and naturally air-cooled type designed for continuous operation in an ambient temperature of 50ºC. Necessary phosphating treatment shall be given to the cubicle and shall be painted with two coats of red oxide primer followed by a coat of gray synthetic enamel paint, shed No RAL7032 on external side and on internal side with glossy white colour.

2.2.2.2.2) The distribution board shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP: 55 as per IS/IEC 60529. The cubicle shall have minimum dimensions of 800mm (H) (including base frame of the size 50 x 50 x 4) x 800mm (W) x 450mm (D) so that all the components shall be approached and replaced easily. It will be provided with the front & rear side door with the handle and handle lock. It should be possible to erect the cubicle side by side. The replacement of the components and testing should be possible from front and backside of cubicle. The cubicle shall be mounted on 'C' Type channel with opening for cable entry on rear side.

2.2.2.2.3) The cubicle shall be designed to receive four single core 50 mm2. Incoming copper cables (outside dia. 14 mm to 20 mm. approx.). Two cables shall be used as Main cables and two cables shall be used as standby. The punched holes shall be provided for above cable entries. The dimensional drawing of the cubicle with all mountings shall be furnished by the bidder. Necessary cable glands shall be supplied with the DCDB.

2.2.2.2.4) There will be 35 Nos. D.C. outlets each rated for 32 Amp. Each 32 Amp. D.C. outlet shall be controlled by MCBs of rating 32 A DC. The cable gland for the cable size 2C x 4 mm2 shall be provided at the bottom for all the outlets. The LED type indicating lamps for incoming and each outgoing feeders indicating availability of supply shall be provided on the front panel of cubicle.

2.2.2.2.5) There will be a Main copper bus bar of electrolytic copper confirming IS 8130:84, which will be liberally rated. It will receive D.C. input from incoming cables through TBs and Switch & HRC fuse of 63 A, L&T/ABB/SIEMENS make for each +ve and –ve line of D.C Supply. The input

to MCB of each outgoing feeder shall be extended from +ve D.C and –ve D.C bus. The thickness and width of bus bar shall not be less than 5 mm and 30 mm respectively. The bus bar shall be of sufficient length to avoid congestion. The separation between connection points of +ve lines of cable of two successive outgoing feeders on D.C +ve Bus and –ve lines of cable of two successive outgoing feeders on D.C –ve Bus shall be 4 cms. Bus bar shall be insulated to avoid accident while working inside DCDB. Insulation on the bus bar may reduce the rate of dissipation of heat generated in bus bar. This will increase temperature of bus bar, which will affect the insulation. Therefore bus bar design should take all these factors into account so that there is no temperature rise.

2.2.2.2.6) Each MCB shall be then connected to Terminal Blocks by using insulated copper cable of not less than 6 mm2. The design of DCDB shall be such that there shall be minimum voltage drop. Special care shall be taken to avoid voltage drop at every level.

2.2.2.2.7) The wiring shall be neat and clean without any congestion and shall be supported mechanically as well as tied up to withstand transit vibrations. More than two wires shallnot be terminated at a point.

2.2.2.2.8) Digital D.C. Voltmeter with transducer having two separate O/Ps of 4 – 20 mA to read D.C. voltage upto 250 V shall be provided. Digital D.C. Ammeter with transducer having two separate O/Ps of 4 – 20 mA shall be provided to read current upto 60 A. The meters and shunts shall be of good quality suitable to give a long and satisfactory service. DC over voltage relay with timers for tripping incomer MCCB in case of over voltage of the DC Bus is to be provided. Ground alarm relays and Pilot indicating lamps for ground indication also to be provided. AC/DC automatic changeover contactor switch, double pole, 50 A rating for switching on DC supply to emergency DC lighting to be provided in the 2 outlets. DC to DC converters to be provided in the one outlet for 110 to 24/12 Volts DC supply with minimum 5 TB's for each voltage and converter should having minimum load capacity of 10 A. All relays are numerical if possible with SCADA compatible. A cubicle light with fuse and switch shall be provided inside the cubicle operating on D.C.

2.2.2.2.9) **OPTIONAL:-** Single core PVC insulated un- armored flexible stranded copper cable with suitable lugs (as required) shall be offered along with Battery charger.

400AH- size of 70 mm2

200 & 100AH size of 35 mm2

Per unit cost of the cable shall be quoted by the bidder along with commercial offer.At the output, the 110V DC distribution boards shall comprise DC MCBs at the output to feed all various equipment. MCB used in DC circuit is suitable and rated for DC application.

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Per unit cost of the cable shall be quoted by the bidder along with commercial offer.

