

**TECHNICAL QUALIFYING REQUIREMENT
(UDANGUDI PROJECT)**

Item: 220V & 48 V BATTERY CHARGER

The bidder/OEM should have designed, manufactured and supplied 48V & 220V DC, SMPS BASED, FLOAT CUM BOOST CHARGER. Supporting document in this regard to be submitted with offer.

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30/10/19

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BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN	<i>[Signature]</i>	<i>[Signature]</i>
TITLE	220V & 48 V BATTERY CHARGER			NAME	SS	SKS
				DATE	19/10/19	19/10/19
				GROUP	TBEM	W.O. No
OWNER	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)					
PROJECT	2 x 660 MW Udangudi STPP (Stage-I)					
SYSTEM	Electrical					

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1 Scope, Quantities, Specific Technical Requirements & Tests

1.1 Scope

The scope of work includes design, engineering, manufacture, testing & inspection, packing, loading at works and transport to site of **220V & 48V Battery Chargers, MCCB box & Discharge resistor** along with its accessories etc. as mentioned in this section and in various other sections of this specification. The scope also includes testing, commissioning and supervision of Erection of 220V & 48V Battery Chargers, MCCB box & Discharge resistor.

Charger shall be sized for below mentioned battery system:

S. No.	Item description	Quantity	AH CAPACITY
1	220V Battery: Lead Acid Plante Battery (High Discharge type)	2 Set (108 cells each)	535
2	48V Battery: Lead Acid Plante Battery (High Discharge type)	2 Set (24 cells each)	645

The equipment is required for the following project:

Name of customer :TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)

Name of the project : 2 x 660 MW Udangudi STPP (Stage-I)

Refer section-3 of this document for project details and general specification.

1.2 Quantities

S. No.	Item description	Quantity	Remarks
1	SUPPLY- BATTERY CHARGER : 220V DC, SMPS BASED, FLOAT CUM BOOST CHARGER	2 No.	
2	SUPPLY- BATTERY CHARGER : 48V DC, SMPS BASED, FLOAT CUM BOOST CHARGER	2 No.	
3	SUPPLY-DSICHARGE RESISTOR FOR 220V BATTERY	1 No.	
4	SUPPLY-DSICHARGE RESISTOR FOR 48V BATTERY	1 No.	
5	SUPPLY-MCCB BOX FOR 220V BATTERY	2 No.	
6	SUPPLY-MCCB BOX FOR 48V BATTERY	2 No.	
7	SPARES- BATTERY CHARGER : 220V DC, SMPS MODULE	10 Nos.	of each type & rating
8	SPARES- BATTERY CHARGER : 220V DC, LED lamps	5 Nos.	of each type & rating
9	SPARES- BATTERY CHARGER : 220V DC, Contactors	2 No.	of each type & rating
10	SPARES- BATTERY CHARGER : 220V	1 LOT	5% of total population of each

	DC, MFM (MULTIFUNCTION METER)		type & rating or one number whichever is higher
11	SPARES- BATTERY CHARGER : 220V DC, Blocking Diode	1 LOT	5% of total population of each type & rating or one number whichever is higher
12	SPARES- BATTERY CHARGER : 220V DC, Relay	1 LOT	5% of total population of each type & rating or one number whichever is higher
13	SPARES- BATTERY CHARGER : 220V DC, Electronic circuit module	1 LOT	1 No. of each type & rating
14	SPARES- BATTERY CHARGER : 220V DC, MCCB	1 LOT	10% of total population of each type & rating or one number whichever is higher
15	SPARES- BATTERY CHARGER : 220V DC, Voltage regulator assembly	1 LOT	10% of total population of each type & rating or one number whichever is higher
16	SPARES- BATTERY CHARGER : 48V DC, SMPS MODULE	10 Nos.	of each type & rating
17	SPARES- BATTERY CHARGER : 48V DC, LED lamps	5 Nos.	of each type & rating
18	SPARES- BATTERY CHARGER : 48V DC, Contactors	2 No.	of each type & rating
19	SPARES- BATTERY CHARGER : 48V DC, MFM (MULTIFUNCTION METER)	1 LOT	5% of total population of each type & rating or one number whichever is higher
20	SPARES- BATTERY CHARGER : 48V DC, Blocking Diode	1 LOT	5% of total population of each type & rating or one number whichever is higher
21	SPARES- BATTERY CHARGER : 48V DC, Relay	1 LOT	5% of total population of each type & rating or one number whichever is higher
22	SPARES- BATTERY CHARGER : 48V DC, Electronic circuit module	1 LOT	1 No. of each type & rating
23	SPARES- BATTERY CHARGER : 48V DC, MCCB	1 LOT	10% of total population of each type & rating or one number whichever is higher
24	SPARES- BATTERY CHARGER : 48V DC, Voltage regulator assembly	1 LOT	10% of total population of each type & rating or one number whichever is higher
25	SERVICES- BATTERY CHARGER : 220V DC SUPERVISION OF INSTALLATION, TESTING AND COMMISSIONING OF CHARGER	2 No.	
26	SERVICES- BATTERY CHARGER : 48V DC SUPERVISION OF INSTALLATION, TESTING AND COMMISSIONING OF CHARGER	2 No.	

