



SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification **Group : BESS system**

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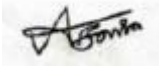


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PREBID TECHNICAL SPECIFICATIONS FOR EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT BHEL/NTPC RAMAGUNDAM

REVISION DETAILS: (00)	Prepared by: SAR 	Reviewed by : VJ 	DATE 10.01.2025
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1. PROVENESS CRITERIA

PROVENESS CRITERIA

The bidder/his sub-vendor(s) is required to meet the Proveness criteria and/or qualification requirement for critical component and bought out item as per the criteria stipulated below:

1.0

Power Conversion System (PCS)

(a) The bidder/ sub vendor should have manufactured grid-interactive bidirectional PCS of cumulative installed capacity of **40 MW** or higher, out of which PCS installation at one location at least should be of **10 MW** capacity or higher. The reference PCS installation of **10 MW** or higher capacity must have been in successful operation for at least six (6) months prior to the tender submission date.

And

(b) The Bidder/sub-vendor should have in-house PCS routine testing facility as per relevant standard of PCS application to BESS

2.0

Engineering Consultant/ System Integrator:-

As per the Pre qualification criteria

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3.0

Battery System:

The Bidder shall associate/collaborate for procurement/sourcing of batteries from Battery Manufacturer who has manufactured and supplied Batteries for grid interactive battery energy storage system(s) of cumulative installed capacity of **40 MW** or higher, out of which at least one grid interactive battery energy storage system should be of **10 MW** capacity or higher. The reference grid interactive battery energy storage system of **10 MW** or higher capacity must have been in successful operation for at least six (6) months prior to the tender submission date.

Bidder shall furnish the documentary evidence/ certificate in suitable format regarding its association/collaboration with above Battery Manufacturer

4.0

PCS Transformers

The Bidder/its Sub-vendor should have designed, manufactured and supplied transformers of 33kV or higher voltage class of cumulative capacity of 40 MVA or above, out of which at least one such supply order for a single plant should be of 10 MVA or above capacity. The reference plant in which transformers of 10 MVA or above capacity (consisting of one or more) were supplied, must have been in successful operation for at least six (6) months prior to the tender submission date.

And

a) Bidder/its sub-vendor should have its own facilities for conducting all routine tests for transformers as per IS: 2026/IEC 60076.

And

b) 2.5 MVA, 33kV or higher rated inverter transformer manufactured by Bidder/ its sub-vendor should have been successfully short circuit tested.



2.PROJECT INFORMATION

INTRODUCTION

NTPC is India's largest energy conglomerate with roots planted way back in 1975 to accelerate power development in India. Since then it has established itself as the dominant power major with presence in the entire value chain of the power generation business. From fossil fuels it has forayed into generating electricity via hydro, nuclear and renewable energy sources. This foray will play a major role in lowering its carbon footprint by reducing green house gas emissions. To strengthen its core business, the corporation has diversified into the fields of consultancy, power trading, training of power professionals, rural electrification, ash utilization and coal mining as well. BHEL/NTPC Ltd is a Premier Maharatna Public Sector Undertaking.

NTPC has planned to setup a 100MW/400MWh Battery Energy Storage System (BESS) at its Ramagundam Super Thermal Power Plant in the state of Telangana

LOCATION AND APPROACH

Location of Site	NTPC Ramagundam
Nearest Town	Ramagundam - 8 Kms Karimnagar - 65kms, Warangal- 130kms
Nearest Highway	SH1(Hyderabad - Ramagundam Road) -1 Kms NH63 - 18 Kms
Nearest Railways Station	Ramagundam - 4 Kms
Nearest Commercial Airport	Hyderabad - 265 km

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AREA AVAILABILITY

Land/Water body availability As per Vicinity Map.

Land will be provided by /NTPC Ramagundam on “as is where is basis” to the the successful Bidder.

TECHNOLOGY

Battery Energy Storage Systems” or “BESS” shall be utilizing methods and technologies such as Advance Chemistry Cells (ACCs), the new generation advance energy storage technologies that can store electric energy either as electrochemical or as chemical energy and convert it back to electric energy as and when required.

STATUTORY COMPLIANCE, GRID CONNECTIVITY AND POWER EVACUATION

The proposed BESS system may be commissioned as integrated part of Solar PV plant at NTPC Ramagundam or as standalones BESS. The Bidder shall be responsible for facilitating statutory compliance for their part when applying for overall compliance upto 400kV switchyard (POI) and ISTS system of Thermal plant.

Bidder shall comply all provisions and it's amendment(s)/Clarification(s) thereof of the following:

- (i) Central Electricity Regulatory Commission (Connectivity and General Network Access to the inter-State Transmission System) Regulations, 2022
- (ii) CERC 'Detailed Procedure for Connectivity and GNA' under the Central Electricity Regulatory Commission (Connectivity and General Network Access to the inter-State Transmission System) Regulations, 2022"
- (iii) CERC (Grant of Connectivity, Long Term Access and Medium-term Access in Interstate Transmission and related matters) Regulation 2009 (if applicable as per extant connectivity regulations/procedures)
- (iv) CERC's revised procedure for "Grant of Connectivity to Projects based on renewable sources to inter-state transmission system" (if applicable as per extant connectivity regulations/procedures)
- (v) CEA (Technical Standards for Connectivity to Grid) Regulation,2007

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- (vi) CEA (Technical Standards for construction of Electrical Plants and Electrical Lines) Regulation,2010
- (vii) CEA (Grid Standard) Regulation,2010
- (viii) CEA (safety requirements for construction, operation and maintenance of Electrical Plants and Electrical Lines) Regulations,2011
- (ix) CEA (Measures relating to Safety and Electrical Supply) Regulations,2010
- (x) CEA (Installation and Operation of Meters) Regulations 2006
- (xi) Indian Electricity Grid Code Regulation,2023
- (xii) CEA (Technical standards for communication system in Power system operations) Regulation 2020
- (xiii) CERC (Communication System for Inter State Transmission of Electricity) Regulations 2017
- (xiv) MOP Order dated 02.07.2020 stating measures to protect the security, integrity and reliability of the strategically important and critical Power Supply System and Network in the Country.
- (xv) CEA (Cyber Security in Power Sector) Guidelines, 2021
- (xvi) Report of the Working Group in respect of Data Submission Procedure And Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid by RE Generators July 2022.
- (xvii) MNRE/CEA/MOP guidelines/OM/Advisory/Clarifications
- (xviii) And any other applicable standards/regulations/Guidelines/clarifications/OMs/Advisories.
- (xix) Indian Electricity Grid Code (IEGC) 2023
- (xx) Any other specific guidelines/Regulation/Advisory issued for BESS

c) Bidder shall facilitate BHEL/NTPC by arranging required documents for submission of connectivity application (connectivity application shall be submitted by BHEL/NTPC) as per CERC guidelines. BHEL/NTPC shall bear the statutory charges to be paid for connectivity application(if applicable).

Grid Compliance Requirements: -

- d) Supply of separate hot standby redundant power plant controllers (PPC) or as part of EMS to function as redundant Power Plant Controller and associated independent equipment/accessories is in the scope of the Bidder. Detailed control logic and setting of the PPC shall be in line with latest CEA (Technical Standards for Connectivity to Grid) and as per RLDC/SLDC requirement. The BESS plant PPC networks shall be suitably designed, so that PPC shall directly and independently be able to control/communicate the individual PCS (dual or multi master) and redundant Power Quality Meters (IEC 61000-4-30 class A) at suitable location/final outgoing portion of plant/As per the directions of SRLDC. It shall also able to two way communicate with RLDC/SLDC on IEC 104 protocol for its various mode of control. Bidder shall install the PQM at ISTS

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end/As per the directions of SRLDC and integrate with PPC at BESS end. PPC healthiness shall be monitored by SCADA.

- e) Bidder shall also submit detailed Grid compliance study (steady state/Dynamic/Power Quality) with Power Plant Controller for solar project (in PSS/E and PSCAD platform) as per CEA technical standard to grid connectivity/CTU requirement/ Report of the Working Group in respect of Data Submission Procedure and Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid and latest guideline of RLDC for first charging clearance. In this regard, Bidder shall submit the single inverter, aggregated and detailed RMS model of the plant in PSS/E along with PSCAD aggregated model in line with CEA Working Group report and/or applicable standard. In case any site testing is required for grid compliance as per RLDC, it shall also be conducted. - BHEL scope.
- f) Bidder shall submit preliminary CEA grid compliance study as per timeline mentioned for CON4 submission to CTU/RLDC in Report of the Working Group in respect of Data Submission Procedure and Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid by RE Generators. Based on the comments received on the submitted report, the study and Model shall be updated and resubmitted again within stipulated timeline, with latest parameters for final acceptance. Availability of required PSSE and PSCAD model of Inverter and PPC shall be ensured by Bidder during selection of respective Manufacturer. - BHEL scope.
- g) Bidder shall provide all data and applicable study/simulation reports as per 'Procedure for Integration of solar plant those are regional entities" for submission to RLDC/SLDC/STU for first time charging clearances (as required by regulatory/statutory body). Some information/documents from the above procedure and Report of the Working Group in respect of Data Submission Procedure And Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid by RE Generators July 2022 are mentioned below. However, bidder shall refer the applicable documents in detailed on their own for compliance.

Dynamic Model - Grid studies in BHEL scope. Bidder need to provide IBR model of inverter.

- 1) Copy of dynamic model as per the connectivity
- 2) Updated dynamic model at least three months ahead of the proposed date of first-time charging
- 3) Following Reports also to be included along with the dynamic model:
 - (i) Parameters of Inverter in .dvr file to be validated with the test report results from the LVRT/HVRT certification and the validation report to be submitted.
 - (ii) Simulation Report of plant model confirming CEA compliance for Dynamic reactive support /LVRT/ HVRT/Frequency control.

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(iii) Simulation Report of Reactive Capability Curve of Plant measured at POI to ISTS system for compliance of CEA technical standard (for Voltage 0.95/1/1.05 pu with pf ranging from 0.95 lag to 0.95 lead) and short circuit study/Load flow study/harmonics analysis results.

- 4) Harmonic study (Voltage and current harmonics) flicker study at Inverter level, Pooling Switchgear Level and POI. Impedance vs Frequency plot of the plant.
- 5) Bidder has to ascertain that all the queries of BHEL/NTPC /CTU/RLDC with respect to submitted reports and models are answered to their satisfaction.
- 6) IBR (Inverter Based Resources) to be submitted to BHEL/NTPC for Grid study. Bidder shall submit above documents within 3 months from LoA. However, the final requirement or any other requirement shall be as per RLDC. The simulation study has to be carried out as per POI data (like SCR, X/R etc.) shared by BHEL/NTPC /RLDC/CTU.
- 7) Bidder shall install suitable reactive compensation equipment for compliance of dynamic reactive power compensation at rated capacity at POI under CEA technical standard of connectivity to Grid and Report of the Working Group in respect of Data Submission Procedure And Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid by RE Generators July 2022 and it's amendments/clarifications thereof.
- 8) Bidder shall measure harmonic content, DC injection and flicker at least once in a year in line with the provisions mentioned as per CEA Technical Standards for Connectivity to the Grid, 2007. Bidder shall ensure that the power quality values at POI are within the limit specified as per CEA Technical Standards for Connectivity to the Grid, 2007. This measurement shall be done every year till the completion of O&M and report shall be submitted to RLDC/NTPC for verification to ensure compliance.

All equipment, materials and services whether explicitly stated or Not in Technical Specifications or anywhere in the tender documents but that are necessary for the successful commissioning of BESS Plant as per latest statutory regulations/procedures/clarifications/Advisories/OMs/Guidelines/standard issued by bodies like CERC/SERC,CEA,RLDC/NLDC/SLDC,CTU/STU,MNRE, other Ministry etc

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A.

PROJECT LOCATION CLASSIFICATION (CORROSION PROTECTION)

Corrosive Category

C3

Classification of environments for Corrosive category shall be in accordance with ISO12944-2, the applicable atmospheric corrosivity categories as per requirement as mentioned above. ISO12944-5 shall be used related to paint systems in combination with guidance for the selection of different types of protective paint system.

Wherever specification allows LT electrical panels, UPS, SCADA panel, Fire protection panel etc. associated with Inverter station to be placed outdoor/ Floating platforms, the enclosure of the same should be well engineered product having proper ventilation system and must be protected from harsh environment & direct sunlight/rainfall. Radiation and absorption effects of outdoor environment must be considered for temperature rise calculations. The temperature rise should not be more than working temperature of components. Requirement of suitable shed/canopy shall be reviewed based on the offered solution during detailed engineering stage.

For metal enclosed outdoor HT switchgear/RMU, suitable shed (for ground mounted)/Canopy (for floating) shall be provided considering the O&M space which shall be reviewed based on the offered solution during detailed engineering stage.

Painting of outdoor metallic enclosed electrical panels including HT switchgear/RMU shall be as per ISO 12944-5, corresponding to corrosive category mentioned in the above table.

For outdoor inverter including containerized solution, painting corresponding to site condition shall be provided.

Unless noted otherwise, all steel structures exposed to environment would be painted to meet the requirements of C3 corrosion category or would be galvanized to minimum 90microns.

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SEISMIC DATA & DESIGN CRITERIA -

All structures and equipment shall be designed for seismic forces adopting the information provided in this document and in accordance with the provisions of IS:1893 (Part 1):2002 and IS:1893 (Part 4):2005.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

Damping in Structures-

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

- a) Steel Structures : 2%
- b) Reinforced Concrete Structures : 5%

WIND DATA & DESIGN CRITERIA

Basic wind speed shall be as per IS 875 (Part-3) (Based on survey of India Political map printed in 2002).

The minimum design wind pressure (Pd) to be considered for design of MMS, Equipment Fixing, Buildings, Rooms, etc. as below:

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3.SCOPE OF THE SPECIFICATION

Bidder Scope:

1. Supply of Battery system , BMS ,PCS
2. Supply of EMS , Scada , PPC controller, OFC , Network management system, Scada printers , LED TV , EWS , OWS , Laptops, Storages , CPUs ,Time synchronization and associated materials as per specification.
3. Supply of all cables - DC , LT , AC , HT ,Instrumentation cable .and associated materials
4. Supply of Transformer , HT panels ,Aux transformer , auxiliary cables, and associated materials,
5. Supply of UPS , Battery system , DCDB , ACDB, LT panels and associated materials.
6. Supply of Metering system , Lightning , Lighting system and associated materials.
7. Supply of Firefighting system , CCTV system , LT panels, Earthing and associated materials as per design , Requiriements.
8. Supply of all BOS items for completion of Erection.
9. Erection support of the supplies.
10. Testing of the systems/supplies (SAT) after Erection , connections.
11. Commissioning of the system.
12. 10 years O&M of the plant from O&M start date.
13. Comprehensive warranty for the supplies for 10 years from O&M start date.
14. Warranty for extra 10 years from O&M completion date for BESS battery system +PCS+EMS.
15. 20 years Battery performance warranty as per tender requirements.
16. Ensuring the RTE , Availability, Guaranteed Energy during PG test and O&M.
17. Autocad drawing of site layout to be provided with dimensions , weight for all supplies for BHEL civil estimate.
18. Support for Grid compliance studies as per LDC requirements.
19. All Hardware , software requirements as per LDC.
20. All other materials required for interconnection of supply items, Specification , Plant requirement.
21. Trial run
22. PG test
23. All spares required by bidder for O&M of BESS system to meet performance requirements shall be considered by bidder as inclusive.
24. Internet connectivity during Commissioning and O&M.
25. All the other materials associated till 33kV is with Bidder scope.
26. Communication to RLDC through PPC/EMS , NTPC PI servers and other networks as mentioned in specifications.

Bidder need to ensure all the supplies as per specifications and approvals

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BHEL scope:

1. All Materials receipt , unloading and insurance.
2. All materials internal movement, Erection, connections.
3. Earthing system supply , Erection , commissioning as per Bidder recommendations.
4. Testing (SAT)Support.
5. All Civil works in BHEL scope (wherever required -input to be provided by bidder).
6. Site grading, clearance of vegetation.
7. Grid compliance studies as per LDC requirements.
8. All clearances, renewals
9. Support for Trial run and PG test.
10. Main control room and Furnitures.

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1.0 BATTERY ENERGY STORAGE SYSTEM:

The scope of work covers the following activities and services in respect of all the equipment & works specified and covered under the specifications and read in conjunction with "Scope of Supply & services" elaborated elsewhere in the technical specification. Successful Bidder shall be responsible for identifying and providing any and all other additional equipment, component, and services necessary to install a fully functional battery energy storage system.

1.01 Design, Engineering, Supply, Packaging and Forwarding, Transportation, Unloading, Storage, Testing, Commissioning of grid connected Battery Energy Storage System (BESS) with **100 MW and 400MWh rated AC discharge capacity at 33KV switchgear interconnection point and With designed service life of 20 years.**

1.02 **Comprehensive Operation and Maintenance (O&M) works of BESS system for 10 years** from the date of successful completion of trial run.

1.03 The BESS shall comprise of Battery System, Battery Management System (BMS), Energy Management System (EMS) and SCADA, Power Conversion System (PCS), Protection system, Communication System, HT & LT System, Auxiliary power system, Monitoring & Control system, Fire Fighting, remote control and monitoring, and all other associated materials and accessories necessary for trouble free operation and maintenance of the BESS system.

1.04 Design and make ready for the electrical connections from the battery energy storage system to the grid.

1.05 ~~Site grading, clearing of vegetation.~~



1.06 ~~Providing power supply and water supply for construction purposes.~~

1.07 Design, engineering, construction and supply Kisok/Cubicle type of control room, with all electrical fitting and furniture, security cabin etc as applicable as per provisions of specifications.