At the output, the 110V DC distribution boards shall comprise DC MCBs at the output to feed all various equipment. MCB used in DC circuit is suitable and rated for DC application.

2.2.3) **Devices on the Instrument Panel:-** The following devices shall be furnished and mounted on the instrument panel of the chargers.

a) MANUAL-AUTOMATIC change-over switch.

b) Boost/Float Selection Switch.

c) DC Leakage detector: Centre “0” DC Analogue meter with E/F detector Alarm.

d) One AC voltmeter for reading the AC input supply voltage with selector switch.

e) One AC ammeter for reading the AC input current with selector switch.

f) Three DC voltmeters with suppressed zero (one for the charger output, one for the battery voltage and one for the load voltage).

g) Four DC ammeter, (one for the charger output current, one for the battery current bi-directional and one for the load current and one for trickle charger) with externally –mounted shunt as applicable.

h) Potentiometer shall be provided for current control and voltage control in float and boost modes separately.

I) An isolating switch to disconnect 415 V AC supply to the charger before MCB is to be provided with HRC fuse rating of minimum 10 A, 16 A & 32 A for 15A, 30 A & 60 A Battery Chargers respectively.

j) Battery disconnecting device with auxiliary switch as per specification.

k) In the DC distribution board, the first incomer should have a normal DC ammeter and second incomer should have a central zero DC ammeter

The control and selector switches shall be of rotary stay put type with escutcheon plates showing functions and positions. The switches shall be of sturdy construction and suitable for mounting on panel front. The switches shall have shrouded live parts and sealed contacts against dust ingress. Auto/normal switch shall be of lockable type in either position. The contact ratings shall be at least the following:

- Make and carry continuously 10 A
- Breaking current at 220 V DC 0.5 A (inductive)
- Breaking current at 240 V AC 5.0 A at 0.3 p.f.

Push button shall be heavy duty, shrouded, push to actuate type with colored button and inscription plate. Each push button shall have 2 NO + 2 NC contacts, rated 10 A at 240 V AC and 5.0 A at 220V DC.

Battery Charger shall be provided with features to communicate with existing SAS in the station/ RTUs/ future SAS, though suitable communication protocol (eg. MODBUS).

There shall be provision to transfer data viz. command points to control (ON/OFF) battery charger and analog/ digital status points for metering & condition monitoring like output DC voltages and currents, input voltages and currents, Battery charger fail, input mains fail, input fuse fail/MCB trip, output MCB/MCCB trip/fuse, fail, DC over voltage, DC under voltage, earth leakage etc. to Local SAS/Remote Control Centre. Necessary protocol converters shall also be provided for integration with IEC 61850 based SAS.

2.2.3.1) **Alarms and Indications:-** The following LED indications shall be provided in the charger and distribution panel to announce and monitor the following events respectively: Test, accept, reset facility shall be provided. Alarm shall be triggered at every event of faults. (Irrespective of persisting alarm).

1) Push button for all LEDs testing.

2) Charger supply on.

3) Supply main failure.

4) Rectifier failure.

5) Charger, fuse/MCB trip.
6) DC output high.
7) DC output low.
8) Charger on boost mode.
9) Battery earth leakage.
10) AC Under voltage and over voltage.
11) Battery isolator open.
12) Output DC filter fuse failure.
13) Single phasing alarm.
14) Fan failure alarm/OVER TEMEPRATURE ALARM.

All alarms shall be wired up to Terminal Block. Item Nos. 4,6,7 and 12 shall be grouped and provided with a potential free contact for remote monitoring. One potential free contact shall be provided for 8, for remote monitoring.

a) Charger shall be self protected against high transient over-voltages in DC and AC control and power circuits. The protection shall be built into the equipment and no special external connections, configuration of leads or connections of any external equipment shall be required.

The circuit interruption and protection on the ac input side is by means of a 100 A moulded case circuit breaker equipped with inverse time overload tripdevice and instantaneous earth fault relay. The breaker is capable of interrupting an RMS symmetrical fault current of 50 kA. The MCCB shall have padlocking feature.

b) Protection against discharge of the battery into the battery chargers upon failure of AC supply, with automatic resumption of pre-set charging rate when power is restored.

c) Single Phasing Prevention (all three phases if a three-phase unit is specified) and SPD's for over voltage and surge voltage protection.

d) Low DC voltage relay.

e) DC over-voltage relay.

f) Any failure of the charger, detected by any of these alarms, or protective devices shall be indicated locally, either by lights, or on the front of the rectifier and on local annunciation panel. These alarms shall be possible for grouping in one common alarm for remote transmission.

g) Forced air cooling system failure alarm shall be provided if such a cooling system is used.

h) Terminal blocks: Nut & Bolt type shall be used.