Note: Any special tools & tackles if required for Battery Chargers, MCCB box & Discharge resistor installation & commissioning, the same shall be inclusive in supplier scope (1 set

non-returnable)

Quantity variation = $\pm 30\%$

1.3 Specific Technical Requirements

- 1.3.1** The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant Indian Standards, and IEC publications and any other standards, if any, except where modified and /or supplemented by this specification
- 1.3.2** AC input supply to charger: 415V, 3-Phase, 4 wire
- 1.3.3** DC supply: 220 V (+10% & -15%), DC, 2 wire, unearthed.
- 1.3.4** Communication system DC supply: 48 V (+10% & -15%), DC, 2 wire, +ve pole earthed.
- 1.3.5** Battery load cycle (FOR CHARGER SIZING):

1. System voltage: 220 V

Max. Voltage = (Sys. Vol. +10%)

Min. Voltage = (Sys. Vol. -15%)

LOAD & CORRESPONDING DURATIONS		
LOAD A1(Amps.)	57.24	119 min
LOAD A2(Amps.)	232.39	1 min

Charger output current = 100A

2. System voltage: 48 V

Max. Voltage = (Sys. Vol. +10%)

Min. Voltage = (Sys. Vol. -15%)

LOAD & CORRESPONDING DURATIONS		
LOAD A1(Amps.)	44	600 min

Charger output current = 110A

- 1.3.6** The following DC systems shall be provided for switchyard area (**Battery & DCDB not in scope of supply for this specification**):
- 220V DC system will be an unearthed system comprising of 2 x 100% rated 220V DC Batteries (lead acid plante type) with associated 2 x 100% SMPS based float cum boost charger and common DC Distribution board.
 - 48V DC system will be an unearthed system comprising of 2 x 100% rated 220V DC Batteries (lead acid plante type) with associated 2 x 100% SMPS based float cum boost charger and common DC Distribution board.
- 1.3.7** Float mode of SMPS-FCBC charger shall be sized for the following:
- Continuous normal DC power requirement.
 - Trickle charging of battery.
- 1.3.8** Boost mode of SMPS-FCBC charger shall be sized to boost charge the fully discharged battery to its normal capacity in a period of 8 hours in case of lead acid batteries.

- 1.3.9 In case of failure of one charger, the other charger shall be capable of float charging both the battery banks (1&2).
- 1.3.10 Voltage regulating diodes shall be provided to limit the voltage with in permissible limits during boost charging.
- 1.3.11 In case of mains failure to charger or charger failure, battery shall supply the full load. After the restoration of supply, selected boost charger shall boost charge the battery and the selected float charger shall supply the DC load.
- 1.3.12 A design margin of 10% shall be considered in selecting the rating of chargers. Higher of the float charging rating and boost charging rating is considered for sizing the FCBC Charger. SMPS charger shall be modular type. For modules of up to 5, one additional module shall be provided for redundancy and for modules of above 5, two additional module shall be provided.