1.08 All associated electrical and civil works required for interfacing with grid (i.e. transformer(s), switchgear, protection system, cables, etc).

1.09 Metering system as per specifications.

1.10 Provide documentation for design and expected performance through design calculations, software, design drawings, equipment drawings, and modifications to the existing drawings.

1.11 ~~Develop detailed start up and site acceptance plan.~~



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- 1.12 Provide training for the operators, engineers, technicians and maintenance personnel.
- 1.13 Supply any special equipment and tools required for the operation and maintenance of the project.
- 1.14 Provide a warranty for the battery energy storage system (BESS) and its constituents equipment as per technical specification.
- 1.15 Providing, Review and approval of engineering drawings, data, process, calculations, test procedures, Structural Design Calculations, Equipment Layout, Drawings / Data sheets of bought out items, PG test procedure (as mentioned in Technical Specification) etc.
- 1.16 Providing Operation & Maintenance/ instruction manuals, as built drawings and other information
- 1.17 Finalization of sub-vendors, manufacturing quality plans and Field quality plans.
- 1.18 ~~Mandatory permission/ licenses/ statutory clearances from Competent Authorities for undertaking blasting related works, disposal of cutting material, etc. shall be carried out by the Bidder~~
- 1.19 Complete manufacturing including conducting all type, routine and acceptance tests.
- 1.20 Packing and transportation from the manufacturer's works to the site including customs clearance & port clearance, port charges, (if any).
- 1.21 ~~Receipt, storage, preservation and conservation of equipment at the site; Fabrication, pre-assembly, (if any), erection, testing, pre-commissioning and commissioning and putting into satisfactory operation all the equipment including successful completion of initial operation~~
- 1.22 ~~Topographical survey & Geo-Technical investigation of land . Site Grading & Clearing of Vegetation (if required)~~
- 1.23 ~~Construction of Pre-Engineered type Inverter room/platform(if applicable) along with associated LT and HT switchgear.~~
- 1.24 All equipment, materials and services that are necessary for implementation of the reactive power compensation system and any other equipment required to make the plant CEA compliant as per the grid study with satisfactory operation of the BESS system and its integration with already existing 100 MW Solar Plant and under construction 176 MW Solar Plant.
- 1.25 Evacuation of power as per tender drawing.
- 1.26 ~~Rerouting of Underground Cabling (including additional cable lengths, if required) of identified four no. of 33KV solar blocks of FSPV & GSPV Project of approx. 23 MW Capacity each~~
- 1.27 EMS/SCADA system for remote monitoring and control of Inverters with all hardware & software.

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- 1.28 CCTV System for remote monitoring of the complete project including supply and installation of all accessories like monitoring system at main control room and associated equipment and services at identified location.
- 1.29 Reliability and Functional guarantee tests after successful commissioning of full Capacity
- 1.30 Supply of Spares required for smooth commissioning, O&M.
- 1.31 Satisfactory completion of the contract.
- 1.32 Special tools and tackles if any required for maintenance of the plant.
- 1.33 It is not the intent to specify herein all aspects of design shall conforming all aspects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Employer, who will interpret the meaning of the specification and drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable Indian / International standards mentioned elsewhere in this specification.

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1.0

4.BASIC ENGINEERING DESIGN PARAMETER

BASIC ENGINEERING DESIGN PARAMETER OF BESS PLANT

- a) **Plant Capacity: 100 MW/400 MWh Dispatchable capacity at COD at 33 KV metering point(till end of first year O&M)**
- b) **PCS Capacity:** The continuous combined rating of all PCSs shall not be less than respective BESS Plant capacity with 0.95 p.f. at 50-degree temperature. However, PCS capacity used in plant may be chosen such that it can comply the 0.95 power factor capability as per CEA regulation of the total plant at 400kV POI of thermal plant switchyard.
- c) It is to clarify that during the entire life of Project, inverter/PCS capacity at delivery point should be suitably designed to meet the reactive as well as active power as per site temperature as per CEA Connectivity to Grid Regulation.
- d) Same size and same make of PCS is recommended for the whole plant.
- e) Licenses for Remote Monitoring of EMS/SCADA: 2 Nos with provision of Concurrent viewing for all users.
- f) **33 kV Switchgear**
 - 1) Bus Bar rating of HT Switchgear: As per Single Line Diagram.
 - 2) System Fault Current Rating: As per Single Line Diagram.
 - 3) Dynamic withstand Current rating: **2.5 times of system fault current.**
 - 4) Spare 33 kV breaker panels with VCB, relay and all other accessories shall be provided. Total quantity of spare panels (if any) are indicated in tender SLD. VCB with protection relay shall be used at all switchgear panels including 33 kV Aux Transformer feeder(if provided)
 - 5) DC Supply shall be used for control and protection system of switchgear. In case UPS AC supply is considered for auxiliary control and protection supply for switchgear (except CMCS), then suitably rated AC/DC converter/power pack shall be used to meet the DC control supply requirement of switchgear panels.
 - 6) The 33kV switchgears (both indoor and outdoor type where allowed as per TS) shall have an internal Arc Classification corresponding to system fault current
 - 7) The switchgear shall be cooled by natural air flow. Forced cooling shall be considered in case current rating is 2000 A or above.

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g) Outdoor containerized solution/compact substation with PCS, inverter (PCS) transformer & HT switchgear as inverter station are acceptable. However, technical specification of inverter, HT switchgear and inverter transformer as per relevant chapter of technical specification shall be applicable.

h) Earth Pit for DC System:

As per Battery/PCS manufacturer recommendation. Earth pit indicated are to be interconnected in single mesh of earth pits. Shall be reviewed during detailed engineering based on actual site requirement and Bidder's earthing proposal.

i) Metering:. As per SLD. ABT Meter has to be provided at following locations

1. Main and Check meters at 33 kV block BESS Incomer .
2. Standby meter at incoming solar and outgoing feeder.
3. 08 No. of 0.2s Class energy meters to be provided for NTPC's Use (for modification in existing Solar Breaker Panels)

j) Basic Wind Speed for Civil and Electrical design as mentioned in Project information.

k) Cable sizing criteria:

The minimum size of cable based on 33kV voltage level power application shall be as per protection time grading requirement subject to min. of 0.3 sec. For any cable feeder the minimum time for cable size calculation shall be the immediate one upstream breaker (towards grid) relay time setting plus 100 msec. For final power evacuation feeder the time for cable size calculation shall be minimum 1.0 sec.

l) EMS/SCADA: Licenses for Remote Monitoring of EMS/SCADA - 2 Nos with provision of Concurrent viewing for all users. Include provision of data telemetry/remote communication to BHEL/NTPC PI server and REAMC Jaipur

m) DC and LT Power cable voltage drop criteria: Maximum Voltage drop shall be limited to 3% of rated voltage. 1.9/3.3kV grade LT cable shall be used for connection between PCS and PCS Transformer.

n) The AC Cables shall be laid in trefoil formation using good quality trefoil clamps and other cable clamps shall also be able to sustain the harsh environment.

o) Closed Circuit Television (CCTV) and control and Monitoring System: CCTV system shall have full coverage for the DC blocks. For detailed specifications of CCTV system, refer relevant chapter of Technical Specifications.

The detailed scope of work in accordance with this specification is elaborated below. The scope of the contractor shall be deemed to include all such items which although are not specifically mentioned in the bid documents and/or in contractor's proposal but are needed to make the system complete in all respects for its safe, reliable, efficient and trouble-free

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification **Group : BESS system**

DOC. NO: SPV-BESS - 01-2025-00

REV. 00

JOB NO.- STD.

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operation and the same shall be furnished and erected unless otherwise specifically excluded as per Section Terminal Points & Exclusions.

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2.0

SUPPLIES & ASSOCIATED WORKS

DC SIDE	
•	Battery System
•	Battery Management System (BMS)
•	DC Cables including field connectors and DWC pipes
•	Power Conditioning System (PCS)
AC SIDE	
•	LT Switchgear
•	HT Switchgear
•	PCS Transformer & Auxiliary Transformer
•	LT Cables
•	HT Cables
•	Cable Laying - DC, LT & HT cables - BHEL scope
•	Energy Management System (EMS) /SCADA & Time Synchronization Equipment and integration with SCADA System of solar plant for BESS operation as per Solar Generation.
•	Instrumentation and Communication cable
•	Earthing System
•	Lightning Protection System
•	Plant Illumination system
•	Auxiliary Power Supply System
•	Battery and Battery Charger(If applicable)
•	UPS
•	PPC and Power Quality Meters
•	Grid compliance study and interfacing equipment so as to meet statutory requirements.(Study in BHEL scope)
GENERAL SYSTEMS	
•	HVAC/Cooling system (if applicable)
•	Fire Detection and protection system
•	Closed Circuit Television (CCTV) and Monitoring System

3.0

BESS SYSTEM

BESS shall be transportable, containerized energy storage system based on commercially available electrochemical storage solutions, capable of receiving, storing and delivering electrical energy at specified rate(s) suitable for the application laid out in the specifications herein. It comprises of unit batteries, battery management system (BMS), auxiliaries, such as HVAC and fire suppression systems, ac switchgear, Control Systems etc.

3.1

The salient Scope of Work :-

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3.1.1.

Initial Design and Fabrication: -

For the initial design and fabrication of the equipment, the Contractor shall

- Design, fabricate, and assemble a fully functional, transportable BESS that meets the requirements delineated herein. This shall include a control system that provides standard input/output channels and appropriate control actions for all required operational and protective features.
- Fully document the design and expected performance of the BESS by means of documents, drawings, reports, data, and other submittals, as required herein.
- Perform factory acceptance testing of the BESS.
- Conduct design review meetings during initial design and fabrication, in Consultation with the Employer with special reference to the geographical/climatic conditions of the Project site.
- Obtain site-specific data in preparation for developing installation implementation plans.
- Develop site installation/construction drawings, specifications, and calculations.
- Supply any special equipment and tools required for maintenance of the BESS.
- Provide warranty for the entire BESS and its constituent equipment.

3.1.2.

Installation/Interconnection

Installation/interconnection -BHEL scope

- Provide on-site Contractor representative during installation and/or interconnection activities by the Employer and during start-up and SAT of the BESS by Contractor.
- Perform start-up testing and SAT of the BESS.
- Provide a complete set of as-built drawings.
- Provide a training class for the Employer's technicians and maintenance personnel.

3.1.3.

Operation and Maintenance

Bidder shall provide the operation and maintenance (O&M) of the BESS on comprehensive basis to the Contractor on turnkey for the O&M Period as specified in this Document. Comprehensive O&M of the Plant during O&M period shall include replacement/disposal etc if any.

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3.1.4.

BESS Parameter

Year wise BESS MWh capacity shall be as quoted by bidder in bid document. BESS capacity for particular year shall be maintained throughout the year for operating ambient temperature of 0°-50° C and under all other extreme ambient condition. Bidder shall install HVAC and other equipment's in case BESS capacity is dependent ambient condition.

Item Description	Requirement
Battery Technology	Any battery technology suitable for operation in site-specific climatic conditions can be used.
Project Capacity	<p>100 MW, 400 MWH at COD and during first year.</p> <p>As bidder is allowed to quote BESS Dischargeable capacity for every year based on actual degradation, replacement of batteries is not envisaged. However, if the actual measured parameters at site are not as per quoted parameters, required replacement/addition shall be done by Bidder considering 20 year design life at no additional financial implication to BHEL/NTPC</p> <p><u>Since O&M is only for 10 years and battery performance is desired for 20 years. Bidder should ensure that the batteries should be able to perform as per quoted parameters in bid document for remaining 10 years after O&M period without any augmentation.</u></p> <p>Bidder to ensure that battery life cycle/degradation etc are duly considered as per Battery OEM guidelines.</p>
Cycle Life/Project Life	Project Life shall be 20 years from COD of the Project. BESS shall be designed to perform 01 complete charge-discharge cycle per day-based application/operation requirement. Bidder shall indicate the minimum BESS Battery DoD level beyond which the Battery cannot be operated. Battery DoD Vs Life Cycle graph also shall be provided. BESS control system shall be designed in such a way that during operation the above minimum DoD

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		level shall not be violated under any operating condition. Bidder shall provide suitable calculation/document in this regard during detail engineering. DoD shall be defined at C/4 Rate of Discharge.
Power rating for full range of environmental condition at project Site	100 MW	
MWh rating (dispatchable Capacity at POI) for full range of environmental condition at project Site	MWh Rating (Dispatchable Capacity) 400 MWh, Dispatchable at the beginning of life (i.e. at the time of COD) and minimum dispatchable throughput capacity at the end of each year of operation shall be as declared in Bid document Dispatchable capacity at any time during the project design life shall not be less than 65% of dispatchable capacity at beginning of project life (at COD)	
Depth of Discharge (DOD)	Bidder to decide the suitable battery storage DOD as per the offered battery technology. During the details engineering stage, the Bidder must specify the BESS Battery maximum DOD level beyond which the Battery cannot be operated. Battery DOD vs life cycle graph also shall be provided. BESS control system shall be designed so that the above maximum DOD level is not violated under any operating conditions/ circumstances during operation	
Round-Trip ac-dc-ac efficiency at POI	Declared efficiency shall be the annual average round trip AC/AC Efficiency (%) of BESS system at Metering Point considering the energy loss (including auxiliary power requirement) of BESS. Annual average round trip AC/AC efficiency shall not be less than 80% for 1 st year. Degradation in efficiency in subsequent years shall be allowed. However, RTE including auxiliary consumption shall not be less than 75 % in any year (upto 20 years).	

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Use case requirements. (Any other control/application mode if required during O&M ,it is to be configured by Contractor to meet special requirement. During FAT, these control modes is to be checked and ensured.)	a. Peak Management b. Grid Ancillary services c. VAR support to Grid / voltage Regulation d. Black Start application e. Frequency Regulation /Grid support f. Energy Arbitrage/energy shifting operation/Solar Smoothing (With existing Solar plant) g. Ramp rate support h. Power Quality mitigation to Grid i. Interaction on real-time with IEX for schedule of charging and discharging.
Charge Discharge Cycles	1. One Charge discharge cycle per day is envisaged at C/4 rate.
Ventilation System inside the Container	Should be such as to maintain minimum and maximum Temperature as recommended by the manufacturer for optimum performance of the batteries on continuous basis.
Charging/Discharging rate/Ramp rate /Response time	Suitable for Application requirement. However, The response time of the BESS system shall not be more than 1 (one) second. It shall be possible to charge the BESS system from zero power to rated charging power within 1 sec and from rated discharge power to zero power within 1 sec. BESS shall be able to discharge from zero power to rated discharge power within 1 sec time duration and from rated charging power to zero power within 1 sec time duration. All measurements shall be at PCC

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Power Factor range at POI (minimum)	As per CEA connectivity regulation when it is charging/discharging condition.
VAR support to Grid facility	In addition to reactive power support to grid as per CEA regulation, BESS shall have facility to provide VAR support to the extent possible to Grid even when there is no active power flow during charging /discharging.
Identification and Traceability	Battery Cells/Racks/Packs assembly shall meet the seismic requirement for the plant location of the BESS. Labeling of cells/batteries shall include manufacturer's name, cell type, name-plate rating, date of manufacture and date of expiry of parts and labor warranty

3.1.5.

Operational Window

Operational Window shall mean the expected hours/duration of system (capacity) availability on each day during the term of the Contract, excluding:

- Maximum BESS recovery time:- The Contractor shall clearly specify the maximum recovery times required to restore the BESS for functional availability between duty cycles. However, in no case, the same shall be more than 1 hour.
- Grid Outages (duly certified to this effect by the Grid Operator) The Contractor shall provide a guarantee for the maximum length of time required for this type of maintenance operation.
- Planned Maintenance Outage duly informed by the contractor to the Employer with at least one month's prior notice, subject to total no. of planned outage period being not more than 200 hours in the year.

It shall be the responsibility of the contractor to make periodic replacements/replenishments of system capacities (to ensure annual guaranteed system ratings), if and when required, up to the Term of the Contract. Outage time as a result of replacement will also be counted as an "Accountable BESS Outage" for the purpose of computing BESS Availability

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3.1.6. Auxiliary Power

The BESS shall include an auxiliary power system with metering so that auxiliary power consumption can be measured and electronically recorded in real time, independently of operation of the PCS or of net power flows to and from the battery.

The auxiliary power system and/or control system design shall provide for whatever emergency power is necessary for an orderly system shutdown during abnormal conditions such as a loss of grid power.

3.1.7. Mechanical Design:-

a.) All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed, and painted or otherwise suitably protected to survive outdoor conditions for at least design life of the system.

b.) Outdoor enclosures shall be weatherproof and capable of surviving intact under the site environmental conditions specified. Outdoor enclosures shall be equipped to prevent condensation.

c.) Components mounted inside enclosures shall be clearly identified with suitable permanent designations that also shall serve to identify the items on drawings provided.

d.) The site temperatures and the effect of temperature on component life shall be considered in developing the thermal design for all components, including the battery and PCS. Irrespective of the heat-removal system design the final rejection of all waste heat from the BESS shall be to the ambient air. Air-handling systems shall include filters to prevent dust intrusion into the BESS.

e.) The BESS shall include an HVAC or ventilation system designed to maintain battery temperatures at levels acceptable to the Contractor's normal Battery warranty conditions, conducive to acceptable battery life, and as required to maintain battery capacity for all seasons/climatic conditions at the site. The air handling/distribution system shall be designed to promote temperature uniformity within the battery.

3.1.8.