I) Zero of earth leakage detector system shall be earthed and voltage of +ve & -ve terminal of DC shall be equal in magnitude with respect to ground.

j) The circuit interruption on the DC side shall be by means of an electrically operated moulded case circuit breaker.

k) Instantaneous trip protection in the event of a short circuit or if the BATTERY CHARGER is connected with reverse polarity to the plant substation battery. HRC fuses shall be incorporated for this protection.

l) Instantaneous trip protection to provide over current protection to each limb of the rectifier bank. Semiconductor fuses shall be incorporated for this protection.

m) Unbalance current protection: This protection shall sense an unbalance current in each limb of rectifier with respect to the normal current. This shall be insensitive to the failure of one limb and shall continue to sense unbalance even with one limb out of circuit. This protection need not be provided if the rectifiers are so designed that none of the limb are overloaded at any time (even when one limb is out of circuit).

n) Protection against discharge of the battery into the battery chargers upon failure of AC supply, with automatic resumption of pre-set charging rate when power is restored.

2.2.4) **Noise Level:-** The level of the noise generated by the charger equipment, which is supplied under this specification, shall meet requirements as specified in the Guaranteed Technical Particulars (62dB).

In case the maximum level of the sound exceeds the specified allowable value, the Supplier/Manufacturer shall use acoustical treatment features, subject to review of KSEB and acceptance, to achieve the sound control design objectives.

2.2.5) **Nameplates, Labels and Marking:-** The nameplate shall be white with black engraved letters. On top portion of each battery bank and charger, on front as well as rear sides, larger and bold nameplates shall be provided to identify the charger. Nameplates with full and clear inscription shall also be provided on and inside of the panels for identification of various equipments and ease of operation and maintenance.

2.2.6) **Painting/Corrosion Protection:-** All sheet steel work shall be phosphated in accordance with IS-6005 "Code of practice for phosphating iron and steel.

Oil, Grease and dirt shall be thoroughly removed by emulsion clearing. Rust and scale shall be removed by picking with diluter acid followed by washing with running water, rinsing with slightly alkaline hot water and drying. After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed stowing type zinc chromate primer. The first coat may be "Lush dried" while the second coat shall be stowed. After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stowing. The second finishing coat shall be applied, after inspection of 1st coat of painting. The exterior paint colour shall be RAL7032. The interior colour shall be white. Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the panels.

2.2.7) **Interior Lighting and Receptacles:-** Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel during maintenance. The fittings shall be complete with switch fuse unit, panel door switch etc. for the automatic switching of the fitting. Each panel shall be provided with 240 V, Single phase, 50 Hz, 5 A, 3 Pin receptacles with switch. This shall be mounted inside the panel at a convenient location.

2.2.8) **Earthing:-** The charger panels shall be equipped with an earth fixed along with inside base of panel. The materials and sizes of the bus bar shall be at least 50 x 6 mm

tinned copper flat, unless specified otherwise, with two ground terminals, one at each end of the panel. Each ground terminal shall have two bolt drillings on the earth bus bars of the end panels for connecting to purchaser's earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply. All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the earth bus by independent copper wires of size not less than 2.5 Sq. mm. The colour of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connections and soldering shall be permitted. Earthing pad of minimum size 50 x 50mm shall be provided on the side of the panel. The copper ground bus shall be designed to withstand 50 kA for 1 sec.

2.2.9) **Cables:-**Appropriate ratings (min 35 sq.mm.) unarmoured acid-resisting single core cable from battery and battery charger to Fuse Box in battery room, with length not less than 35 meter, shall be supplied.

Conductors: Tinned annealed copper as per IS 8130:1984
Flexibility: Class 5 as per IS 8130:1984
Temperature Withstand: 90 deg Celsius
Insulation: XLPE as per IS 7098-I or PVC insulation as per IS 1554-I
Sheath: FR-LSH, Category C2 as per IS 7098-I or IS 1554-I
Sheath colour: Red and Black, for cables connected to +ve and –ve terminals respectively.

2.2.10) **ANNUNCIATION SYSTEM**:-

Solid–state, audio visual annunciation system shall be provided for battery chargers. Visual indication shall be provided to indicate the operating conditions of the charger by the means of indicating lamps/LED or annunciation facia windows as per EEUA-45D, arranged on the top of the charger panels.

Control power supply for Alarms & LED indications shall be fed from both Input AC & DC battery with proper isolation and auxiliary diode.

One (1) minimum twelve-points alarm facia shall be provided on float cum- boost charger panel, complete with proper actuating devices, circuitry, legends, push buttons (Accept, Reset and Test) and hooter.

The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button is pressed.