1.4 Tests

- 1.4.1 All type, routine and acceptance tests shall be conducted on the Battery Chargers, Fuse box & Discharge resistor as per applicable standard with latest amendments. Copies of from accredited LAB certified reports of all type tests carried out on similar type and rating shall be furnished. **All type tests reports for offered material shall not be older than (5) years from 02/07/2015, that is 02/07/2010.** In case the test reports are earlier than 02/07/2010, the bidder shall repeat these test(s) at no extra cost to BHEL.
- 1.4.2 In case type test reports are found to be technically unacceptable to BHEL/TANGEDCO, the type test shall be conducted without cost and delivery implication to BHEL.
- 1.4.3 Type Test reports shall be submitted for approval before the dispatch of Equipment.
- 1.4.4 Following tests shall constitute functional tests for the charger panel.
- Voltage regulation
 - Ripple content at different loads and noise measurement
 - Insulation resistance test
 - General operation
 - Voltage/current stability test
 - High voltage test
 - Measurement of surface temperature of charger panel
 - Current limiting features.
 - Efficiency & PF measurement
 - Temperature Rise test
 - Short circuit at full load
 - Short circuit at No load
- 1.4.5 Following tests shall constitute type tests on the charger panel.
- Degree of protection Test for Battery Charger Panel
 - Vibration Test of the Electronic Card Rack/Panel
 - Environmental Tests on the Electronic Cards
 - RFI Test
 - Surge Withstand capability Test



1.4.6 Site tests for charger

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out

- Complete physical examination
- Checking of proper operation of annunciation system
- Temperature rise test at full load
- Insulation resistance test
- Automatic voltage regulator operation
- Load limiter operation.
- Dynamic response test -overshoot/ undershoot in output voltage of the charger as a result of sudden change in load from 100% to 20% and 20% to 100% shall be measured with the batteries connected and disconnected. Output voltage of the charger connected with battery shall be within 94% to 106% of the voltage setting in above conditions and shall return to, and remain, within the limits specified as mentioned elsewhere, in less than 2 seconds (as applicable).

2 Equipment Specification

2.1 Technical Requirements

2.1.1. Charger shall be SMPS type and shall have following features:

- Pulse width modulation
- High frequency DC/AC converting
- Voltage stabilization tolerance: $\leq \pm 0.5\%$
- Current stabilization tolerance: $\leq \pm 0.5\%$
- Ripple coefficient: $\leq 0.05\%$
- Power factor: ≥ 0.92
- Efficiency: $\geq 92\%$
- Standby mode: N+1 module on-line
- MTBF: $\geq 100,000$ h
- Remote control functions
- Modular Design
- LCD Control Display Panel
- Multi-Point Monitoring
- Remote Communication
- Software Programmable (PLC Based)
- AC Ripple $< 0.5\%$
- Dynamic Response < 100 micro. sec.
- THD $< 5\%$
- Enhance earth fault monitoring
- Tunable Output
- Intelligent float boost & equalize charging
- Temperature compensated charging for VRLA
- Calculating battery charge/ discharge capacity
- Discharge calculation with K factor & temperature compensation
- Total control on each charging module
- Storing historic alarms
- Remote communication with RS 232 & 485
- Ground fault identification suitable for opto-coupler loads
- Both positive & negative monitoring

2.1.2. The Insulation monitoring system shall on-line monitor the insulation between the DC bus and the earth, as well as the grounding resistance and capacitance of branches. The detector shall be divided into two parts: master and slave. The master shall monitor the bus, while the slave shall monitor the system output branches. Each master shall be configured with a built-in slave. It shall have following features:

- Real-time monitoring combined with branch polling.
- RS485 serial port communication.
- Capable of monitoring one or two sections of independent DC buses.
- Automatic capacitance compensation function addressing the big branch capacitance, ensuring measurement precision of branch grounding resistance.
- Alarm threshold configurable through controller.
- Capable of monitoring equal insulation deterioration at positive bus and negative bus.