Other Design Requirements

Fire Protection: -

The Contractor shall design and install a fire protection system that conforms to national and local codes, good engineering practice and CEA guidelines. The fire protection system design and associated alarms shall take into account that the BESS will be unattended at most of the times. If required by the type of fire protection system provided,



the Contractor shall calculate and take into account the heat content of the battery cell materials in designing an appropriate fire protection system. Separate fire protection systems may be used in the battery, PCS, and control areas. For high energy density technologies, the contractor shall also provide thermal runaway characterization of the battery storage systems.

Toxic Materials:-

If any toxic substance can be emitted from the equipment during a failure, fire, or emergency or protective operation, description of the toxic nature of the substances as well as treatment for exposure to it shall be included in the O&M manual. Their treatment and disposal shall be in accordance with the New Hazardous Waste Management Rules 2016/latest guidelines notified by the Central/State Government authorities.

3.1.9. Maintenance and Repair

The Contractor shall supply all equipment, and materials and deploy manpower needed to maintain the BESS performance and safe operation, including all maintenance required to satisfy the operation performance and warranty terms and conditions. The Contractor shall list all maintenance activities to be carried out under the maintenance contract. For each maintenance item, the list shall include a description of the item, the expected frequency (maintenance interval), the time required to perform the maintenance, any anticipated parts replacement, and any potential problems in carrying out the maintenance.

3.1.10. Factory Acceptance Testing of BESS

The Contractor shall develop and submit to the Employer for its review and approval a comprehensive FAT plan that shall demonstrate that the BESS will meet the requirements of the specification. The Employer shall have the right to request reasonable changes to the test plan.

Where full-scale testing of larger systems at the factory may be difficult or impossible due to the large system, the FAT shall be carried out at a subsystem or module level and shall consist of tests of 100% of the subsystems or modules that comprise the complete BESS, to the extent possible. In the FAT plan, the Contractor shall clearly state what is being tested and shall fully explain any features or functions of the fully assembled BESS that would not be fully tested in the reduced-scale testing proposed. In such a case, the SAT plan shall further describe how the tests that could not be carried out in the factory will instead be carried out at the site.

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After the Contractor determines that the BESS is fully operational, the Contractor shall conduct a FAT in which the Contractor shall demonstrate to the Employer that the BESS is fully operational and performs as specified. This includes but is not limited to the following:

- Visual inspection of all provided equipment, including dimensions and overall design.
- Verification of proper mechanical construction such as electrical connection torques.
- Verification of sensors, metering, and alarms.
- Verification of all control functions, including remote control and monitoring, and communications interfaces.
- Verification of BESS performance at full and partial power and energy ratings
- Verification of maintenance and replacement features for unit batteries and other key components.
- Verification of compliance with specifications.

During the FAT, the BESS shall meet the following:

- Be operated and function as specified and designed in all the operating states, use cases, and duty cycles specified herein.
- Meet the power and energy requirements specified herein
- Be demonstrated to meet the safety and response to catastrophic failure requirements specified herein.
- Have the efficiencies, response capabilities, and other features specified here in and/or proposed by the Contractor

Operation of all control, protective relaying, and instrumentation circuits shall be demonstrated by direct test, if feasible, or by simulating operating states for all parameters that cannot be directly tested. Automatic, local (control console), and remote operation of the controls shall be demonstrated.

Factory testing shall, if required, demonstrate operation at expected temperature extremes at the independent laboratory. Certification of operation of critical components and subsystems in the battery, PCS, and control systems shall be submitted at the time of the FAT. The Contractor shall submit to the Employer for approval, 90 days before the FAT, a list of components and subsystems for which independent lab testing certification will be sought.

The Contractor shall perform any and all system modifications required during start-up and testing. The testing may be suspended as a result of a BESS malfunction and resumed only on rectification of problem items. Such suspension and resumption will occur at the sole discretion of the Employer.

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3.1.14.8.

The BESS will not be accepted for shipment until all FATs have been successfully completed. In addition, the Employer will verify that all provisions of the contract have been met, including verification of all required submittals, any spare parts delivery, and any required system modifications.

3.1.11.

Warranty

The Contractor shall provide warranty for the entire BESS and its constituent equipment as per standard warranty conditions of the respective equipment. However warranties for Battery and associated system is envisaged for complete life of project (20 years) as per desired operational requirement.

Contractor shall procure performance guarantees from the OEM to ensure minimum performance levels for predefined application(s) as per the terms of the specification. The Warranty shall clearly indicate life expectancy given discharge profiles provided for the application.

For the battery storage (unit or racks), the warranty shall cover parts warranty including battery nominal capacity ratings in order to meet the complete project Life condition described in this specification.

Warranty replacement shall be required for individual unit batteries that degrade in performance to the point at which the BESS cannot meet the requirements specified in this specification up to the End of Project Life and/or for unit batteries that materially degrade the availability, reliability, safety, or functionality of the BESS.

Additional warranty requirements are as follows:

The warranty shall specify the terms and conditions of the warranty, including operating conditions requirements, procedures that must be followed, and all maintenance requirements. The warranty terms shall be easy to understand and shall be clearly stated.

The warranty shall provide an explicit statement as to the warranted cycle life and the warranted calendar life of the battery.

The warranty shall include a simple and easy to understand proration formula, if any, to be used in crediting the Employer for unused life or capacity of equipment replaced or repaired.

The warranty shall specify the scope of service associated with software updates. The warranty shall specify the scope of service included in replacement or repair of the equipment.

The warranty shall specify all labor, materials, shipping charges, and other

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3.1.12.

Employer expenses not included in the warranty.

The warranty shall specify the estimated time to complete the repairs/replacement required to restore the BESS to the warranted performance level. The time shall be given as the number of working days from the time of notice to the Contractor that the BESS has failed to meet the performance requirements.

APPLICATION REQUIREMENT

The BESS shall be integrated with the existing/under implementation BHEL / NTPC solar project at 33kV. There are four numbers of 33kV Solar Block feeders identified each with approx. 25MW rating. The BESS Bidder scope includes measuring active and reactive power (with 0.2 class transducer/EM) of these 33kV solar incomers and outgoing feeders to pooling switchgear and integrating measured data into the BESS EMS/SCADA. All required materials and services are in the BESS Bidder scope.

Bidder to operate the BESS plant as per BHEL/NTPC requirement.

Solar Energy Time Shifting: -BESS shall automatically charge the battery with power from the solar PV plant and discharge the battery by supplying power to the grid during peak load demand periods or as per BHEL/NTPC requirements. The operation in this mode shall be based on the BESS charge and discharge schedule.

Solar Plant Generation Smoothing: The BESS shall have at least three different solar plant-generated power smoothing algorithms. (i) Smoothing algorithm based on moving average method. It shall be possible to select the moving average window to 60 minutes, 30 minutes, and 15 minutes through HMI. (ii) Smoothing algorithm based on ramp-rate control. It shall be possible to freely select the ramp-rate percentage value (20%/ 15%/ 10%/ 5%/ or any other value) through HMI. (iii) Any other smoothing algorithm as per the Bidder choice. The algorithm shall be suitable for optimizing battery uses and generating better solar plant power smoothing curve/profile to the grid. In all the smoothing algorithms, the BESS battery SOC shall be controlled in such a manner that the BESS shall operate continuously without tripping due to low battery SOC value.

Scheduled Based Solar Power Dispatch to Grid: In this mode, the BESS shall have the facility to input the solar power generation schedule for the entire solar hour duration with 15minutes time block interval. Generate real-time BESS power (charging and discharging) setpoint with the real-time measured solar generation data and scheduled solar power to the grid. Charge and discharge its battery according to the BESS power setpoint to maintain the scheduled power dispatch of the solar PV plant to the grid. Deviation percentage allowed as per CERC DSM Regulation shall also to be taken into account while developing the required logic.

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Schedule Charge and Discharge: The BESS shall be provided with scheduled-based charging and discharging facility. The BESS plant operator shall be able to schedule the BESS charging and discharging power. The facility shall also be provided to schedule the BESS charging and discharging power from the BHEL/NTPC switchyard control room by BHEL/NTPC operation staff. The BESS scheduling shall be possible for complete one day with 15minutes time block interval. Schedule revision shall be possible as many as required during operation. Schedule overwriting facility shall be provided.

Manual Control: In this mode, the BESS shall be able to charge and discharge its battery through manual intervention. The BESS operator shall be able to provide power set point to through BESS SCADA HMI. BESS SCADA shall also have the facility to receive the charge and discharge power setpoint from RLDC/LDC and BHEL/NTPC control center.

Ancillary Services: For participation in the ancillary services market based on CERC Ancillary Services Regulations, the BESS shall be provided with all required control logic and facility/provision for the following types of Ancillary Services, namely:

- (a) Primary Reserve Ancillary Service (PRAS);
- (b) Secondary Reserve Ancillary Service (SRAS);
- (c) Tertiary Reserve Ancillary Service (TRAS); and
- (d) Such other Ancillary Services as specified in the Grid Code.

For this, the bi-directional communication system with RLDC, as per the requirements, shall be provided.

Provision shall be provided to select the operation mode in the BESS SCADA HMI. At a time, only one operational mode shall be selected.

Reactive Power Control: The BESS shall be required to provide reactive power (capacitive and inductive) support to the grid for voltage regulation purposes. BESS operator shall be able to provide reactive power/power factor set point through BESS SCADA HMI (manual intervention). BESS SCADA shall also have the facility to receive the reactive power setpoint from RLDC/LDC and BHEL/NTPC control center.

Black Start/Island Mode: BESS shall have the black start operation feature and shall be able to form a grid with local loads connected at the existing 33kV switchgear. BESS shall set and automatically control the grid voltage and frequency within the acceptable limit and shall discharge the battery based on load requirement. BESS shall have all the required hardware, control, and protection features for the safe operation of the micro-grid.

The Automatic Generation Control (AGC) : BESS shall have capability to operate in

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AGC. The details regarding AGC signals required but not limited to, are given (the conventional power plant signal link) at the link, <https://posoco.in/download/detailed-signal-list-for-connecting-generators-under-agc/?wpdml=29546>. BESS shall be able to operate in AGC and be able to comply with the requirements desired by system operators. Some of the BESS signal list for implementation of AGC can be like below (list is indicative only):

- a. Maximum MW permissible (dynamic or user entry)
- b. Minimum MW permissible (dynamic or user entry)
- c. Ramp rate up permissible (dynamic or user entry)
- d. Ramp rate down permissible (dynamic or user entry)
- e. Actual MW
- f. Actual MVAR
- g. Auxiliary Consumption MW
- h. Scheduled MW (dynamic or user entry)
- i. BESS Temperature (for monitoring and correlation)
- j. Ambient Temperature (for monitoring and correlation)
- k. Cycle limits (0-100%) per day (user entry)
- l. Circuit breaker status
- m. Local/Remote status
- n. AGC Set Point MW from NLDC to BESS
- o. Voltage (kV) at grid level
- p. Voltage (V) at BESS LV side

The BESS shall be possible to charge and discharge continuously at any power between 0 (zero) to rated power.

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3.1.13.

The BESS charging and discharging power shall be limited to it is rated power for all operation control modes. The BESS active power capacity shall be the remaining capacity left after providing reactive power.

Bidder to do all the required software logic/coding modification during commissioning and O&M stage as per BHEL/NTPC requirement for the applications listed above

Other necessary Criteria: -

- a) BESS shall be capacity of operating in the frequency range of 47.5 Hz to 52 Hz and be able to deliver rated output in the frequency range of 49.5 Hz to 50.5 Hz.
- b) BESS shall be capacity of operating when voltage at the interconnection point on any or all phases dips/rises to the high or low levels. The levels applicable for wind/solar inverter-based generation may be referred as available in Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations.
- c) The safe and reliable operation of power system is ensured by frequency control as well as voltage control. BESS to be implemented shall have provisions for Primary frequency control with a droop which can be set as per system requirement between 1-3 percent. The BESS performs regulations in one or several pre-defined ways (e.g. regulating its own output power according to the orders given by EMS/SCADA system) to achieve an active power balance between generation and demand to maintain the power system frequency within a reasonable range.
- d) BESS shall operate to maintain voltages as per specified voltage ranges in Grid standards. BESS shall have feature to detect the voltage of interconnection point, and regulate voltage independently. The response time of the BESS shall not exceed the value specified in relevant standards or grid codes.
- e) BESS shall operate in a manner to promote the power system reliability and improve the power quality. When power quality problems, such as voltage dip, flicker, unsatisfactory power factor, etc., occur in power system, the BESS could eliminate these problems by flexible active and reactive power output in this function.
- f) The BESS should provide reliable protection and not be limited to as an overvoltage/under-voltage protection, overcurrent protection, low- temperature/over- temperature protection of battery, DC insulation monitoring, etc.
- g) BESS is required to have the following basic functions:
 - A.) Monitoring: Monitor operational parameters, equipment status and communication status, alarm and faults of main equipment and BESS system, etc.
 - B.) Information exchange: Receive and process information with RLDC/NLDC including operation parameters, switching information various alarms and alerts, protective action signals, control information, etc.

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C.) Control: Including control mode and parameter setting with RLDC/NLDC.

h) The static information like detailed write-up on present operation methodology of BESS, forbidden zones, number of cycle limits, Auxiliary consumption details, capability curve, simulation models (RMS/PSCAD) along with description or any specific information about BESS shall also be furnished as and when required by RLDC/NLDC.

3.0 POWER EVACUATION SYSTEM, TELEMETRY & SCADA

3.1 Power Evacuation System:

Power Evacuation shall be through tie transformers at 400 kV Voltage level to get connected to existing 400 kV Switchyard through 33 KV system of existing/under construction Solar PV Plant. However, bidders scope of supply and services is only till 33 KV interconnection point as indicated in tender SLD. Supply and installation of metering system along with control cable shall be in bidder's scope. ABT/SEM metering arrangement shall be as per CTU requirement/standard.

3.2 Telemetry System: The arrangement to transmit data required by the Load Dispatch Centre (LDC) from BESS system to NLDC/RLDC as per extant regulations and procedures for grid management is in contractor's scope. The bidder may integrate the BESS data telemetry system with existing/under implementation telemetry system of Thermal/Solar Plant.

The required hardware and software, including laying of Communication/Fibre Optic cable to Owners' FOTE panel at 400 kV Switchyard required for communication of BESS plant data is included in the contractor's scope. Communication link and communication controller/Gateway used for data communication to FOTE panel/LDC shall be redundant (one for normal operation and other as hot standby). If any upgradation/ modification required at FOTE, it shall be done by the bidder.

Bidders are advised to update themselves with LDC requirement for compliance related to Automatic Meter Reading (AMR), telemetry data, channel, and procedures for engineering of telemetry solution accordingly.

The above real time data communication facility with REMC/RLDC shall comply CERC (Communication System for Interstate Transmission of electricity) Regulation 2017, Procedure for Implementation of the Framework on Forecasting and Scheduling for Renewable Energy (RE) Generating Stations, CEA (Technical Standards for Communication System in Power Systems Operations) Regulations, 2020 and amendments thereof.

Provision of SCADA/EMS/ HMIS/SERVER Operator Work-Station (OWS) at Main Control Room

3.3

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SCADA, & other associated electrical system shall be placed at the identified location inside Main Control Room.

Sl No	Description	Quantity
1	Engineering cum Operator work station (EWS+OWS) (Server with Monitor)	01 Set
2	Operator work station (OWS) (Server with Monitor)	01 Set
3	Portable (laptop based) EWS	01 No
4	Historian (Desktop)	01 No
5	50 Inch LED display	01 No
6	Time Synchronization equipment*	01 No
7	Control Desk	01 Set
8	Chairs for Control Desk	02 No
9	Laser Printer	01 No

3.4

***The EMS/SCADA all other related system shall have facility to synchronize time on Network Time Protocol with Time Synchronization Equipment to be supplied under the package.**

Provision of SCADA HMIS/SERVER Operator Work-Station (OWS) at Central Control Room and Switchyard Control Room

Bidder shall arrange one additional OWS at CCR and one additional OWS at Switchyard Control room of NTPC Power project with communication link (OFC or Wireless Access or combination of both as feasible), required software, hardware and Desk for monitoring and control of BESS Plant from OWS provided at CCR and Switchyard.

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MISCELLANEOUS

1.0

CODES AND STANDARDS

All works shall be carried out as per the standards/codes (IEC, IS etc.) referred in the specification. All standards, specifications and codes of practice referred to shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those codes/standards referred the former shall prevail.

Equipment complying with other internationally accepted standards such as BS, UL, DIN, VDE etc. will also be considered, if they ensure performance and constructional features equivalent or superior to standards listed in the specification. In such case the Bidder shall clearly indicate the standards adopted, furnish a copy in the English of the latest revisions in force as on date of opening of bid and shall clearly bring out salient features for comparison.

2.0

APPROVALS

The scope of the bidder includes complete design and engineering, technical coordination (including participation and arranging technical co-ordination meetings), finalization of drawings/ documents, submission of engineering drawing / documents and processing of their approvals by the Employer Technical Specification and other relevant requirements given elsewhere in the Technical Specifications. Further, the scope shall also include submission, in proper shape & format, of all types of manuals, handbooks & documents in requisite numbers to the Employer at different phases of the project as per the requirement of Employer. The contractor shall have to arrange technical coordination meetings and ensure participation

3.0

PAINTING

The bidder's scope of work includes painting of all equipment and structures as per the Employer's standard color-coding scheme. The painting shall include required application of finish paint indicated elsewhere in the Technical Specification. The quality and finish of paints shall be as per standards of BIS or approved equivalent, suitable for coastal (corrosive) conditions of site. Employer's Color-Coding scheme shall be furnished during detailed engineering stage.