The following indications shall be provided in the charger and distribution panel to announce and monitor the following events.

AC supply failure

- Rectifier fuse failure
- Surge circuit fuse failure
- Output DC Filter fuse failure
- Load limiter operated
- Overload alarm and trip
- DC output high.
- DC output low.
- Charger on boost mode.
- DC earth leakage.
- AC Under voltage and over voltage.
- Float charger failure
- Boost charger failure
- Battery fuse blown / Battery isolator open.
- Single phasing alarm/phase sequence reversal protection
- Fan failure alarm.
- Battery fully discharged

Alarm shall be triggered at every event of faults. (Irrespective of persisting alarm)

Each time a window lights up, a master relay will get energized to provide group alarm signals for remote panel. In case of failure of charger on fault, it should give buzzer as well as LED indication. However, the buzzer alarm should be provided for battery fuse fail, load fuse fail and charger trip due to over load indication with an accept and reset switch.

3.0) TESTING AND INSPECTION:-

3.1) General:- Testing of the battery charger shall be performed in line with this specification and in accordance with the relevant IS/ IEC Standards (as minimum requirement) and other Standards as may be approved by KSEB Limited. The battery charger system shall be subject to inspection and test by KSEB Limited.

Acceptance by KSEB Limited representative of any unit shall not relieve the manufacturer from any of his performance guarantees or from any other obligations. Test certificates for each unit shall be submitted prior to delivery of the unit.

KSEB Limited reserves the right to perform checks during manufacturing process at any time or all the times. It shall be at the discretion of KSEB Limited to witness tests on 100% or any percentage quantity of each lot for routine tests, apart from the type tests, wherever called for.

Zero of Earth Leakage Meter shall be earthed. Both sides shall be ± 55V.

3.2) **Factory Tests:-**

Type Tests:- All equipment to be supplied shall be of type-tested quality. The bidder shall furnish all type test reports for KSEBL approval. The Type tests should have been carried out within last seven years from the date of bid opening on the bid item and the tests should have been conducted as per clause 9 of Annexure-I, Conditions for Pre-Qualification of Part I of Pre-Qualification Bid. Type tests witnessed by an approved agency acceptable to KSEB Limited shall also be considered.

In the absence of such type tests reports or in case such reports are not found to be meeting the specification/ standards requirements, bidder shall conduct all such type tests without any commercial/ delivery implication to KSEBL according to the relevant standards and reports shall be submitted to KSEBL for approval.

However, if deemed necessary, KSEB shall decide if additional special tests are required to be performed by the Supplier/Manufacturer. The Supplier/Manufacturer shall supply certified copies of type test certificates covering the proposed battery chargers of similar operating range, data features, design and construction.

The battery charger system/equipment shall be fully type tested, including capacity test, No load test, insulation test and temperature rise test, as defined in the relevant IS/ IEC recommendation (as a minimum requirement).

Evidence shall be given that the battery charger under these specifications, have successfully passed all type tests of design, service frequency, impulse, insulation level, dynamic operating range, and electrical and mechanical endurance performance, as appropriate and as specified.

The bidder shall furnish Type Tests reports for each type & rating of battery charger. The following tests shall constitute the type tests as per standards:

i) Temperature rise test at full load

ii) Temperature rise test for rectifier assembly at current specified in GTP.

iii) Insulation resistance test.

iv) High voltage (power frequency) test on power & control circuits except low voltage electronic circuit

v) Ripple content test at no load, half and full load.

vi) Automatic voltage regulation operation test at specified AC supply variations at no load, half and full load

vii) Short circuit test at No Load and full Load at rated voltage for sustained short circuit

viii) Load limiter operation test

ix) Efficiency and power factor measurement: The test shall be carried out at input minimum voltage and maximum input voltage adjusted through a variac at input side. An adjustable resistance load shall be connected across the output terminals. Load current shall be adjusted to the set value as nearly as possible at both minimum and maximum input voltage. The tests shall be carried out individually for specific current values specified under trickle and boost charge conditions. For this test, input current, voltage and power on the AC side shall also be recorded at the minimum and maximum output voltages. The efficiency and the power factor shall then be computed from the test results.

x) Input and output surge withstand capacity test. Surge voltage as per ANSI- C37.90A shall be applied for a period of not less than 2 seconds at the following points of the charger operating at 50°C at full load:

a) Across each AC input phases

b) Across AC input line to ground

c) Across DC output terminals

d) Across each DC output terminal to ground

The charger shall not exhibit any component damage and there shall be no deterioration in performance of the charger.

xi) Environmental Tests: Steady state performance tests (temperature rise test at full load & load limiter operation test) shall be carried out before & after the following tests.