- Capable of self-checking, convenient for maintenance.
 - The master being capable of dry contact output for dual-section bus poor insulation alarm.
- 2.1.3.** The charger shall be able to monitor the battery parameters, charge/discharge current and ambient temperature. Its function shall include:
- Carrying out current-limit boost charge (BC) automatically according to the preset conditions after the battery discharge.
 - Carrying out normal battery BC by controlling the bus voltage.
 - Carrying out timed battery BC and BC/FC voltage temperature compensation automatically.
- 2.1.4.** The battery insulation monitoring relay shall monitor the insulation of the DC system. The insulation relay shall observe and when bus insulation deteriorates to a certain set level, the faulty branch shall be identified and reported to controller and alarm shall be made.
- 2.1.5.** The charger system shall transfer battery from float charge (FC) to boost charge(BC) based on the battery charge current, and from BC to FC based on the charge current and time. It shall be equipped with a temperature sensor, to make temperature compensation to the FC voltage. Based on the battery current and total load current, the system shall ensure the charging effect and prolong the battery life span by adjusting rectifier output current and current limit to control battery current and voltage, and prevent battery over charging-current.
- 2.1.6.** The scheme shall employ a SMPS based dual Float cum Boost charger with centralized monitor and control unit. The system shall operate with 3 Phase AC supply of 415V, 50 Hz. Each individual charger shall be provided with AC 3 pole MCCB on the input side enables to isolate the system from the AC mains. The system shall be provided with 3 Phase Surge Protection Device on the input side. Each charging rectifier module shall be provided with individual MCBs at the input for isolation. All the charging rectifier modules of each charger shall be connected in parallel and configured as Float cum Boost Charger. The MCCB of suitable rating shall be provided on the DC output side for isolation.
- 2.1.7.** In normal operation, both the chargers are working in Float mode float charging the batteries connected to it and simultaneously feeding the rated DC load. In case of failure of either of the chargers, the other charger will Float charge the batteries and simultaneously feeding the rated DC load. During of mains failure, the batteries will take care of the complete DC load without any break. When the mains supply is restored, the discharged batteries requires to be boost charged. Under this condition, one of the charger is put into boost mode for charging the battery bank connected to it while it is disconnected from the system load. During this time, the other charger will be float charging the battery connected to it while feeding the rated DC load. After completion of boost charge of one of the battery set, the respective charger is put into Float mode and the other charger is put into boost mode for charging the other discharged battery.
- 2.1.8.** The DC output voltage of the Float charger shall be maintained within $\pm 0.5\%$ of the set voltage with output ripple content less than 0.05% for the specified input voltage range. The FCBC shall be capable of boost charging the batteries in constant current mode settable from 10% to 100% of the rated current. The current shall stabilized within $\pm 0.5\%$ of the set value for the specified voltage range. The automatic changeover from Boost to Float mode and vice versa shall be controlled by monitoring.

- 2.1.9.** Insulation monitoring system for monitoring the insulation of individual DC feeders shall be included in the system. The feature of individual DC feeder status monitoring shall also provide in the system, placed in the DCDB.
- 2.1.10.** A separate unit of suitable rating called Super Filter consisting of Filter circuits for reducing the input harmonics to the specified level shall be placed between the AC mains supply and each Battery charger unit.
- 2.1.11.** A separate DCDB consisting of the specified incoming & outgoing DC feeders shall be provided.
- 2.1.12.** Digital indicating meters shall be provided on the front to read the following. Further transducers shall be provided for these measurements and shall be connected to remote DCS/EMS/SAS for remote monitoring.
- AC incoming voltage
 - AC incoming current
 - DC output voltage of float cum boost charger
 - DC output current of float cum boost charger
 - DC charge/discharge current of battery
 - DC load voltage
 - DC load current
 - DC leakage current
- 2.1.13.** The following LED Status indications shall be provided as a minimum on the panel for each Charger.
- Battery status
 - R,Y,B supply ON
 - Float charger ON
 - Boost charger ON
- 2.1.14.** The following annunciations shall be provided as a minimum on the panel for each Charger.
- Charger overload
 - Charger fail/trip
 - DC output MCCB failure
 - Positive grounded
 - Negative grounded
 - AC input supply of float cum boost charger failure
 - Battery fully discharged
 - Battery on Boost.
 - AC input supply failure
 - AC input under voltage
 - DC voltage low
 - DC voltage high
 - DC system earth fault.
 - SMPS module fail
- 2.1.15.** For remote indication/ Annunciation in DCS/EMS/SAS, the following potential free contacts shall be provided for each Charger.
- DC system under voltage /over voltage



- Battery on Boost
- AC under voltage /AC Over voltage
- Charger fail
- DC earth fault
- Battery fully discharged
- AC Overload trip
- SMPS module fail

2.1.16. Isolated 4-20 mA signals for DC voltage, Current, AC input Voltage current, frequency, Inverter output Voltage and current etc., and alarm signals for Charger Over Load ,AC input supply failure, DC voltage Low, DC voltage High, DC system earth fault, DC output MCCB failure, Discharge Resistor connected etc. shall be considered for remote connection to DCS/EMS/SAS.