4.0

TESTING

During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification. Unless specified, the type test should have conducted within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under

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this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However, if the contractor is not able to submit report of the type test(s) conducted within applicable period or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client /owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

5.0 SPARES

The Bidder shall ensure availability of spares required to meet system availability and reliability. The Bidder shall include in his scope of supply all the necessary Mandatory spares as described elsewhere in the Bid documents.

6.0 TRAINING OF EMPLOYERS PERSONNEL

The bidder shall provide training (free of cost) to the personnel of BHEL/NTPC for 15 man-days at his works and at site for erection, testing, commissioning and O&M. Expenses towards travel, lodging, and boarding and other expenses for the personnel shall be borne by BHEL/NTPC .

7.0 PERFORMANCE GUARANTEE (PG) TEST

The performance guarantee tests shall be carried out as per the procedure specified elsewhere in the Technical Specification. All special equipment, tools and tackles instruments, measuring devices required for the successful conductance of PG test shall be provided by the bidder, free of cost. All costs associated with the PG tests shall be included in bid price.

8.0 OPERATION AND MAINTENANCE (O&M)

Comprehensive O&M of the complete BESS system upto 33 KV interconnection point under subject package for a period of 10 years from the date of start of trial run of full project capacity is in the scope of the bidder. Additionally, the comprehensive O&M of the project part capacity commissioned AND/OR the comprehensive O&M of the plant from the date of declaration of COD of full project capacity to the date of start of full project capacity trial run shall also be in the scope of the bidder. Additionally, bidder to refer commercial portion of bidding document for details regarding O&M of part capacity commissioned and payments.

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5.TERMINAL POINT

1.0 ELECTRICAL INTERFACES

1.01 TERMINAL POINT

The Bidder shall develop 4 blocks of BESS system of approx. 25 MW each (Max 30 MW) and interconnect with Solar blocks at 33 KV by rerouting the cables from nearby point going from solar block to solar pooling switchgear as indicated in Tender SLD.

For data telemetry and communication bidder shall ensure required provision for integration at switchyard FOTE panel along with required modification, if any.

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6.DETAILED TECHNICAL SPECIFICATION OF THE SUPPLIES

6.01 DC CABLES

1. Cables used between battery system and PCSs shall be of suitable grade as per maximum DC voltage of battery string.
2. Cables used shall be of min. 1.5 kV (DC) grade. These cables shall confirm to the requirements of the standards & codes specified at Chapter B-4 (AC Cables) or any other relevant standard elsewhere in the specification.
3. In case bidder offers 1500V DC system 3.3kV(E) grade cables shall be provided. These Power cables shall have compacted Aluminum/copper conductor, XLPE insulated, PVC inner sheathed (as applicable), Armoured/ Unarmoured, FRLS PVC outer sheathed conforming to IS: 7098 (Part-2).
4. The cable insulation grade shall be as per PCS manufacturer recommendation based on DC side waveform.
5. DC CABLES SIZING CRITERIA

As per relevant standards.

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6.02 BATTERY AND BATTERY MANAGEMENT SYSTEM

1.0 CODES AND STANDARDS

The BESS shall conform to all applicable IEC and UL standards. Where an applicable IEC/UL standard is not available, IS/ any applicable international standard shall be referred to as best practice.

As a minimum requirement, the following standards as applicable shall be complied with:

IEC 62485-2	Safety requirements for secondary batteries and battery installations - to meet requirements on safety aspects associated with the erection, use, inspection, maintenance and disposal: Applicable for Lead Acid and NiCd / NiMH batteries	Applicable on ly for Lead Acid and NiCd / NiMH batteries
IEC 61850/ DNP3	Communications networks and management systems. (BESS control system communication).	
UL1973 (battery) Or (IEC 62619 (battery) + IEC 63056 (battery))	Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications / Secondary cells and batteries containing alkaline or other nonacid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications	Either UL 1642 or UL1973 or (IEC 62619+ IEC 63056) for the Battery level
UL 1642 or UL 1973, Appendix E (cell) or IEC 62619 (cell) + IEC63056 (cell)	Secondary cells and batteries containing alkaline or other non-acid electrolytes. Safety requirements for secondary lithium cells and batteries, for use in industrial applications	Required for Cell

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IEC 62933-2-1	Electrical Energy Storage (EES) systems-Part-2-1: Unit Parameters and Testing methods-general Specification	Tests for Class-B application: 1.Duty cycle Round Trip Efficiency test 2.Equipment and basic Function Test 3.Available Energy Test 4.Insulation Test
EC 62281 / UN 38.3	Safety of primary and secondary lithium cells and batteries during transport: Applicable for storage systems using Lithium Ion chemistries	Required for both Battery and Cell
UL 9540 or (IEC TS 62933-5-1 + IEC 62933-5-2)	Electrical energy storage (EES) systems - Part 5-1: Safety considerations for grid integrated EES systems - General specification / Standard for Energy Storage Systems and Equipment	Either UL9540 or (IEC 62933-5-1 + IEC 62933-5-2) is required for BESS system level
IEC 61427-2/IS 16270	Secondary cells and batteries for renewable energy storage for On grid applications - General requirements and methods of test	Required for Cells and Battery Modules
UL9540A	Standard for Thermal runaway	Required for BESS system level

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2.0 Battery Subsystem Design Requirements: -

2.1 Electrochemical Cells

Only cells that are commercially available or for which suitable (not necessarily identical) replacement cells can be supplied on short notice will be allowed. For both premature cell failures and end-of- battery-life replacement, the Contractor shall guarantee cell availability and the length of down time (hours or days) required to replace cells. The cells may be supplied as separate, individual units or as group of cells combined into modules. The cells shall meet the seismic requirements for the planned location of the BESS. Cell and module design shall accommodate the anticipated vibrations and shocks associated with the transportation of the BESS and shall resist deterioration due to vibrations resulting from the same. Associated hardware and paraphernalia should also be able to withstand the rigors of transportation. The transport plan shall be shared with the Employer and approved prior to dispatch.

Labelling of cells or unit batteries shall include manufacturer's name, cell type, nameplate rating, and date of manufacture, in fully legible characters. All cells shall be traceable to the point of origin for purpose of addressing safety issues.

2.2 Electrochemical Storage System

2.2.1 The storage system may consist of one or more unit batteries. If the storage system consists of more than one unit battery, these may be electrically interconnected in any desirable series and parallel configuration to achieve the overall system storage and power rating requirements. The DC voltage of battery system shall be selected by the Bidder to suit the PCS and battery efficient and safe operational requirement.

2.2.2 Each electrically series-connected string of unit batteries shall include a means of disconnecting the string from the rest of the system and of providing over-current protection (during a fault).

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This protection shall be coordinated with the PCS capabilities and battery string protection and shall take into account switching or other transients and the inductance/resistance (L/R) ratio at the relevant areas of the dc system. The means of disconnect shall provide for a physical interruption of the string electrical circuit, which shall be visible to anyone servicing the individual unit batteries in the string.

2.2.3 If the disconnect means consists of removal of a unit battery, the storage system shall be designed to allow maintenance personnel to determine that there is no current flowing in the string and provisions to ensure that the PCS is off before the unit battery is removed. Procedures for maintenance and/or field replacement of unit batteries shall neither require nor recommend removal of the unit battery without first ensuring that no current is flowing in the string circuit.

2.2.4 Over-current protection, whether on the ac or dc side, in paralleled unit battery strings shall be sized and coordinated so that currents from other strings do not contribute to a fault in any unit battery string.

2.2.5 Where appropriate, dc wiring shall be braced for available fault currents. Protection shall include a dc breaker, fuse, or other current-limiting device on the battery bus. This protection shall be coordinated with the PCS capabilities and battery string protection. The Contractor shall produce a fault analysis and protection coordination study for the battery dc subsystem during final design. The Employer reserves the right to withhold permission to ship the BESS until the fault analysis has been satisfactorily completed.

2.2.6 Cells, wiring, switch gear, and all dc electrical components shall be insulated for the maximum expected voltages plus a suitable factor of safety as per standard/subject to approval during detail engineering. Cell and module terminals and interconnects shall have adequate current-carrying capacity. The polarities of cell and module terminal posts shall be embossed on the cover at the terminal.

2.2.7 The battery system shall include a system to detect and alarm

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excessive ground leakage current levels. Ground fault detection shall be enabled for the container or, if more than one electrical series string is installed in the container, for each series string. The detection/trip level shall be field adjustable. The Contractor shall have overall responsibility for the safety of the electrical design and installation of the battery, as well as all aspects of the BESS.

2.2.8 The battery system shall include a monitoring/alarm system and/or prescribed maintenance procedures to detect abnormal unit battery conditions and notify proper personnel of their occurrence.

2.2.9 Abnormal conditions shall include but not be limited to (1) weak unit batteries that could reasonably be expected to fail to provide rated capacity upon full discharge, (2) high-resistance or open-unit batteries, (3) high-resistance or open external unit battery connections, (4) unit batteries with temperatures exceeding operating thresholds, and (5) internally shorted unit batteries. Unit battery monitoring, whether automatic or manual, should be specified to alert the proper personnel in a timely manner that an abnormal unit battery condition exists or may exist. All alarms shall be part of the control system and shall include remote display or annunciation capability.

The unit batteries shall be racked or shall be housed in stackable modules. The unit batteries or cells shall be arranged and installed to permit easy access for equipment and personnel. The moveable units shall be arranged and installed to permit easy access for equipment and personnel to carry out unit removal and replacement activities. For all systems, it shall be possible to remove and replace a prematurely failed unit battery or cell (as appropriate), when system performance specifications cannot be met. The lengths and widths of all aisles and spaces into which personnel may enter in the field for operations and/or routine or unscheduled maintenance purposes, as well as egress routes from these aisles and spaces, shall conform to applicable codes and standards. All racks and metallic conductive members of stackable modules shall be grounded to earth. Racks shall meet the seismic load and road vibration requirements and shall include means to restrain cell

movement during seismic events and transport. The Contractor shall furnish analyses and/or other data that show that the rack and cell designs are designed to meet all potential seismic and transport vibration requirements.

2.2.10 Preferably, Provision shall be made for future Augmentation/Replacement by keeping Spare Racks for accommodating Battery Stack Modules capacity.

2.2.11 The design of all modules and racks shall specifically account for the anticipated vibrations and shocks associated with the transportation of the BESS.

2.2.12 Cell/Battery Auxiliary Systems

The cells and battery system shall be supplied with all required and/or recommended

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accessories. This includes inter-cell connectors & monitoring devices for cell temperature and cell voltage, if required.

3.0 BATTERY MANAGEMENT SYSTEM (BMS):

The BMS shall be designed to provide automatic, unattended operation of the battery storage system. BMS shall manage a rechargeable battery (cell or battery pack), including protecting the battery from operating outside its Safe Operating Area, monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it and / or balancing it.

- a) Battery storage shall discharge based on battery capacity and real-time load. The reference value shall be updated periodically depending upon the electrical parameter measurement. The charging shall be performed in constant current constant voltage (CCCV) mode. However, change of operating mode from CC to CV during charging shall be determined on the basis of Supplier recommendations and the battery type and technology offered.

The battery storage shall discharge on real time basis as per functional requirement. Battery SoC shall be monitored periodically to evaluate the remaining capacity at start of discharge operation and accordingly a constant rate of discharge will be defined. Further, an additional feature shall be provided to change/edit the discharge duration and rate of discharge whenever required.

- b) BMS shall monitor battery system parameters such as string voltage & current, cumulative number of cycles and throughput along with DoD. It shall automatically determine the State of Charge (SOC) and State of Health (SOH) of the battery individual cell/module.
- c) It shall also monitor utility side parameters such as voltage, charge/discharge current and protection system readings/status.
- d) BMS shall automatically control the charging state of each module based on monitoring of parameters and power/energy requirements. It should charge the module in float/boost mode and/or Constant Current Constant Voltage (CC-CV) mode as per requirements of battery sub system. It shall also be designed to protect the battery cells/module/string from out of tolerance and unsafe operating conditions under any eventuality and mitigate fire risk. Further, it should regulate the voltage to limit the temperature rise in the cell.
- e) The BMS shall automatically control the charge and discharge of the individual cells/module, balancing between cells/module to optimize energy consumption and range, monitor cell/module health and provide critical safeguards to protect the batteries from damage.
- f) Monitoring and storing the battery's parameters and communicating the same to SCADA/EMS.
- g) Alarm and fault generation and communicating the same to SCADA/EMS
- h) Isolating the battery in cases of any emergency.
- i) BMS, EMS and PCS shall be operated in coordinated manner in order to achieve the above requirement.

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4.0

TYPE TESTING:

During detailed engineering, the contractor shall submit all the type test reports carried out within last ten years from the date of techno-commercial bid opening for Owner's approval. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either should have been witnessed by a client or conducted at an independent laboratory by one of the ILAC member signatory accredited laboratories. In case of module types/ BESS/equipment for which such Test facilities may not exist in India at present, test certificates from reputed ILAC Member body accredited Labs abroad will be acceptable.

However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

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1.0

6.03 POWER CONDITIONING UNIT

The Power Conversion System (PCS) shall be bi-directional Inverter and shall act as an interface between the DC battery system & the AC grid. PCS shall be designed to charge & discharge the BESS battery in coordination with energy management system and battery management system. The PCS shall consist of fast acting solid state electronic switch along with all associated control & protection, filtering, measuring instruments and data logging devices. The PCS shall be bi-directional inverter with four quadrant operation. The PCS output shall always follow the grid voltage & frequency by sensing the grid voltage and phase and the PCS shall always remain synchronized with the grid. The PCS shall use only self- commutated device which shall be adequately rated. The continuous combined rating of all PCSs shall be as per Chapter 2-A, Part A

2.0

CODES AND STANDARDS

The PCS shall conform to all applicable IEC standard. Where an applicable IEC standard is not available, IS/ any applicable international standard shall be referred to as best practice

IEC 60068-2-14:2009	Environmental testing - Part 2-14: Tests - Test N: Change of temperature
IEC 60068-2-30:2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h+ 12 h cycle)
IEC 62116 Ed.2	Testing procedure—Islanding prevention measures for power conditioners used in grid- connected photovoltaic (PV) power generation systems
IEC 62477-1	Safety Requirements for power electronic converter systems and equipment- Part-1: General
IEC 62477-2	Safety Requirements for power electronic converter systems and equipment-Part-2: Power electronic converters from 1000Vac or 1500V DC up to 36kV AC or 54kV DC
IEEE 1547/IEC 61727/ BDEW (as applicable)	Standard for interfacing solar PV plant with utility grid.
IEC 60529	Ingress protection test

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CEA Gri Connectivity standard	Relevant CEA regulations and Indian grid code as amended and revised from time to time.
IEC-61683 Ed.1	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency requirements
IEC 61000-6-2 Ed.2	Electromagnetic compatibility (EMC) - Part 6- 2: Generic standards - Immunity standard for industrial environments
IEC 61000-6-2 Ed.2.1	Electromagnetic compatibility (EMC) - Part 6- 4: Generic standards - Emission standard for industrial environments
IEEE 519-2022	Recommended practices and requirements for harmonic control in electrical power systems.
IEC 60068-2-1:2007	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2:2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat

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3.0

GENERAL REQUIREMENTS

3.01 PCS shall meet the following technical parameter

1.	Nominal output voltage frequency	50Hz
2.	Continuous operating frequency range	47.5 Hz to 52 Hz
3.	AC Voltage Range	± 10% of rated AC voltage
4.	Euro efficiency	Minimum 97% (as per IEC 61683)
5.	Surge Protection Device (SPD)	Type-I & II DC side
		Type-II AC side
6.	Euro efficiency	Minimum 97% (as per IEC 61683)
7.	Operating power factor range	0.8 Lead to 0.8 Lag (minimum)
8.	SVG /Four Quadrant Operation	Required.
9.	Current harmonics	As per CEA regulation ent/IEEE 519
10.	Current THD value	< 3% at nominal power
11.	DC Injection	<0.5 % at rated current
12.	Operating ambient temperature	0 to 60 ° C
13.	Humidity	95 % non-condensing
14.	Maximum Noise level	75 dBA (for indoor n)
15.	Flicker	As per CEA regulation ent
16.	Remote start and stop from SCADA/EMS	Required.
17.	Active power limit control, reactive and power factor control features.	Required. Possible both PPC and/or EMS SCADA.
18.	PCS designed DC fault current level	Maximum short circuit current of system connected to PCS and suitable duration.
19.	PCS designed AC fault current level	Maximum short circuit current of Inverter Duty transformer and duration one sec.

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feature to protect itself and the Battery system from damage in the event of PCS component failure or from parameters beyond the PCS's safe operating range due to internal or external causes. The self- protective features shall not allow signals from the PCS front panel to cause the PCS to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PCU, including commutation failure, shall be cleared by the PCS protective devices.