a) Soak test:- The electronic modules shall be subject to continuous operation for a minimum period of 72 hours. During last 48 hours, the ambient temperature shall be maintained at 50°C. The 48 hour test period shall be divided into 4 equal 12 hour segments. The input voltage during each 12hours shall be nominal voltage for 11 hours followed by 110% of nominal voltage for 30 minutes, followed by 90% of nominal voltage for 30 minutes.

b) Degree of protection test

xii) Complete physical examination

Type Test of rectifier transformer: Following tests shall be carried out on the rectifier transformer:

I) Measurement of resistance: Resistance of primary and secondary windings, shall be measured, preferably with a bridge instrument, at ambient temperature and recorded.

ii) Open circuit test: Rated primary voltage shall be applied to the primary of the transformer and the primary and secondary voltages and no-load losses shall be recorded keeping potentiometer at maximum and minimum positions.

iii) Short circuit test: With the control switches (potentiometer) set to the max. voltages and the secondary shorted, suitable voltage shall be applied to primary to pass the maximum rated current in the primary and the primary voltage, current and power shall be recorded and the full load losses calculated. This shall not exceed the guaranteed value by more than 10%.

If the presented type test reports are not in accordance with the above requirements, KSEB Limited may decide to ask for the type tests to be carried out in the manufacturer's premises or other places subject to the approval of KSEB Limited at no additional cost, and in the presence of an approved agency acceptable

to KSEB Limited and should issue the relevant type test certificates upon successful test.

3.2.1) **Sample Tests:-** Sample Tests shall be performed, comprising as a minimum the following tests.

1. Visual checks and measurements of dimensions.
2. Battery Charger labeling as per this specification.
3. Functional tests.

3.2.2) **Routine Tests:-** The Supplier/Manufacturer are required to carry out routine tests on each assembled and finished charger system to demonstrate the integrity of the DC Supply system. Routine test certificates shall be submitted for KSEB Limited's review and approval before shipment of the charger.

The battery charger shall pass all the routine tests as laid down in the relevant IEC/other specified Standard. The proposed routine tests are:

1) Visual inspection to determine conformity of the battery charger.
2) Insulation resistance test (HV test)
3) **Voltage regulation (both load and line regulation)** check from 0 to 100% loads with + / - 1 0 % voltage variation in all modes of charging
4) Ripple content measurement.

In addition to the standard routine tests on the charger, the following tests shall be performed:

- Load test and **temperature rise test for the transformer and thyristor**
- Automatic voltage regulator operation
- Performance test on the completed panel
- Surge withstand capacity test
- Load limiting feature
- Efficiency of the charger at full load

- Sensitivity of Ground fault protection cards
- Stability Test
- Dynamic response test
- DC short circuit test without blowing HRC fuses and without tripping MCBs at load terminal and also at Battery charger output terminals with observation of total current limit.

3.2.3) **Special Tests: -** The following test shall carried out in addition to what has been stipulated in the IEC Standard:-

1) Ripple Test (with and without battery)
2) Noise measurement
3) High voltage test on power and control circuits

3.3) **Acceptance Tests: -** The tests shall comprise but not limited to the following tests:

3.3.1) **Physical Inspection:-**

a) Checking of the battery charger cabinet interior to verify clearances between live electrical parts, insulation of phase and neutral buses from cabinet, and tightness of all mechanical connections.

b) Checking of main breaker trip element dimension and ratings at the battery charger cabinet shall be performed and comparison with the approved wiring diagrams.

c) Checking the operation of the main breaker by application open-close-open sequence manually.

d) Checking of wiring termination and conductor sizes.

e) Checking of tightness of connection and fastenings, and use of proper tools.

f) Checking the correct phasing of equipment connection.

g) Checking the proper grounding.

h) Checking of all current carrying connections, including bus connections and wiring, as installed by Supplier/Manufacturer, in agreement with wiring drawings.

i) Checking of physical integrity of major parts and all instruments and components.

j) Checking of proper battery charger cabinet and cable identification **and proper terminations.**

k) Checking the correct circuit **fuse rating.**

l) Checking the ratings, dimensions, protection class of all major components, as panels, cubicles, silicon rectifiers, buses, circuit breaker, fuses, relays, transformers, etc. and confirmation that the equipment complies with the specification. Any non-compliance shall be reported to the Contracting Officer.