2.1.17. MCCB shall be Triple pole type for incoming supply to Battery charger, Double Pole type for outgoing supply from Battery charger. It shall be quick make, quick break, and independent manual type with trip free feature. All MCCB shall have the following:

- Short circuit release
- ON/OFF Trip position indicators
- Test trip push button
- Voltage rating shall be suitable for 500 volts AC/DC.

2.1.18. The annunciation system shall have audio-visual arrangement and shall have LCD display. It shall also be provided with acknowledge, reset and test push buttons. On occurrence of fault, the corresponding LED lights up and stays in lighted condition until the fault is cleared and the reset push button is pressed.

2.1.19. Chargers shall be metal enclosed, fixed type, suitable for indoor mounting on floor. Panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. The frames shall be enclosed by cold rolled sheet steel of thickness not less than 1.6 mm. At bottom removable gland plates of atleast 3 mm thick non-magnetic material shall be provided. All incoming and outgoing cables shall be terminated on suitable terminal blocks.

2.1.20. The charger panels shall be provided with an illuminating CFL lamp, a 5 Amp socket and space heaters with thermostat. Toggle switches and fuses shall be provided separately for each of the above fittings. Space heaters "ON" indication to be provided. Two separate grounding pads shall be provided for each panel suitable for connecting of GI earthing strip.

2.1.21. The panel shall be of sheet metal, enclosed, dust and vermin proof, conforming to IP 31 degree of protection. Battery charger shall be located in Air conditioned room.

2.2 Battery MCCB Box

2.2.1. For each Battery, MCCB box shall be provided for maintenance isolation and for short circuit protection.

2.2.2. The MCCB box shall comprise MCCB sized for the Battery capacity.



- 2.2.3. MCCB shall be designed to carry the rated current in both direction of current flow and also shall protect against the short circuit in both the direction.
- 2.2.4. It shall be enclosed in sheet steel enclosure of at least 2 mm, having IP: 54 degree of protection.
- 2.2.5. The MCCB box shall be wall mounted type located in Battery room.
- 2.2.6. MCCB shall be double pole type rated for DC. It shall be quick make, quick break, and independent manual type with trip free feature. It shall have the following:
- Short circuit release
 - ON/OFF Trip position indicators
 - Test trip push button
 - Voltage rating shall be suitable for 220 volts DC.

2.3 Discharge Resistor

Discharge resistor shall be provided for testing the Battery. The discharge resistor shall be adequately sized for charge – discharge cycle testing of different type & rating of batteries with necessary tapping. It shall be enclosed in sheet steel enclosure of at least 3 mm, having IP: 31 degree of protection. Resistor shall be of punched stainless steel. Temperature rise shall be limited to 150 degree C over ambient. The Discharge resistor shall be mounted on trolley with bi-directional wheels.

2.4 PAINTING

Painting shall be carried out by an approved process by powder coating. After preparation of the under surface, the equipment shall be painted with epoxy based paint. The final thickness of paint film on steel shall not be less than 50 microns. Final shade shall be RAL-7035 (light grey).

2.5 Information to be furnished after order

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Battery sizing calculation
- Technical data sheet
- General arrangement, layout drawing and section
- Battery room layout
- Rating factor & Battery selection table
- Erection and commissioning procedures
- Operation and maintenance manual
- Test reports
- Manufacturing quality plan

2.6 Technical documents to be furnished with the offer

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Charger sizing calculation



- Technical data sheet
- General arrangement, layout drawing and section
- Charger room layout
- Schematic wiring diagram
- Drawing for MCCB box
- Drawing for discharge resistor
- Erection and commissioning procedures
- Operation and maintenance manual
- Test reports



3 General Technical Requirements

Please refer TB-400-316-000-REV 01: 'General Technical Requirements- Section 3'