- 3.09 PCS shall have necessary limiters in build in the controller so as to ensure safe operation of the PCU within the designed operational parameters.
- 3.10 PCS shall have thermal overloading protection to prevent failure of switching devices and other components of Inverter. PCS controller shall automatically regulate/limit the power output to reduce the PCS cabinet and switching devices temperature. Bidder to submit the PCS power vs ambient temperature curve during details engineering stage. PCS shall be able to provide inverter inside cabinet and switching devices temperature (in soft analog value) to SCADA system for remote monitoring, storing and report generation purpose.
- 3.11 PCS shall have AC and DC side monitoring capability and reporting to SCADA/EMS system (measured analog and digital value measured within PCS). Any special software if required for this purpose shall be provided for local and remote monitoring and report generation.
- 3.12 All-important alarm and trip signals shall be configured in the PCS and their corresponding modbus address shall be provided for SCADA/EMS configuration. Signal shall necessarily be included such as LVRT in action and trip operated, HVRT trip, islanding protection operated, over current operated, Inverter cabinet temperature high alarm and all other important signals. Details shall be finalized during details engineering stage.
- 3.13 The PCS shall be earthed as per manufacturer recommendation. During detail engineering the Bidder needs to submit the details earthing arrangement of PCS and system earth pit requirement during detail engineering stage. The detail specification for panel earthing for safety has been mentioned elsewhere in this specification.
- 3.14 The PCS shall be capable of starting and operating as black start i.e., without the presence of the utility voltage. Exercise of the black start capability shall be manual and interlocked and shall under no circumstance result in an accidental energizing of the Host Utility's bus. PCS black start shall be possible from EMS without any setting modification at PCS panel locally.
- 3.15 In case auxiliary supply of PCS is met internally, then it should have

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sufficient power backup to meet the LVRT requirement.

- 3.16 Bidder to submit third-party verified OND files of the PCS during detail engineering.

4.0 CENTRAL PCS:-

- 4.01 PCS must have provision to be isolated from grid through Air Circuit Breaker/MCCB. The ACB/MCCB as required can be provided as a part of PCS/its Modules or separately based on standard design and configuration of PCS manufacturer. The ACB and MCCB shall be able to withstand the maximum fault current for minimum one sec duration. ACB/MCCB shall be able to isolate PCS from AC grid under all fault current condition. Any alternate provision other than ACB/MCCB which is recommended by OEM and meeting the requirement, shall be considered on case-to-case basis during detailed engineering stage.
- 4.02 PCS shall have suitable rated DC isolator/contactors for isolation of DC Battery system from inverter. Suitable rated fuse shall be provided (at inverter end) in incoming DC cable from battery system. One set spare terminals with fuse/link (as applicable) and holder shall be provided for the future use.
- 4.03 String Monitoring facility:- PCS shall be provided with current monitoring transducer at incoming DC cables from each battery array. The current transducers used for this purpose shall have accuracy of 1.0 class or better
- 4.04 The PCS should be designed for parallel operation through galvanic isolation. Solid state electronic devices shall be protected to ensure smooth functioning as well as ensure long life of the inverter. Parallel operated PCS system are also accepted subjected to recommendation of PCS manufacturer. In such case, PCS design shall also ensure that no abnormal interaction shall take place among the PCS unit during any grid operating condition which may result in outages.
- 4.05 Local Display unit for viewing important parameters configuration and troubleshooting purpose shall be provided.
- 4.06 PCS shall have suitable communication card (Modbus TCP/IP) for networking and SCADA/EMS integration and same shall support dual master communication. PCS shall include all important measured & internal calculated analog values and alarm & trip signals for remote monitoring, storing and report generation purpose in SCADA system. Details list of above such parameters shall be provided along with their Modbus address during detail engineering stage.

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- 4.07 In case of modular design of PCS is offered, the Contractor shall ensure that no abnormal interaction shall take place among the various PCS modules during any grid operating condition which may result in outages. The PCS controller offered by the Contractor shall be such as to ensure stability, reliability, and a good dynamic performance. The Bidder shall indicate the control scheme adopted for modular PCS and its merits and the test which will check its performance.
- 4.08 Bidder may offer liquid cooling system subject to BHEL/NTPC approval. In case Liquid cooled inverters are offered, Bidder to ensure that coolant is used in closed cycle. Complete inverter along with cooling system shall be of proven design.
- 4.09 PCS shall have emergency stop push button for tripping of inverter with complete DC & AC electric isolation.
- 4.10 Automatic 'sleep' mode shall be provided so that unnecessary losses are
- 4.11 Outdoor PCS:-
- a) Outdoor PCS enclosure must be suitable to withstand the harsh environmental conditions for complete life of plant
 - b) The PCS enclosure protection class shall IP 54 or better protection. For outdoor solution (Other than containerized), the electronic card compartment shall have IP 65 or better protection.
 - c) Bidder to submit temperature endurance test report of complete assembly during detail engineering stage.
 - d) Containerized solution shall have projection of at least 60cm wherever an opening in the inverter door exposes the inverter component to outside environment.
 - e) Structural steel and paints for shed shall be as per ISO 12944-5.
 - f) Outdoor inverter (including containerized solution) platform shall be raised Min 1250 mm from NGL. Cable bending radius and other relevant factors to be considered during platform design. This shall be reviewed during detailed engineering.

Type Testing:-

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During detailed engineering, the contractor shall submit all the type test reports including temperature rise test and surge withstand test carried out within last ten years from the date of techno-commercial bid opening for Owner's approval. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval

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6.04 LT SWITCHGEAR

1.0

CODES AND STANDARDS

The design, materials, and method of LT Switchgear shall conform to the applicable IEC standard. All equipment shall be installed, and all work shall be carried out in accordance with relevant IEC standards. Where an applicable IEC standard is not available, IS/ any applicable international standard shall be referred to as best practice. All standards, specifications and codes of practice shall be the latest editions including all applicable official amendments and revisions.

As a minimum requirement, the following standards shall be complied with:

IS	Details
IEC 60947/ IS13947	Low-voltage Switchgear and control gear
IS 2705	Current Transformers
IS 3043	Code of practice for earthing.
IS 3072	Code of practice for installation and maintenance of Switchgear
IS 3156	Voltage Transformers
IS 3202	Code of practice for climate proofing of electrical equipment.
IS 3231	Electrical relays for power system protection.
IS 13703 / IEC 60269	HRC Cartridge fuses
IS 10118 (4 parts)	Code of practice for selection, installation and maintenance of Switchgear and control gear.
IEC 60255	Electrical Relays

2.0

TECHNICAL PARAMETERS

A. POWER SUPPLY (AC SYSTEM)		
(i)	Voltage	415V \pm 10%, 3 Phase, 4 wire, Neutral Solidly Earthed
(ii)	Frequency	50 Hz \pm 5%
(iii)	Minimum system fault level	As per system fault current (for 1 sec)
(iv)	Short time rating for bus bars,	As per system fault current (for 1

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	ckt. breakers, current transformers and swgr. Assembly.	sec)
(v)	Maximum ambient air Temperature	50 deg. C
BUS BARS		
(vi)	Continuous current rating at 50°C ambient:	As Per Requirement
(vii)	Temperature Rise allowed above ambient	40°C for plain joints 55°C for Silver plated joints
B. MCCB		
(i)	Rated voltage	415V
(ii)	Rated Insulation Level	690V
(iii)	Rated ultimate and service SC breaking capacity (As per system requirement)	As per system fault current (for 1 sec)
(iv)	Rated making capacity	2.1 times of System fault current
(v)	Utilization category	A
C. DIGITAL MFM		
(i)	Accuracy class	0.5
(ii)	MFM shall be provided at LT incomer feeder. MFM shall have suitable communication port for integration with SCADA system.	
D. CURRENT TRANSFORMERS		
(i)	Type	Cast Resin Bar Primary
(ii)	Voltage class and frequency	650V, 50HZ
(iii)	CT Secondary Current	1 A
(iv)	Class of insulation	E or better
(v)	Accuracy class & burden	
	a) For Protection	5P20, 5VA
	b) For Metering	Class 1.0, 5VA (min)
(vi)	Instrument Security Factor for metering CT	5
E. VOLTAGE TRANSFORMERS		
(i)	Type	Cast Resin
(ii)	Voltage Ratio	415 / 110V for line PT

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		415/√3 / 110/√3V for Bus PT
(iii)	Method of Construction	Vee Vee
(iv)	Accuracy Class	0.5
(v)	Rated Voltage factor	1.1 continuous, 1.5 for 30 sec.
(vi)	Class of insulation	E or better
(vii)	One minute power frequency withstand voltage	2.5 KV
F. HRC FUSES		
(i)	Voltage Class	650 Volts
(ii)	Rupturing capacity	80kA (RMS) for AC circuits
G. CONTACTORS		
(i)	Type	Air break electro magnetic
(ii)	Utilising Category	AC3 of IS/IEC 60947 for non reversible AC4 of IS/IEC 60947 for reversible drives
H. SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS		
(i)	Colour finish	
	Exterior	RAL9002 (Main body) RAL 5012 (Extreme end covers) The paint thickness shall not be less than 50 microns
	Cable entry	
(ii)	Power Cables	Bottom
	Control Cables	Bottom

The quantities/Nos. of the Feeders /MCCB shall be so as to meet the system requirements. 5% spare with minimum 01 No. to be provided on each board/switchgear having more than 5 MCCB. However, no spare Air circuit breaker panels are required.

3.0

DETAILS OF DISTRIBUTION BOARDS

Applicable for Auxiliary Power Supply system and ~~String Inverter~~ distribution board of rating up to & including 400A.

3.1 Switchboards in CMCS shall be of metal enclosed, indoor, floor-mounted, free- standing type. Distribution boards of small size can be of wall/channel mounted type. For inverter stations, if outdoor distribution boards/LT pooling switchgear is proposed, the same shall be of suitable IP class and shall be kept under shed.

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- 3.2 All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.
- 3.3 All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.
- 3.4 The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut outs shall be true in shape and devoid of sharp edges.
- 3.5 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS/IEC 60947. All cutouts shall be provided with EPDM / Neoprene gaskets.
- 3.6 All switchboards shall be of uniform height not exceeding 2450 mm.
- 3.7 Switchboards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates.
- 3.8 All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. Replacement /Maintenance of individual equipment/ component shall be possible without switching off or isolating the other equipment's/components.
- 3.9 Each switchboard shall be provided with undrilled, removable type gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall be provided with gasket to ensure enclosure protection. The minimum clearance in air between phases and between phases and earth for the entire busbars shall be 25mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be at least ten(10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars up to switch / fuses/MCCB shall be fully insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits. All busbars and jumper connections shall be of high conductivity aluminium alloy / copper of adequate size.
- 3.10 All switchboards shall be provided with three phase and neutral busbars. Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant

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- properties and working temperature of 105°C.
- 3.11 The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.
- 3.12 All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet molded compound or equivalent type polyester fiber glass molded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure.
- 3.13 All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied just before making a joint. All bolts shall be tightened by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All copper to aluminium joints shall be provided with suitable bimetallic washers.
- 3.14 All busbars shall be colour coded as per IS: 375.
- 3.15 Wherever the busbars are painted with black Matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.
- 3.16 The Bidder shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.
- 3.17 Panel space heaters shall be provided and the supply for this shall be tapped from incomer, before the isolating switch/circuit breaker. Incoming circuit to space-heater shall have an isolating switch, HRC fuse and neutral link of suitable rating. Panel illumination and plug-socket shall also be tapped from the space heater supply.
- 3.18 A galvanized steel / Copper / Aluminium earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.
- 3.19 The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth without exceeding the allowable temperature rise.
- 3.20 All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.
- 3.21 All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded copper wires of size not less than
- 3.22 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation color code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections, which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.
- 3.23 VT and CT secondary neutral point earthing shall be at one place only, i.e. on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.
- 3.24 All hinged doors having potential carrying equipment mounted on it shall be earthed by

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- flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also acceptable. The Contractor shall establish earth continuity at site also.
- 3.25 All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.
- 3.26 All auxiliary wiring shall be carried out with 650V grade, single core stranded copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm² (min.) for control circuit wiring and 2.5 mm² (min) for CT and space heater circuits.
- 3.27 Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.
- 3.28 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.
- 3.29 All internal wiring terminations shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.
- 3.30 Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.
- 3.31 Cable termination arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded aluminium conductor, PVC/ XLPE insulated, armoured / unarmoured and PVC sheathed cables. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc., shall be provided by the contractor, to suit the final cable sizes.
- 3.32
- 3.33 All power cable terminals shall be of stud type and the power cable lugs shall be solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.
- 3.34 All Switchgears, MCCs, Distribution Boards, Fuse boards, all feeders, local push- button stations etc. shall be provided with prominent, engraved identification plates.
- 3.35 All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Inscription & lettering sizes shall be subject to Employer's approval.
- 3.36 Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.
- 3.37 The gaskets, wherever specified, shall be of good quality EPDM / neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.
- 3.38 The bidder shall, ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per indian standards / specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.
- 3.39 ON/OFF status and protection trip status of incomers and bus coupler (if applicable as per SLD) be provided for SCADA system.
- 3.40 Suitable changeover and interlocking arrangement shall be provided for incomers and bus coupler (if applicable as per SLD).
- 3.41 It shall be the responsibility of the contractor to fully coordinate the overload and short circuit breakers/fuses with the upstream and downstream circuit breakers / fuses, to provide satisfactory discrimination. Further the various equipment supplied shall meet the requirements of type ii class of co-ordination as per IS: 8544.

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- 3.42 All sheet steel work shall be pretreated, in tanks, in accordance with is: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-c" as specified in is: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, electrostatic powder coating shall be used. Powder should meet requirements of is 13871 (powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the employer. The paint thickness shall not be less than 50 microns.

MCCB

1. MCCB shall be fixed type module, air break type, having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.
2. MCCB shall have inbuilt front adjustable releases (overload & short circuit) and shall have adjustable earth fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status (on/off etc).
3. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door can not be opened unless the MCCB is in OFF position. Means shall be provided for defeating this interlock at any time. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked. The MCCBs being offered shall have common/interchangeable accessories for all ratings like aux. switch, shunt trip, alarm switch etc. The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturer's discrimination table.

FUSES

1. All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80kA rms (prospective) breaking capacity at 415V AC and for DC circuits, 20kA rms breaking capacity at 240V DC.
2. Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses. Fuse shall be mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard.
3. The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.

LT SWITCHGEAR

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In addition to the above the following shall also be applicable for switchgear ratings more than 400A

All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments

- (a) **BUSBAR COMPARTMENT:-** A completely enclosed bus bar compartment shall be provided for the horizontal and vertical busbars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power busbars shall be in separate compartments.
 - (b) **SWITCHGEAR / FEEDER COMPARTMENT:-** All equipment associated with an feeder of rating above 400A shall be housed in a separate compartment of the vertical section. ACB shall be provided for feeders of rating 1000A and above. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity as per system requirement. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure.
 - (c) **CABLE COMPARTMENT/CABLE ALLEY:-** A full-height vertical cable alley of minimum 250mm width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley of capacity more than 400 A shall be designed to meet the Form IVb and for less than 400A A shall be designed to meet the Form 3b (as per IEC 61439) for safety purpose. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged.
 - (d) **CONTROL COMPARTMENT:-** A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.
1. All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 4X as per IS/IEC 60947 (for indoor panels). All cutouts shall be provided with EPDM / Neoprene gaskets. However, the control / relay compartments shall have degree of protection not less than IP 5X. If outdoor LT switchgear is proposed at inverter stations, the same shall be of suitable IP class and shall be kept under shed.
 2. Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.
 3. Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust into panels.
 4. The minimum clearance in air between phases and between phases and earth for the entire busbars. and bus-link connections at circuit-breaker shall be 25mm. All busbars and jumper connections shall be of high conductivity aluminum alloy / copper of adequate size.
 5. After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker

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compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.

6. All switchgear (circuit-breaker) panels shall be of single-front type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more.
7. All circuit-breaker modules shall be of fully draw out type having distinct 'Service' and 'Test' positions. Suitable arrangement with cradle / rollers, guides along with tool / lever operated racking in / out mechanism shall be provided for smooth and effortless movement of the chassis.
8. All switchboards shall be provided with three phase and neutral busbars. Two separate sets of vertical busbars shall be provided in each panel of double front DBs. Interleaving arrangement for busbars shall be adopted for switchboards with a rating of more than 1600A. Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant properties and working temperature of 105°C.
9. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door cannot be opened unless the MCCB is in OFF position. Means shall be provided for defeating this interlock at any time. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked.
10. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear switchgear also.
11. Temperature raise test of LT switchgear of rating more than 400A:- The temperature rise of the horizontal and vertical busbars and main bus links including all power draw out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 40 deg C with all other types of joints over an outside ambient temperature of 50 deg
12. C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current.
13. The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.
14. Electrically controlled circuit breaker boards shall be provided with DC control supply.

CIRCUIT BREAKERS

1. Circuit breakers shall be three pole, air break, horizontal draw out type, and shall have fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameters of continuous current rating and fault making / breaking capacity only after provision of cooling fans or special device shall not be acceptable.
2. Circuit breakers along with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimize misalignment of the breaker.
3. There shall be "SERVICE", "TEST" and "FULLY WITHDRAWN" positions for the breakers. In "Test" position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent

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- movement of the circuit breaker from the "SERVICE", "TEST" or "FULLLY WITHDRAWN" position. Circuit Breaker rack-in and rack-out from Service to Test, Test to Isolated position, or vice-versa shall be possible only in the compartment door closed condition.
4. Separate limit switches, each having required numbers of contacts shall be provided in both "SERVICE" and "TEST" position of the breaker. All contacts shall be rated for making, continuously carrying and breaking 10 Amp at 240 V AC and 1 Amp (Inductive) at 240 V DC respectively.
 5. Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE ", "TEST" AND "SPRING CHARGED" positions.
 6. Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half a cycle of rated frequency.
 7. Movement of a circuit breaker between "SERVICE" and "TEST" position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In case the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exists between the fixed and drawout contact at the time of breaker trip so that no arcing takes place even with the breaker carrying its full rated current.
 8. Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position or in "FULLY WITHDRAWN" position.
 9. Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.
 10. Breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
 11. Circuit breakers shall be provided with coded key / electrical interlocking devices, as per requirements.
 12. Circuit breaker shall be provided with anti-pumping feature and trip free feature, even if mechanical anti-pumping feature is provided.
 13. Mechanical tripping shall be possible by means of front mounted Red "trip" push- button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.
 14. Complete shrouding / segregation shall be provided between incoming and outgoing bus links of breakers. In case of bus coupler breaker panels the busbar connection to and from the breaker terminals shall be segregated such that each connection can be approached and maintained independently with the other bus section live. Dummy panels if required to achieve the above feature shall be included in the Bidder's scope of supply.
 15. Circuit breaker open/close shall be possible from SCADA and open/close status and all other important signal status shall be provided for SCADA monitoring.
 16. Power operated mechanism shall be provided with a Universal motor suitable for operation on DC Control supply. In case of DC supply motor should satisfactorily operate with voltage variation between 85% to 110% nominal control supply voltage. Motor insulation shall be class "E" or better.
 17. The motor shall be such that it requires not more than 30 Seconds for fully charging the closing spring at minimum available control voltage.
 18. Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.
 19. The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply

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at least one open-close-open operation shall be possible.

20. Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
21. All circuit breakers shall be provided with closing and trip coils. The closing coil shall operate correctly at all values of voltage between 85% to 110% nominal control supply voltage. The trip coil shall operate satisfactorily at all values of voltage between 70% to 110% nominal control supply voltage.
22. Provision for mechanical closing of the breaker only in "Test" and "WITHDRAWN" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.
23. The ACB Panel door shall not be possible to open in breaker closed condition. Further, the racking mechanism shall be accessible only after opening the breaker panel door.
24. Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit-breaker module in a cubicle at each location. The trolley shall be such that the top most breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn /inserted of particular switchgear.

25. Electrical Parameter of Circuit Breaker

1)	Type	Air break spring charged stored energy type
2)	Operating duty	O-3 MIN-CO-3 MIN-OC
3)	Symmetrical interrupting	As per system fault current (for one sec)
4)	Short circuit rating	2.1 times of System fault current (peak)
5)	Short Circuit Breaking current	
	a) AC Component	As per system fault current (for one sec)
	b) DC Component	As per IS:13947

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6)	Short time withstand	As per system fault current
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AC JUNCTION BOXES

1. Separate AC Junction box shall be used for string inverters AC output connection. Protection class for AC junction box shall be IP 54 or better protection. All components of junction box shall be suitable for rated output voltage (with + 10% variation) of string inverter, grid frequency of 50 Hz +/- 5%, ambient temperature 50 deg. C and system fault current for 1 sec.
2. AC junction box shall be of metal enclosed type. All frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold- rolled sheet steel and 4.0 mm for non-magnetic material. The minimum clearance in air between phases and between phases and earth shall be at least twenty five
3. (25) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers.
4. All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.
5. EPDM / Neoprene gasket shall be used to prevent ingress of dust into panels.
6. All non-current carrying metal work of the junction box shall be effectively connected to the system earth bus.
7. Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns.

TEMPERATURE-RISE (For LT Switchgear having capacity more than 400A)

The temperature rise of the horizontal and vertical busbars and main bus links including all power draw out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 40 deg C with all other types of joints over an outside ambient temperature of 50 deg

C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current.

DERATING OF COMPONENTS

The Bidder shall, ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.

The Bidder shall clearly indicate the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient. temperature of 50 deg C.

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6.05 HT SWITCHGEAR

CODES AND STANDARDS

All standards, specification and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of Techno commercial bid. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes.

Sl No	IS Code	Name Of Equipment
a)	IS: 722	AC electricity meters.
b)	IS: 996	Single phase small AC and universal electrical motors.
c)	IS: 1248	Direct Acting indicating analogue electrical measuring instruments and Accessories.
d)	IS/IEC: 60947	Degree of protection provided by enclosures for low voltage switchgear and control gear.
e)	IS: 2544	Porcelain post insulators for systems with nominal voltages greater than 1000 Volts.
f)	IS: 2705	Current transformers.
g)	IS: 3156	Voltage Transformers
h)	IS: 6005	Code of practice for phosphating of iron and steel.
i)	IS: 5082	Specification for wrought aluminium and aluminium alloy bars, rods, tubes and selections for electrical purposes.
j)	IEC: 61850	Communication Standard for Numerical relays
k)	IEC: 61131-3	Automation Standard for Numerical relays
l)	IS: 9046	AC contactors for voltages above 1000 volts and upto and including 11000 Volts.
m)	IS: 13703	Low voltage fuses
n)	IS: 9385	HV fuses
o)	IS: 9431	Specification for indoor post insulators of organic material for system with nominal voltages greater than 1000 volts upto and including 300 kV
p)	IS: 9921	A.C. disconnectors (isolators) and Earthing switches for voltages above 1000 V
q)	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
r)	IS: 13118	Specification for high voltage AC circuit breakers.
s)	IEC: 60099-4	Metal oxide surge arrester without gap for AC system
t)	IS/IEC: 62271-100	High voltage alternating current circuit breakers.
u)	IS/IEC: 62271-200	High voltage metal enclosed switchgear and control gear.
v)	IEC: 60947-7-1	Terminal blocks for copper conductors
w)	IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips

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TECHNICAL PARAMETERS

A. SYSTEM PARAMETERS

a)	Nominal System voltage	33kV
b)	Highest System voltage	36kV
c)	Rated Frequency	50Hz
d)	Number of phases/ poles	Three
e)	System neutral earthing	Solidly Earthed
f)	One minute power frequency withstand voltage	
	- for Type tests	70kV
	- for Routine tests	70kV
g)	1.2/50 microsecond Impulse withstand voltage	170kV (peak)
h)	Minimum system fault level	As per System Fault current (Refer Cl. 1.0 of Chapter 2-A, Part A)
i)	Short time rating for bus bars, circuit breakers, current transformers and switchgear assembly.	
j)	Dynamic withstand rating	2.5 times of system fault current
k)	- Space heaters	240 V AC single phase with neutral solidly earthed
l)	Maximum ambient air temperature	50 deg. C
m)	Internal Arc testing	As per system fault current (for Min 1 sec)

B. BUS BARS

a)	Continuous current rating at 50 ⁰ C ambient:	As Per Requirement
b)	Temper Rise allowed above ambient	As per IEC 62271-1, 2017

C. SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS

a)	Colour finish	
	Exterior	RAL9002 (Main body)

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		RAL 5012 (Extreme end covers)
b)	Cable entry	
	Power Cables	Bottom
	Control Cables	Bottom
c)	Earthing conductor	Galvanized steel strip
d)	Service Continuity of swgrs (LSC2B-PM)	as per IS/IEC 62271-200

D. CIRCUIT BREAKERS

a)	The circuit breakers current rating shall be selected from the load current at an ambient of 50 deg. C.	
b)	Short circuit breaker Current	
	a) A.C. component	As per Specification
	b) D.C. component	As per IS: 13118 or IEC-62271
c)	Short Circuit making current	2.5 times of system fault current (peak)
d)	Operating Duty	O-3 min-CO-3 min-CO
e)	Total break time	Not more than 4 cycles
f)	Total make time	Not more than 5 cycles
g)	Operating Mechanism	Motor wound spring charged stored energy type as per IEC-62271

E. CURRENT TRANSFORMER

a)	Secondary Current	1A
b)	Class of Insulation	Class E or better
c)	Rated output of each	Adequate for the relays and devices connected, but not less than five (5) VA.
d)	Accuracy class	
	Protection	5P20/PS as per requirement
	Measurement	0.5 class or better as per requirement
e)	Instrument Security Factor for Measurement CTs	5
f)	CT Ratio	CT ratio shall be finalized during details engineering stage. Minimum CT primary side current shall be 110% of rated current.

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F. VOLTAGE TRANSFORMERS

a)	Rated Voltage Factor	1.2 continuous for all VTs, and 1.9 for 8 Hours for star connected VTs.
b)	Class of insulation	Class E or better
c)	Other parameters	0.5 Class or better as per requirement. VA requirement shall be based on application/ requirement. Additional open delta core with damping resistor shall be provided in all VT's to prevent damage on account of Ferro-Resonance conditions
d)	At pooling switchgear, Bus VTs panels and line VTs in outgoing feeders shall be provided. All other switchgear location, at outgoing feeder cable charge indication shall be provided based on voltage sensing or use of voltage transformer.	

G. DIGITAL MFM

a)	Accuracy Class	0.5 or better
b)	Digital MFM shall be provided for VCB panels as per requirement/SLD.	

SWITCHGEAR PANEL

1. The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with clause No. 3.102 of IEC 62271-200, comprising of a row of free standing floor mounted panels. Each circuit shall have a separate vertical panel with distinct compartments for circuit breaker truck, cable termination, main busbars and auxiliary control devices. The adjacent panels shall be completely separated by steel / Aluzinc sheets except in bus bar compartments where insulated barriers shall be provided to segregate adjacent panels. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IS/ IEC 62271-200). However, manufacturer's standard switchgear designs without inter panel barriers in busbar compartment may also be considered.
2. The circuit breakers and bus VTs shall be mounted on withdrawable trucks which shall roll out horizontally from service position to isolated position. For complete withdrawal from the panel, the truck shall rollout on the floor or shall roll out on telescopic rails. In case the later arrangement is offered, suitable trolley shall be provided by the Bidder for withdrawal and insertion of the truck from and into the panel. Testing of the breaker shall be possible in isolated position by keeping the control plug connected.
3. The trucks shall have distinct SERVICE and ISOLATED positions. It shall be possible to close the breaker compartment door in isolated position also, so that the switchgear retains its specified degree of protection. Circuit Breaker rack-in and rack-out from Service to Test, Test to Isolated position, or vice-versa shall be possible only in the compartment door closed condition. While switchboard designs with doors for breaker compartments would be preferred, standard designs of reputed switchgear manufacturers where the truck front serves as the compartment cover may also be considered provided the breaker compartment is completely sealed from all other compartments and retains the IP-4X degree of protection in the Isolated position. In case the latter arrangement is offered, the Bidder shall explain how this sealing is achieved and shall include blanking covers one for each size of panel per switchboard in his total Techno commercial bid price.

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4. The switchgear assembly shall be dust, moisture, rodent and vermin proof, with the truck in any position SERVICE, ISOLATED or removed, and all doors and covers closed. All doors, removable covers and glass windows shall have gaskets all round with synthetic rubber or neoprene gaskets.
5. The control / relay compartments shall have degree of protection not less than IP 5X in accordance with IS/IEC 60947. However, remaining compartments can have a degree of protection of IP 4X. All louvers, if provided, shall have very fine brass or GI mesh screen. Tight fitting gaskets / gaskets are to be provided at all openings in relay compartment. Numerical Relays shall be fully Flush mounted on the switchgear panels at a suitable height.
6. The Switchgear shall have an internal Arc Classification of IAC FLR corresponding to system fault current. The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panels shall be specially designed to withstand these. Pressure relief device shall be provided in each high voltage compartment of a panel, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of its spreading to other compartments and panels. The pressure relief device shall not however reduce the degree of protection of panels under normal working conditions. To demonstrate that the pressure relief device operates satisfactorily the Contractor shall submit a type test report in line with IEC 62271-200 Annex - A for each high voltage chamber. Wherever louvers are provided, the construction of louvers should be such that the IAC requirements are satisfied. Further, viewing glass windows shall have the same strength as the enclosure against Internal Arc.
7. Enclosure shall be constructed with rolled steel / Aluzinc sections. The doors and covers shall be constructed from cold rolled steel sheets of 2.0 mm or higher thickness. Gland plates shall be 2.5 mm thick made out of hot rolled or cold rolled steel sheets and for non-magnetic material it shall be 3.0 mm.
8. The switchgear shall be cooled by natural air flow. Forced cooling shall be considered in case current rating is above 2000 A or above.
9. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800mm and shall not be less than 700mm.
10. Necessary guide channels shall be provided in the breaker compartments for proper alignment of plug and socket contacts when truck is being moved to SERVICE position. A crank or lever arrangement shall preferably be provided for smooth and positive movement of truck between Service and Isolated positions.
11. Safety shutters complying with IEC 62271-200 shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the truck is moved to ISOLATED position. The shutters shall move automatically, through a linkage with the movement of the truck. Preferably it shall however, be possible to open the shutters of busbar side and cable side individually against spring pressure for testing purpose after defeating the interlock with truck movement deliberately. In case, insulating shutters are provided, these shall meet the requirements of IEC 62271-200 and necessary tests as per IEC 62271-200 Clause 5.103.3.3 shall be carried out. A clearly visible warning label "Isolate elsewhere before earthing" shall be provided on the shutters of incoming and tie connections which could be energized from other end.
12. Switchgear construction shall have a bushing or other sealing arrangement between the circuit breaker compartment and the busbar / cable compartments, so that there is no air communication around the isolating contacts in the shutter area with the truck in service position.
13. The breaker and the auxiliary compartments provided on the front side shall have strong hinged doors. Standard and proven designs of switchgear manufacturers (other than above)

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shall be reviewed during detailed engineering stage. Busbar and cabling compartments provided on the rear side shall have separate bolted covers with self-retaining bolts for easy maintenance and safety. Breaker compartment doors shall be provided with single-shot latch type handle and shall have locking facility. Suitable interlock shall be provided, which will ensure that breaker is OFF before opening the back doors. Suitable interlock shall be provided to prevent opening of any compartment doors which has any of the MV equipment, in case the supply is ON.

14. In the Service position, the truck shall be so secured that it is not displaced by short circuit forces. Busbars, jumpers and other components of the switchgear shall also be properly supported to withstand all possible short circuit forces corresponding to the short circuit rating specified.
15. Suitable base frames made out of steel channels shall be supplied along with necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled when the flooring is being done, welding of base frame to the insert plates as per approved installation drawings shall be in Bidder's scope.
16. Alternatively, Outdoor HT switchgear can be offered for ICOG configuration. The outdoor switchgear shall have minimum IP 55 or better protection with painting and shed requirement as mentioned in Appendix-1 of Part-A, Sub section-1. The bidder shall submit the relevant details of the switchgear including the datasheets, drawings and applicable type test reports during the detailed engineering for Employers approval. Internal Arc requirement for metal enclosed outdoor HT switchgear shall be same as indoor type switchgear. The main pooling/final pooling switchgear shall be indoor only.

CIRCUIT BREAKERS

1. The circuit breakers shall be of Vacuum type.
2. They shall comprise of three separate, identical single pole interrupting units, operated through a common shaft by a sturdy operating mechanism.
3. Circuit breaker shall be restrike free, stored energy operated and trip free type. Motor wound closing spring charging shall only be acceptable. An anti-pumping relay shall be provided for each breaker, even if it has built-in mechanical antipumping features. An arrangement of two breakers in parallel to meet a specified current rating shall not be acceptable.
4. During closing, main poles shall not rebound objectionably and mechanism shall not require adjustments. Necessary dampers shall be provided to withstand the impact at the end of opening stroke.
5. Plug and socket isolating Contacts for main power circuit shall be silver plated, of self-aligning type, of robust design and capable of withstanding the specified short circuit currents. They shall preferably be shrouded with an insulating material. Plug and socket contacts for auxiliary circuits shall also be silver plated, sturdy and of self-aligning type having a high degree of reliability. Thickness of silver plating shall not be less than 10 microns.
6. All working part of the mechanism shall be of corrosion resisting material. Bearings which require greasing shall be equipped with pressure type grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately secured and locked to prevent loosening or change in adjustment due to repeated operation of the breaker and the mechanism.
7. The operating mechanism shall be such that failure of any auxiliary spring shall not prevent tripping and shall not lead to closing or tripping of circuit breaker. Failure of any auxiliary spring shall also not cause damage to the circuit breaker or endanger the operator.
8. Mechanical indicators shall be provided on the breaker trucks to indicate OPEN / CLOSED

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conditions of the circuit breaker, and CHARGED / DISCHARGED conditions of the closing spring. An operation counter shall also be provided. These shall be visible without opening the breaker compartment door.

9. The rated control supply voltage shall be as mentioned elsewhere under Technical parameters. The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between 85% to 110% rated DC voltage. The shunt trip coil shall operate satisfactorily under all operating conditions of the circuit breaker upto its rated short circuit breaking current at all values of control supply voltage between 70% to 110% of rated DC voltage. The trip coil shall be so designed that it does not get energized when its healthiness is monitored by two indicating lamps (Red) and one trip coil supervision relay.
10. The time taken for charging of closing spring shall not exceed 30 seconds. The spring charging shall take place automatically preferably after a closing operation. Breaker operation shall be independent of the spring charging motor which shall only charge the closing spring. Opening spring shall get charged automatically during closing operation. As long as power supply is available to the charging motor a continuous sequence of closing and opening operations shall be possible. One open-close- open operation of the circuit breaker shall be possible after failure of power supply to the motor. Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable winding temperature when the control supply voltage is anywhere between 85% to 110% rated DC voltage. The initial temperature shall be as prevalent in the switchgear panel during full load operation with 50 deg. C ambient air temperature. The motor shall be provided with short circuit protection.
11. Motor windings shall be provided with class E insulation or better. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in a hot, humid and tropical climate.
12. Circuit breaker shall be provided with inter pole barriers of insulating materials. The use of inflammable materials like Hylam shall not be acceptable.