3.3.2) **Tests:-**

a) Polarity check.

b) Proper settings and calibrations **of all equipment used.**

c) Meter calibration and operation.

d) Functional check of all alarm circuits including low voltage, ground detection and AC failure.

e) Insulation resistance test.

f) Output ripple test.

g) The ability of the charger to maintain this desired operating voltage level.

h) Testing of breaker trip settings.

i) Measurement the continuity of each current carrying connection by MEGGER.

j) Testing the changing output voltage function by disconnected battery.

k) Testing the quick charge and trickle charge mode.

l) Testing the charging current limiting (maximum current) by short-circuited DC output.

m) Testing of automatic periodic dis-charging/re-charging.

n) Testing the Battery Charger inputs/digital outputs and control (LED's) and protection functions at/from the Battery Charger Board.

o) Testing the Battery Charger inputs/digital outputs, alarm indications (LED's) and fault monitoring at the Battery Charger Board.

p) Measurement of Voltage Regulation.

q) Efficiency of the charger at full load.

r) Sensitivity of Ground fault protection circuits.

3.3.3) **TESTS AT SITE:-** The KSEBL reserves the right to conduct all the test on the Battery charger after arrival at site and the Supplier/Manufacturer shall guarantee routine test certificate figures under actual service conditions. The Supplier/Manufacturer shall verify the full operational functionality of the system by performing a site acceptance test (SAT) after installation of all equipment. Initial charging/discharging cycle of battery at sufficient load is also included in the scope of SAT. SAT shall be carried out before acceptance and handing over of the system. The system shall be considered for acceptance only if its performance complies with the technical requirements.

Following typical checks to be carried out at site:

Preliminary Checks

a) Check name plate details of all associated equipment according to specification.
b) Check for physical damage.
c) Check tightness of all bolts, clamps and connecting terminals.
d) Check cleanliness.
e) Check earthing.
f) Check for Lamps, Sockets etc.
g) Check for general layout.
h) Check provision of all protective relays, meters and transducers as per drawing.
i) Check for proper mounting of power devices like thyristors, Diodes etc. on heat sinks.

Commissioning Checks

a) Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawings. All interconnection between panels / equipment shall be similarly checked. Check connections (AC, DC & Battery connection).
b) Insulation test of all circuits: All the wired terminals shall be meggered to earth. Megger test between bus bars and bus bars to earth.

c) Settings of relays, MCCBs, other alarms tripping devices and interlocks as per scheme.

d) Functional checking of all control circuits including float, equalise and boost conditions, metering and relay circuits.

e) Insulation resistance test of all circuits.

f) Measurement of voltage regulation.

g) No load current and voltage (AC) and voltage and current (both AC. and DC.) at different loads.

h) Measurement of harmonics injected in to the system for different loading conditions.

i) Measurements of output voltage ripple contents.

j) Checking of battery current limit setting and verification of rectifier control circuitry under various conditions of operation.

k) Test for diode voltage regulator operation.

l) Voltage at the tap cell (while boost charging).

m) Priority logic test on integrated set of Charger for transfer of charger.

n) All interlocks and sequence operation of circuits such as indications on front panel, alarms and trips shall be shown.

o) Functional tests on rectifiers control.

p) Functional check of auxiliary devices such as alarms, indicating lamps etc.

4.0) Documents: - User/Technical/ commissioning Manual shall be submitted for approval Manual shall contain following information but not limited to the same.

1) General arrangement drawing with main dimensions.

2) Detailed drawing and explanation showing all functional block diagram, user inputs, user accessible settings, controller card, thyristor assembly, DC distribution, Alarm circuited layout etc.

3) Detailed description of working of charger in Float Mode, Boost Mode (Manual and Automatic), Initial charging of Batteries, various configuration settings, pre cautions to be taken in handling and commissioning etc shall be explained in Manual.

4) Detailed proposed wiring diagram. As Built wiring diagram shall be provided along with equipment after implementing all approved deviations.

5) Bill of Materials

4.1) Important points to be included in the drawing:-

1) Battery charger circuit to be shown clearly including the functions of each mode (Auto, Float and Boost) and shall be explained in the drawing as foot note for O&M application at site.

2) Initial charging facility provided to be specified.

3) Power circuit wiring shall be provided with adequate cable capacity up to 15A Charger transformer circuit 4 mm2 and above 15A charger 10 mm2 minimum. For PCB related components with small terminals, cables with appropriate current rating should be used. Direct soldering of control wires in PCB board is not allowed.

4) Rear side door should be manufactured as double leaf whose panel width above 600mm size for easy maintenance and due to space constrains in the substation.

5) The rectifier transformer used in the power circuit and control circuit should be manufactured with copper winding with adequate VA and as per IS 2026 and its latest amendments. The connection shall be Star/Star or Star/Delta. The minimum VA required for the charger is 2500/5000/10000 for 15A/30A/60A chargers respectively.

6) Single phase prevention scheme & SPD's protection scheme including direction of circuit activation to be specified.

7) Voltage and current selection scheme to be clearly shown.

8) Supply side and battery side fuses and electronic switch contacts should be provide with adequate capacity/ rating. Over rated contacts paralleling not recommended, preferably use single contacts with adequate rating or use 2 equal rating of contacts in parallel.

5.0) **Training:-** Training shall be provided at site free of cost for the KSEBL's engineers and technicians.

6.0) **Installation Commissioning:-** Installation shall be done by KSEB Limited and advance notice will be given for commissioning. Commissioning of charger and onsite training are responsibilities of Supplier/Manufacturer. Manufacturer of Battery Charger shall supervise the installation and commissioning and perform commissioning tests as recommended in O&M

manual / or relevant standards. All necessary instruments, material, tools and tackles required for installation, testing at site and commissioning are to be arranged by the Supplier/Manufacturer.

Sd/-

Chief Engineer (SCM & CSC)

GUARANTEED TECHNICAL PARTICULARS

(Technical Particulars of Type tested item/ model which is offered as per the technical specification of this tender shall be furnished)

Sl. No.		Required	Tendered		
1	**BATTERY CHARGER**		**15A**	**30A**	**60A**
1.01	**General**				
1.01.1	Manufacturer				
1.01.1.1	Name				
1.01.1.2	Country of manufacturing				
1.01.2	Applicable Standards	IEC 60146 (1963) Reaffirmed in: 2016			
1.01.3	Configuration	3 Phase 4 wire thyristor controlled full wave bridge rectifier with float cum boost charger			
1.01.4	Type test	To be carried out at any approved lab/witnessed by Central Govt. Utility Engineer/ KSEB Engineer			
1.01.4.1	Carried out	Yes/No			
1.01.4.2	Date	DD/MM/YY			
1.01.4.3	Testing Laboratory	-			
1.01.4.3.1	Name	-			

1.0.1.4.3.2	Country	-			
2.02	**Design Data**				
2.02.1	AC input details				
2.02.1.1	Rated input voltage (if 3 phase) (V)	415V-15%+10%			
2.02.1.2	Rated frequency Hz	50			
2.02.1.3	Input Power VA	2500/5000/ 10000 for 15 A/30 A/60 A respectively			
2.02.2	Nominal output voltage V	110			
2.02.3	Charger characteristics follows	Float Cum Boost Charger			
2.02.4	Constant voltage/constant current	Yes			
2.02.5	Output voltage stability from no load to full load with the AC variation as specified above %	0.5			
2.02.6	Radio interference suppression degree of interference	Yes			
2.02.7	Charger continuous rated output current	100%			

		(at 40^0c) including the derating factor				
	2.02.7.1	On float mode A	15/30/60 A			
	2.02.7.2	On boost mode A	15/30/60 A			
	2.02.8	Ripple content in DC output	<1%			
	2.02.8.1	With battery mV	1			
	2.02.8.2	Without battery mV	<1.5%			
	2.02.9	Charger rated output voltage	110 V DC normal Up to 150 V for initial charging			
	2.02.9.1	Float charging Voltage	90-127 VDC			
	2.02.9.2	Boost charging Voltage	0-150 VDC			
	2.02.10	Load limiter current setting range for float charge %	100 %			
	2.02.11	Time required to charge an empty battery after a discharge cycle Hrs	10 Hrs			
	2.02.12	Automatic voltage regulator (float/boost charge)	Yes			
	2.02.12.1	Type				
	2.02.13	Manual voltage regulator	Yes			

		(float/boost charge)				
	2.02.13.1	Type	Potentio-meter			
	2.02.13.2	Voltage setting range V	Float 90-127 V Boost 90-150 V			
	2.02.13.3	Boost charging current setting range A	>1.5 to 15 A >3 to 30 A > 6 to 60 A			
	2.02.13.4	Boost charging voltage limit setting range V	90-150 VDC			
	2.02.14	Rectifier input transformer				
	2.02.14.1	Manufacturer				
	2.02.14.1.1	Name				
	2.02.14.1.2	Country of manufacturing				
	2.02.14.2	Type (3Ø Star-Star or Star - Delta)	Double wound dry type with copper winding			
	2.02.14.3	Rated power	2500/5000 /10000 for 15 A/30 A/60 A			
	2.02.14.3.1	Float charging KVA	Preferably 100 %			
	2.02.14.3.2	Boost charging KVA	100 %			
	2.02.14.4	Class of insulation	Class F			
	2.02.14.5	Power frequency withstand voltage(1 min) KVrms	>=2			