CONTROLS AND INTERLOCKS

13. Rotary type Control switches shall be provided in each switchgear panel. The circuit breaker will normally be controlled from remote control panels through closing and shunt trip coils. The control switch and local control console of the relay flush mounted on the switchgear would normally be used only for testing of circuit breaker in isolated position, and for tripping it in an emergency. The closing and opening of the breaker shall also be possible from the Laptop through front serial port of the relay to facilitate commissioning activities.
14. The basic control scheme shall be developed in the numerical relay using programmable (soft) logics. Tripping of breaker shall be done either through numerical relay or Master Trip Relay.

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1. Facilities shall be provided for mechanical tripping of the breaker and for manual charging of the stored energy mechanism for a complete duty cycle, in an emergency.
2. Each panel shall have two separate limit switches, one for the Service position and the other for isolated position.
3. Auxiliary Contacts of breaker may be mounted in the fixed portion or in the withdrawable truck as per the standard practice of the manufacturer, and shall be directly operated by the breaker operating mechanism.
4. Auxiliary contacts mounted in the fixed portion shall not be operable by the operating mechanism, once the truck is withdrawn from the service position, but remain in the position corresponding to breaker open position. Auxiliary contacts mounted on the truck portion, and dedicated for Employer's use shall be wired out in series with a contact denoting breaker service position. With truck withdrawn, the auxiliary contacts shall be operable by hand for testing. There shall be at least 2 NO and 2 NC breaker/contact original Auxiliary contacts made available for the of the Employer's use.
5. The contacts of all limit switches and all breaker auxiliary contacts located on truck portion and fixed portion shall be silver plated, rated to make, carry and break 1.0A 240V DC (Inductive) / 10A 240V AC. Contacts of control plug and socket shall be capable of carrying the above current continuously.
6. Movement of truck between SERVICE and ISOLATED positions shall be mechanically prevented when the breaker is closed. An attempt to withdraw a closed breaker shall not trip it.
7. Closing of the breaker shall be possible only when truck is either in TEST/ISOLATED or in-SERVICE position and shall not be possible when truck is in between. Further, closing shall be possible only when the auxiliary circuits to breaker truck have been connected up, and closing spring is fully charged.
8. It shall be possible to easily insert breaker of one typical rating into any one of the panels meant for same rating but at the same time shall be prevented from inserting it into panels meant for a different type or rating.
9. Indications shall be provided in the relay console flush mounted on the panel front as brought out in the specification elsewhere. It shall be possible to easily make out whether the truck in SERVICE OR ISOLATED POSITION even when the compartment door is closed.
10. Reverse blocking and Inter tripping shall be implemented in switchgear boards level. Detailed scheme for the same shall be finalized during detailed engineering stage.
11. All required interlock shall be provided for safe operation of switchgears. Capacitive voltage detection or other alternative suitable arrangement (VT shall not be used) shall be used for outgoing feeder backdoor (cable chamber) open interlock
12. NUMERICAL RELAYS AND NETWORKING
13. Circuit breaker feeders (with protection function as per requirement) shall be provided with communicable numerical relays (IED, i.e. Intelligent Electronic Device) complying with IEC-61850, having protection, control, and monitoring features. These relays shall be networked and suitably interfaced with the BESS EMS/SCADA system for dynamic SLD display, status monitoring, measurements, event / alarm displays, reports, etc. The relays shall be flush mounted on panel front with connections from the inside. These numerical relays shall be of types as proven for the application and shall be subject to Employer's approval. Numerical relays shall have appropriate setting ranges, accuracy, resetting ratio and other characteristics to provide required sensitivity. All equipments shall have necessary

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protections.

14. The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm / status of each of protection function and trip operation shall be communicated to BESS EMS/SCADA. The numerical relays shall have built in feature / hardware interface to provide such inputs to BESS EMS/ SCADA / for analog / digital values.
15. All relays shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Contacts for breaker close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker without the need of any interposing / master trip relays. Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage.
16. One minute power frequency withstand test voltage for all numerical relays shall at least be 2kV (rms).
17. Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker operation.
18. Disturbance Record waveforms, event records & alarms shall be stored in Nonvolatile memory and failure of control supply shall not result in deletion of any of these data.
19. All numerical relays shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts as per the requirement of control schematics. The quantities of such input / outputs shall be finalized during detailed engineering.
20. All the numerical relays shall have communications on two ports, local front port communication to laptop and rear port on IEC 61850 to communicate with the interface equipment for connectivity with the BESS EMS/ SCADA. Laptop provided with PCU/SCADA shall be used to facilitate numerical relay configuration, DR and event/fault records downloading from relay locally. Latest version of hardware and Software for interfacing the numerical relays with laptop shall be provided. At least two sets of communication cable for Laptop to relay communication shall be provided.
21. All the numerical relays shall have adequate processor memory for implementing the programmable scheme logic required for the realization of the protection / control schemes, in addition to the built in protection algorithms. Numerical relays shall have inrush detection feature for blocking of user selectable protection functions.
22. Numerical relays shall have feature of current measurement. Relay shall be able to provide the same in soft to BESS EMS/ SCADA system.
23. Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping.
24. Master trip (86) and non-86 trips shall be software configurable to output contacts.
25. Numerical relays used at main pooling switchgear shall have provision of both current and voltage inputs. Number of CT inputs for numerical relays at all switchgear panels shall be as per actual protections requirement but not less than 4 sets, 3 nos. for phase fault & 1 no. for earth fault. Relays shall be suitable for CT secondary current of 1A. All 33kV feeders shall be provided with nondirectional EF and OC protection. Numerical relays used at main pooling switchgear shall have voltage protection and measurement feature.
26. Relay setting shall be based on time grading principle with minimum 100mSec shall be the

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- grading margin. Least time setting at inverter transformer feeders and shall be increased towards the evacuation point (towards grid). Relay time setting shall be minimum 100 ms. However, relay current and time setting including time grading margin shall be as per Bidder offered system (with minimum as per above) considering smooth plant operation and proper protection integration/coordination with grid. Bidder can use same relay time setting for tie feeder panels between two switchgears. Relay setting of BESS Block feeders shall be done in coordination with 33kV main pooling switch (grid side) relay setting. Any special/other protections, control interlocks etc as per requirement shall be provided by the Bidder. Details shall be finalized during detailed engineering stage.
27. For relay setting calculation grid side shall be taken upstream and inverter side shall be taken downstream. For any switchgear outgoing feeder shall be towards grid and incoming feeders shall be towards inverter to be considered.
28. All CT & VT terminals on the relays shall be of fixed type suitable for connection of ring-type lugs to avoid any hazard due to loose connection leading to CT opencircuit. In no circumstances Plug In type connectors shall be used for CT / VT connections.
29. All numerical relay shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.
30. Relays shall have self-diagnostic feature with self-check for power failure, programmable routines, memory and main CPU failures and a separate output contact for indication of any failure.
31. Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC / ANSI programmable characteristics.
32. Design of the relay must be immune to any kind of electromagnetic interference. Vendor shall submit all related type test reports for the offered model along with the offer.
33. All cards / hardware of numerical relays shall be suitable for operation in Harsh Environmental conditions with respect to high temperature, humidity & dust.
34. Relay shall be immune to capacitance effect due to long length of connected control cables. Any external hardware, if required for avoiding mal operation of the relay due to cable capacitance shall be included as a standard feature.
35. All I/Os shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.
36. Numerical relays shall have two level password protections, one for read only and other for authorization for modifying the setting etc.
37. Numerical relays shall have feature for Time synchronization through the SCADA System / networking. The resolution of time synchronization shall be +/- 1.0 millisecond or better throughout the entire system.
38. Ethernet switches shall be suitable to accept both AC & DC supplies with range of 70 % to 120 % of rated voltage.
39. Disturbance Record waveforms, event records & alarms shall be stored in Nonvolatile memory and failure of control supply shall not result in deletion of any of these data.
40. Bidder to depute relay OEM protection engineer at BHEL/NTPC office for finalization of relay setting and configuration during detail engineering stage. All numerical protection relay configuration and setting shall be done as per approved setting and configuration at switchgear manufacturer work by relay OEM or his authorized representative. All numerical relay testing and logic/interlock checking during commissioning stage at site

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shall be done under the supervision of Relay OEM or his authorized representative.

OTHER PROTECTIONS AND CONTROL FUNCTIONS IN THE RELAYS

1. Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker trip circuit both in pre trip and post trip conditions.
2. Schematics requiring auxiliary relays / timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer function for protection function shall be as required. Timer functions shall be programmable for on/off delays.
3. The numerical relay shall be able to provide supervisory functions such as trip circuit monitoring, circuit breaker state monitoring, PT and CT supervisions and recording facilities with Post fault analysis.
4. The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.
5. At least 200 time tagged events / records shall be stored with time stamping. Details of at least 5 previous faults including the type of protection operated, operating time, all currents & voltages and time of fault.
6. Diagnostics Automatic testing, power on diagnostics with continuous monitoring to ensure high degree of reliability shall be provided. The results of the self-reset functions shall be stored in battery back memory. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be available on the user interface.
7. The alarm/status of each individual protection function and trip operation shall be communicated to BESS EMS/ SCADA.
8. Sequence of events shall have 1 ms resolution at device level.
9. Measurement accuracy shall be 1 % for RMS Current and voltage.

BUSBARS AND INSULATORS

1. All Busbar and jumper connections shall be of high conductivity aluminium alloy. They shall be adequately supported on insulators as per manufacturer's standard proven design to withstand electrical and mechanical stresses due to specified short circuit currents.
2. Busbar cross-section shall be uniform throughout the length of switchgear. Busbars and other high voltage connection shall be sufficiently corona free at maximum working voltage.
3. Contact surfaces at all joints shall be silver plated or properly cleaned and nonoxide grease applied to ensure an efficient and trouble free connection. All bolted joints shall have necessary plain and spring washers. All connection hardware shall have high corrosion resistance. Bimetallic connectors or any other technically proven method shall be used for aluminium to copper connections.
4. Busbar insulators shall be of arc and track resistant, high strength, nonhygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators. In case of organic

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insulator partial discharge shall be limited to 100pico coulomb at rated voltage x 1.1 / Sq root of 3 . Use of insulators and barriers of in-flammable material such as Hylam shall not be accepted.

5. Successful Bidder shall furnish calculation establishing adequacy of busbar sizes for the specified continuous and short time current ratings.
6. All busbars shall be color coded.
7. The temperature of the busbar and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of IEC 62271-1,2017, duly considering the specified ambient temperature (50 deg. C).

EARTHING AND EARTHING DEVICES

1. A copper / galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar.
2. A copper / galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar.
3. The earth bus shall have sufficient cross section to carry the momentary shortcircuit and short time fault currents to earth as indicated under switchgear parameters without exceeding the allowable temperature rise.
4. Suitable arrangement shall be provided at each end of the earth bus for bolting to Employer's earthing conductors. All joint splices to the earth bus shall be made through at least two bolts and taps by proper lug and bolt connection.
5. All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical continuity of the whole switchgear enclosure frame work and the truck shall be maintained even after painting.
6. The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions i.e. SERVICE and ISOLATED as well as throughout the intermediate travel. The truck shall also get and remain earthed when the control plug is connected irrespective of its position.
8. All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. Looping of earth connections which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earth bus is acceptable.
9. VT and CT secondary neutral point earthing shall be at one place only on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits.
10. Separate earthing trucks shall be provided by the Contractor for maintenance work. These trucks shall be suitable for earthing the switchgear busbars as well as outgoing / incoming cables or busducts. The trucks shall have a interlock to prevent earthing of any live connection.
11. As an alternative to separate earthing trucks the Bidder may also offer built-in earthing

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facilities for the busbars and outgoing / incoming connections, in case such facilities are available in their standard proven switchgear design. The inbuilt earthing switches shall have provision for short circuiting and earthing a circuit intended to be earthed. These switches shall be quick make type, independent of the action of the operator and shall be operable from the front of the switchgear panel. These switches shall have facility for padlocking in the earthed condition.

12. Interlocks shall be provided to prevent :

- a) Closing of the earthing switch if the associated circuit breaker truck is in Service position.
- b) Insertion of the breaker truck to Service position if earthing switch is in closed position.
- c) Closing of the earth switch on a live connection.
- d) Energizing an earthed Section: Complete details of arrangement offered shall be provided during detailed engineering, describing the safety features and interlocks.

13. The earthing device (truck / switch) shall have the short circuit withstand capability equal to that of associated switchgear panel.

14. All hinged doors shall be earthed through flexible earthing braid

PAINTING (INDOOR SWITCHGEAR)

1. All sheet steel work shall be pretreated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder coating specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall be 50 microns or more as per the ambient conditions of installation area. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

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INSTRUMENT TRANSFORMERS

1. All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulation shall be E or better.
2. All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.
3. The parameters of instrument transformers specified in this specification are tentative and shall be finalized by the Employer in due course duly considering the actual burden of various relays and other devices finally selected. In case the Bidder finds that the specified ratings are not adequate for the relays and other devices offered by him, he shall offer instrument transformer of adequate ratings and shall bring out this fact clearly in his Techno commercial bid.
4. All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block.
5. Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate panel on a truck so as to be fully withdrawable.
6. All voltage transformers shall have suitable current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted on the withdrawable portion. Replacement of the primary fuses shall be possible with VT truck in isolated position. The secondary fuses shall be mounted on the fixed portion and the fuse replacement shall be possible without drawing out the VT truck from service position.
7. All voltage transformers shall be designed and manufactured for 0.8 Tesla operating point on B-H curve. VT shall be fully insulated type (i.e. double pole construction and neutral side fully insulated to rated BIL). VT shall be manufactured without any joint in secondary winding.

SURGE ARRESTOR

1. The surge arrestors shall be provided as per tender SLD/ as per system requirement and shall be of metal oxide, gapless type generally in accordance with IEC 60099-4 and suitable for indoor duty. These shall be mounted within the switchgear cubicle between line and earth, preferably in the cable compartment. Surge arrestor selected shall be suitable for un-earthed system and rating shall be in such a way that the value of steep fronted switching over voltage generated at the switchgear terminals shall be limited to the requirements of switchgear.

CONTROL SUPPLY AND SPACE HEATER SUPPLY

1. Each switchboard shall be provided at least two (02) Nos of DC feeders for the control supply.
2. In case two DC sources are provided, then suitable rated blocking diodes in both circuit has to be provided. Alternately Bidder can provide source selection switch.
3. One suitable rated 240V single phase AC supply feeder per switchboard / Switchboard section for space heater supply. Bidder shall provide necessary switch and fuse to receive,

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isolate and distribute to each panel.

4. Each sub circuit shall have separate fuses. Fuse size shall be determined so as to achieve selective clearance between main circuit and sub circuit in case of fault. Potential circuits for protection and metering shall also be protected by separate fuse.
5. All fuses shall be of link type conforming to IS: 13703 / 9385 mounted on suitable fuse bases. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage. All accessible live connection to fuse bases shall be adequately shrouded.
6. All DC circuits shall be fused on both poles. Single phase AC circuits shall have fuses on line and link on neutral.
7. DC and AC supply monitoring relay shall be provided and alarm shall be generated in SCADA system in case of failure of supply.

SPACE HEATER

8. Each switchgear panel shall be equipped with thermostatically controlled space heater(s), suitably located in breaker and cable compartments to prevent condensation within the enclosure. The space heater shall be connected to 240V.
9. single phase AC auxiliary supply available in the switchgear, through switches and fuses provided separately for each panel.
10. A 240V single phase 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF switch for connection of hand lamp.

TERMINAL BLOCKS

1. Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of nonferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design.
2. Terminal blocks for CT and VT secondary leads shall be of stud type, made up of unbreakable polyamide 6.6 grade. They shall be provided with links to facilitate testing, isolation star / delta formation and earthing. Terminal blocks for CT secondary shall have the short circuiting facility. The terminals for remote ammeter connection etc. shall also be disconnecting type only. All metal parts shall be of non-ferrous material. Screws shall be captive.
3. At least 10% spare terminals for external connections shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available in each panel.
4. There shall be minimum clearances of 250 mm between the terminal blocks and the cable gland plate and 150 mm between two rows of terminal blocks.
5. All panel wiring for external connections shall terminate on separate terminal blocks which shall be suitable for connecting two (2) stranded copper conductors of 2.5 sq. mm on each side, or alternatively, the terminal blocks shall have the possibility of double shorting space to facilitate looping.

SWITCHGEAR WIRING

1. All Switchgear panels shall be supplied completely wired internally upto the terminal block ready to receive Employer's external cabling. All inter cubicle wiring and connections

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between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided / done by the Contractor.

2. All internal wiring shall be carried out with 650 V grade, single core, 1.5 sq. mm. stranded copper wires having minimum of seven strands per conductor and color coded, PVC insulation. CT circuits shall be wired with 2.5 sq. mm. wires which otherwise are similar to the above. Extra flexible wires shall be used for wiring between fixed and moving parts such as hinged doors.
3. All wiring shall be properly supported neatly arranged, readily accessible and securely connected to equipment, terminals and terminal blocks. Wiring troughs or gutters be used for this purpose.
4. Internal wire terminals shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor. Insulation sleeves shall be provided over the exposed parts of lugs.
5. Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.
6. Interconnection to adjacent panels shall be brought out to a separate set of terminal blocks located near the slots or holes, meant for the interconnecting wires. Arrangement shall permit neat layout and easy interconnections to adjacent panels at site and wires for this purpose shall be provided by Contractor looped and bunched properly inside the panels.
7. Contractor shall be fully responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.
8. The Contractor shall provide the necessary clamps wiring troughs etc. for all wiring in side the switchgear enclosed including the Employer's power and control cables.