	2.02.14.6	Overload capacity %	110			
	2.02.15	DC Instrument				
	2.02.15.1	Voltmeter				
	2.02.15.1.1	Manufacturer				
	2.02.15.1.1.1	Name				
	2.02.15.1.1.2	Country of manufacturing				
	2.02.15.1.2	Type				
	2.02.15.1.3	Range V	0-150 V			
	2.02.15.1.4	Accuracy class %	1			
	2.02.15.2	Ammeter for load current				
	2.02.15.2.1	Manufacturer				
	2.02.15.2.1.1	Name				
	2.02.15.2.1.2	Country of manufacturing				
	2.02.15.2.2	Type	Analogue			
	2.02.15.2.3	Range	Min 150 % of FL			
	2.02.15.2.4	Accuracy class %	1			
	2.02.15.3	Ammeter for battery				
	2.02.15.3.1	Manufacturer				
	2.02.15.3.1.1	Name				
	2.02.15.3.1.2	Country of manufacturing				
	2.02.15.3.2	Type	Analogue			
	2.02.15.3.3	Range Current	Centre Zero meter with 150% FL capacity			

	2.02.15.3.4	Accuracy class %	1			
	2.02.16.	AC Instrument				
	2.02.16.1	Voltmeter				
	2.02.16.1.1	Manufacturer				
	2.02.16.1.1.1	Name				
	2.02.16.1.1.2	Country of manufacturing				
	2.02.16.1.2	Type				
	2.02.16.1.3	Range Voltage	0-500 V			
	2.02.16.1.4	Accuracy class %	1			
	2.02.16.2	Ammeter				
	2.02.16.2.1	Manufacturer				
	2.02.16.2.1.1	Name				
	2.02.16.2.1.2	Country of manufacturing				
	2.02.16.2.2	Type	Analogue			
	2.02.16.2.3	Range	Based on Transformer input VA			
	2.02.16.2.4	Accuracy class %	1			
2.02.17		Float charging A	Depends on charger capacity			
2.02.17.1		Boost charging A	150% of FL			
2.02.17.2		Short time current rating A	>110 - 150 % of rated current			
2.02.17.3		Float charging A	Based on charger capacity			
2.02.17.4		Boost charging A	150% of FL			
2.02.17.5		Type of semi-conducting material	Silicon			

2.02.17.6	Rectifier input protection	Ultra fast rectifier fuses with fuse failure alarm			
2.02.18	DC Outlet MCBs for 15A Charger (i) DP- 3Nos. A (ii) DP-12Nos.A	 25 16			
2.02.19	DC Outlet MCBs for 30A Charger (i) DP- 2Nos. A (ii) DP- 6Nos.A (iii) DP- 12Nos. A	 50 25 16			
2.02.20	DC Outlet MCBs for 60A Charger &DCDB (i) DP- 4Nos. A in charger (ii) DP- 4Nos. A (2 in Charger & 2 in DCDB) (iii) DP- 32Nos. A in DCDB	 100 50 35			
2.02.21	Guaranteed efficiency at rated load %	80			
2.02.22	Noise level (maximum) dB(A)	62			
2.02.23	Automatic voltage regulators	Yes			
2.02.24	Automatic current regulators	Yes			

2.02.25	Soft start feature	Yes			
2.02.26	Smoothing resistor/capacitor filter circuit	Yes			
2.02.27	Selector switch for automatic and manual	Yes			
2.02.28	Climatic requirement				
2.02.28.1	Operation temperature (max.) ^{0}C	40			
2.02.28.2	Operation temperature (min.)^{0}C	4			
2.02.28.3	Relative humidity				
2.02.28.3.1	Maximum %	95			
2.02.28.3.2	Minimum%	5			
2.03	**Other Performance Data**				
2.03.1	First commercial operation of the battery charger DD/MM/YY				
2.03.2	Reference list attached Yes/No				
2.04	**Supporting Documents**				
2.04.1	All drawings and technical literature of	Yes			

	battery chargers enclosed				
3.00	**TESTS**				
B.	**Battery Charger**				
3.01	Insulation test	Yes			
3.02	Load test	Yes			
3.03	Ripple test	Yes			
3.04	Noise measurement test	Yes			
3.05	Voltage regulation checks	Yes			
3.06	Current limit facility test	Yes			
3.07	Recharge test of discharged battery	Yes			
3.08	Checking of all auxiliary contacts	Yes			
3.09	Alarm indications checks	Yes			
3.10.	Verification of voltage and current adjustments	Yes			
3.11	Heat Run Tests	Yes			

4.00	**SUPPORTING DOCUMENTS**				
4.01	All assembly and detailed drawings	Yes			
4.02	Technical literature of chargers enclosed	Yes			
4.03	Type test reports enclosed	Yes			

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