POWER CABLE TERMINATION

1. Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, shielded, armoured / unarmoured, PVC jacketed, single core / three core, unearthed / earthed grade power cable(s).
2. A minimum clearance of about 600 mm shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Interphase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc. and the electrical clearances available shall be submitted for Employer's approval during detail engineering.
3. Cable termination compartment shall have provision for termination of power cables of sizes as indicated during detailed engineering with removable undrilled gland plates. For all single core cables gland plates shall be of nonmagnetic material. Cable entry shall be from bottom. Any change will be intimated later

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NAME PLATES AND LABELS

9. Each switch board shall have a name plate for its identification. All enclosure mounted equipment shall be provided with individual engraved name plates for clear equipment identification. All panels shall be identified on front as well as backside by large engraved name plates giving the distinct feeder description along with panel numbers. Back side name plates shall be fixed in panel frame and not on the rear removable cover.
10. Name plate shall be of non-rusting metal or 3-ply lamicaid with white engraved letterings, on black background or as per manufacturer's proven standards. Inscriptions and lettering shall be subjected to Employer's approval.
11. Suitable stenciled paint mark shall be provided for identification of all equipment, located inside the enclosure, as well as for door mounted equipment, from the back side in addition to plastic sticker labels, if provided. These labels shall be located directly by the side of the respective equipment, shall be clearly visible and shall not be hidden by equipment wiring. Labels shall have device number as mentioned in wiring drawings. Type of labels and fixing of labels shall be such that they are not likely to peel off / fall off during prolonged use.

MODULE DESCRIPTION (Typical)

SI No	Panel Type	Application	Applicability
1	DB	Transformer Feeder	Transformer Feeder
2	DC	Incomer Feeder	Incomer Feeder
3	DD	Bus Coupler Feeder	Bus Coupler Panel for MV Boards
4	DE-IC	Tie Feeder	Tie Incomer Panel
5	DE-OG	Tie Feeder	Tie Outgoing Panel
6	G	Bus PT	Bus PT Panel
7	ICOG	Standalone Transformer feeder	Standalone panel with both incoming & outgoing cables

TEST

TYPE TESTS

All equipment to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the following type tests carried out not earlier ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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	A)	Reports of the following type tests carried out on circuit breaker / circuit breaker panels, of each voltage class and current rating shall be submitted.
	i)	Short circuit duty test on circuit breaker, mounted inside the panel offered along with CTs , bushing and seperators
	ii)	Short time withstand test on circuit breaker, mounted inside panel offered together with CTs, bushings and separators.
	iii)	Power frequency withstand test on breaker mounted in side panel.
	iv)	Lightning impulse withstand test on breaker mounted in side panel.
	v)	Temperature rise test on breaker and panel together. For this test, the test set up shall include three panels with breakers, the test breaker and panel being placed in the centre.
		The adjacent panels shall also be loaded to their rated current capacity. Alternatively the test panel may be suitably insulated at the sides, which will be adjoining to other panels in actual site configuration
	vi)	Internal Arc Test as per IEC 62271-200
	vii)	Measurement of resistance of main circuit.
	viii)	Mechanical operation test.
	B)	Short circuit withstand test of earthing device (truck / switch).
	C)	Testing to observe compliance to degree of protection, shall be checked for each switch board enclosure and busbar chambers during routine inspection shall be as under. <div style="margin-left: 40px;">IP -4X: It shall not be possible to insert a one (1) mm. dia steel wire into the enclosure from any direction, without using force.</div> <div style="margin-left: 40px;">IP-5X: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.</div>
<ul style="list-style-type: none"> • However if the contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract free of at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval. • All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. • The type test reports once approved for any projects shall be treated as reference. For subsequent projects of BHEL/NTPC , an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet. 		

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Sl. No.	TEST ITEMS	Standard
i)	Dimensions of structure and visual inspection	IEC 60297-3-101
ii)	Functional requirements: - Steady-state simulation - Dynamic simulation	Relevant IEC 60255-100 series
iii)	Product safety requirements (including the dielectric tests and thermal short time rating)	IEC 60255-27
iv)	EMC requirements: - Emission - Immunity	IEC 60255-26
v)	Energizing quantities: - Burden - Change of auxiliary energizing quantity	N/A IEC 60255-11
vi)	Contact performance	N/A
vii)	Communication requirements	IEC 61850
viii)	Climatic environmental requirements: - Cold - Dry heat - Change of temperature - Damp heat	IEC 60068-2-14, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-78, IEC 60068-2-30, IEC 60255-27
ix)	Mechanical requirements: - Shock - Vibration - Bump - Seismic	IEC 60255-21-1, IEC 60255-21-2, IEC 60255-21-3
x)	Enclosure protection	IEC 60529, IEC 60255-27

Two (2) protected soft copies on CD-ROM of the approved test results shall be furnished with the equipment. These shall include complete reports and results of the routine tests and type tests (if the latter is carried out) on equipment. If the type tests are not conducted, the CDs shall contain copies of the results of type tests carried out on identical equipment earlier.

ROUTINE TESTS

All acceptance and routine tests as per the specification and relevant standards IEC 62271-200 & IEC 62271-100 shall be carried out. Charges for these shall be deemed to be included in the equipment price

An indicative lists of tests / checks is mentioned as QA chapter on HT switchgear. However, the manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents

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COMMISSIONING CHECKS / TESTS

After installation of panels, power and Control wiring and connections, Contractor shall perform commissioning checks as listed below to verify proper operation of switchgear / panels and correctness of all equipment in all respects. In addition the Contractor shall carry out all other checks and tests recommended by the manufacturers.

General

- (a) Check name plate details according to specification.
- (b) Check for physical damage
- (c) Check tightness of all bolts, clamps and connecting terminals
- (d) Check earth connections.
- (e) Check cleanliness of insulators and bushings
- (f) Check heaters are provided
- (g) H.V. test on complete switchboard with CT & breaker in position.
- (h) Check all moving parts are properly lubricated.
- (i) Check for alignment of busbars with the insulators to ensure alignment and fitness of insulators.
- (j) Check for interchange ability of breakers.
- (k) Check continuity and IR value of space heater.
- (l) Check earth continuity for the complete switchgear board

Circuit Breakers

- (a) Check alignment of trucks for free movement.
- (b) Check correct operation of shutters.
- (c) Check slow closing operation (if provided)
- (d) Check control wiring for correctness of connections, continuity and IR values.
- (e) Manual operation of breakers completely assembled.
- (f) Power closing / opening operation, manually and electrically at extreme condition of control supply voltage.
- (g) Closing and tripping time.
- (h) Trip free and anti-pumping operation.
- (i) IR values, resistance and minimum pick up voltage of coils.
- (j) Simultaneous closing of all the three phases.
- (k) Check electrical and mechanical interlocks provided.

Checks on spring charging motor, correct operation of limit switches and time of charging
(m) All functional checks.

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Current Transformers

- (a) IR value between windings and winding terminals to body.
- (b) Polarity tests.
- (c) Ratio identification checking of all ratios on all cores by primary injection of current.
- (d) Magnetisation characteristics & secondary winding resistance.
- (e) Spare CT cores, if any to be shorted and earthed.

Voltage Transformers

- (a) Insulation resistance test.
- (b) Ratio test on all cores.
- (c) Polarity test.
- (d) Line connections as per connection diagram.

Cubicle Wiring

- (a) Check all switch developments.
- (b) It should be made sure that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked.
- (c) All the wires shall be checked for IR value.
- (d) Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component / equipment.
- (e) Check terminations and connections.
- (f) Wire ducting

SPECIFICATION FOR 33KV RING MAIN UNIT (If applicable) 33kV RING MAIN UNIT

Each Ring Main Unit shall have all the following major components in addition to the other items required for satisfactory performance of equipment:

- a. Painted MS enclosure with steel base frame for Ring Main Unit.
- b. 33 KV Ring Main Units, Non-extensible type along with requisite number of electrically operated breakers and manually operated Load break switches and earth switches as per Single line Diagram
- c. Control protection and metering requirements as per system requirement and single line Diagram
- d. Internal cabling for connections between the equipments of Ring Main Unit, lighting & earthing system along with required hardware, gaskets, gland plates etc as required.

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Technical requirements for RMU

CODES AND STANDARDS: IS: 13118, IEC: 62271-200

The equipment shall have the following features:

1. ELECTRICAL SYSTEM PARAMETERS		
i	Nominal system voltage	33 KV
ii	Highest system voltage	36 KV
iii	Rated insulation level	
	i) Impulse with stand voltage with 1.2 / 50 Micro second wave ii) One minute power frequency with stand voltage	170 KV(Peak) 70 KV (RMS)
iv	Rated short circuit breaking capacity at specified site conditions (Minimum)	As per system fault current (Refer Cl. 1.0 of Chapter 2-A, Part A) with %age of DC component as per IEC-62271-100 corresponding to minimum operating time with operating conditions specified.
v	Rated short circuit making current (Minimum)	2.5 Times of system fault current.
vi	Rated short time withstand capacity (Minimum)	As per system fault current
vii	Rated operating duty cycle	O-3 minute-CO-3 minute - CO
viii	Maximum temperature rise over and ambient temperature of 50 deg.C	As per IEC : 62271-100
2. RMU CONFIGURATION		
i	RMU Configuration	Two Nos. Load break switches (LBS) and transformer circuit breaker as per system requirement.
ii	Extensibility	Non extensible type
iii	Load break switch, Circuit breaker& earth switch in RMU panel	All shall be fixed (Non draw out) type
iv	Insulation medium for panel/ bus bar	SF6 gas or Dry air in sealed metallic tank
v	Breakers & load break switches	SF6 gas or Vacuum type (with disconnect & earth switch)
vi	Internal Arc classified FLR	As per system fault current (for Min 1 sec)
3. RMU CONSTRUCTIONAL FEATURES		
i	RMU Panel type	Metal enclosed panel construction
ii	Service Location	Indoor/Outdoor
iii	Mounting	Free Standing
iv	Overall enclosure protection	IP54 minimum for MV Switchgear Compartments, Vermin proof
v	Doors	Front access with anti-theft hinge

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	vi	Covers	Bolted for rear access, with handles. All the accessible bolts / screws shall be vandal proof. One set of required Special tools per RMU shall be in the scope of supply.
	vii	Construction	Sheet metal 2 mm thick CRCA/Aluzinc/Stainless Steel (minimum) suitable for outdoor application.
	viii	Base frame made of steel for RMU	Raised frame of 300 mm height
	ix	Lifting lugs	Four numbers
	x	Cable entry	Bottom
	xi	Bus bar continuous rated current at designed 50 deg.C ambient temperature	As per system requirement.
	xii	Bus bar short time withstand capacity	As per system fault current (Minimum)
	xiii	Maximum temperature rise above reference ambient 50 deg C	As per IEC reference standard
	xiv	Earth bus bar	Aluminum sized for rated fault duty for 1 sec
	xv	Cooling arrangement	By natural air (without fan)
	xvi	Panel internal wiring	Stranded flexible color coded PVC insulated copper wire 1.5 sq mm.(min.), 1100 volt grade
	xvii	Gasket	Neoprene rubber
	xviii	Marshalling terminal blocks	1.5 Sq mm, Nylon 66 material, screw type + 20% spare in each row of TB.
	xix	Padlock facility	Required for all earth switches & all handles
	xx	Explosion vents	To ensure operator's safety, design should ensure that gases / flames generated during flash over / blast in any of the compartment, must not come out from the front of RMU. Cable
			compartment & other compartments of the RMU should withstand Internal arc test for the indicated system fault current.
		4. Requirements of sealed housing live parts (RMU SF6 gas chamber)	
	i	Enclosure	Stainless steel enclosure, IP67 class
	ii	SF6 gas pressure low alarm	To be given
	iii	Provision for SF6 gas filling	To be given (For 'sealed for life' design of RMU, this is not applicable)
	iv	Provision for SF6 gas pressure measurement	Manometer with non-return valve indication

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v	Arc interruption method for SF6 breaker / Load break switch	Puffer type / rotating arc type
vi	Potential free contacts for SF6 gas 1NO +1NC pressure low	1NO +1NC
vii	Electrical Bushing	Preferably, bushing should be suitable for replacement at site.
5. LOAD BREAK SWITCH (LOAD BREAK ISOLATOR)		
i	Type	Three poles operated simultaneously by a common shaft
ii	Arc interruption in dielectric medium	SF6 or vacuum
iii	Operating mechanism for close/open	Electrically operated through SCADA.
iv	Continuous current rating of LBS at design ambient temperature of 50 deg C	100 Amps minimum or as per system requirement
6. CIRCUIT BREAKER		
i	Type	Three poles operated simultaneously by a common shaft
ii	Arc interruption in dielectric medium	SF6 or vacuum
iii	Operating mechanism	Electrically Operated
iv	Emergency trip / open push button	On panel Front
v	Continuous current rating of Breaker at design ambient temp of 50 deg.C	100 Amps minimum or as per system requirement Other ratings as per manufacturer's standard may also be adopted. Sufficient space must be provided both in horizontal & vertical directions for mounting of CT's. Additionally, some CAUTION marking (by sticker/ paint) should be there to avoid CT's installation above the screen of cable (i.e. earth potential point.)
vi	Short time withstand capacity	As per system fault current
vii	Breaker status auxiliary contact	2NO + 2NC wired to terminal block
viii	Current transformer Ratio	Suggestive rating: 100/1 A or as per requirement
ix	CT accuracy class	Protection : 5P20 Metering : 0.5
x	Potential Transformer (PT) ratio and Accuracy Class	33000/ 23 /110/ 23 Accuracy class : 0.5 suitable for converter duty application as mentioned elsewhere in the specification
xi	Protections	Numerical relay as per requirements mentioned elsewhere in the specification. In addition to above Transformer protections like OTI, WTI, Buchholz, and Pressure Relief Valve (PRV) operated shall

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		be suitably integrated in the protection circuit. Any AC/DC auxiliary supply requirement for the RMU shall be arranged as per requirement mentioned elsewhere in the specification.
xii	Relay aux contacts for remote indication	1NO+1NC Potential free wired to TB
xiii	Shunt trip (for door limit switch of enclosure or transformer) as per the adopted voltage	To be wired to terminal blocks

7. EARTH SWITCH

i	Type	Three poles operated simultaneously by a common shaft
ii	Switching in dielectric medium	Dry air in sealed medium or SF6
iii	Operating mechanism for Close/Open	Manual
iv	Short time withstand capacity	As per system fault current
v	Aux contacts	1NO+1NC free wired to TB
vi	LBS Earth Switch close / open	Potential free contacts wired to terminal block.
vii	CB Earth Switch close /open	Potential free contacts wired to terminal block.

8. INDICATION

i	Cable charge status indication for all Load Break Switches & Circuit Breaker	Circuit breaker capacitor type voltage indicators with LED on all the phases (Shall be clearly visible in day light)
ii	Spring charge status indication	On front for breaker
iii	Earth switch closed indication (For Each LBS)	front
iv	Load break switch ON/OFF indication	Green for OFF / Red for ON
v	Circuit breaker ON/OFF indication	Green for OFF / Red for ON
vi	Cable Fault Direction	Cable fault passage indicator.
vii	CB close / open	Potential free contacts wired to terminal block.
viii	Protection relay operated	Potential free contacts wired to terminal block.
ix	SF6 gas pressure low	Potential free contacts wired to terminal block.

9. RMU OPERATIONAL INTERLOCK

i	Interlock type	Mechanical
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ii	Load break switch & respective earth switch	Only one in 'close' condition at a time
iii	Circuit breaker & respective earth switch	Only one in 'close' condition at a time
iv	Prevent the removal of respective cable covers if load break switch or circuit breaker is 'ON'	Electrical / Mechanical
v	Prevent the closure of load break switch or circuit breaker if respective cable cover is open	Electrical / Mechanical
vi	Cable test plug for LBS/CB accessible only if Earth switch connected to earth	Mechanical
10. MIMIC DIAGRAM, LABEL AND FINISH		
i	On panel front with description of function & direction of operation of handles/buttons	
ii	Mimic diagram (Shall not be preferred with Stickers)	
iii	Operating instruction chart and Do's & Don'ts to be displayed on left / front side of panel enclosure on A1 Sheet, duly affixed on panel.	
iv	Name plate on panel front	Fixing by rivet only
v	Material	Anodized aluminum 16SWG / SS
vi	Background	Satin Silver
vii	Letters, diagram & border	Black
viii	Process	Etching
ix	Name plate details	Month & year of manufacture, equipment type, input & output rating, purchaser name & order Number, guarantee period.
x	Labels for meters & indications	Anodized aluminum with white character on black background OR 3 Ply lamicoid.
xi	Danger plate on front & rear side	Anodized aluminum with white letters on red background
xii	Painting surface preparation	As per Appendix-1 of Part-A (For outdoor)
xiii	Painting external finish	As per Appendix-1 of Part-A (For outdoor) Shade-RAL 7032
xiv	Painting internal finish	As per Appendix-1 of Part-A (For outdoor) Shade-White

TESTS OF RMU

1. 33 kV Switchgear/Ring Mains Unit shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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2. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.
3. All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
4. The type test reports once approved for any projects shall be treated as reference. For subsequent projects of BHEL/NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

6.06 INVERTER (PCS) TRANSFORMER **TECHNICAL REQUIRMENTS (OIL FILLED TRANSFORMER)**

Sr. No.	TRANSFORMER	INVERTER (PCS) TRANSFORMER
i)	VA Rating & Quantity	As per system requirement
ii)	Voltage Ratio (KV)	As per system requirement
iii)	Duty, Service & Application	Continuous Bidirectional PCS application and converter duty (Outdoor).Bi-directional active reactive power flow.
iv)	Winding	AS per system requirement
v)	Frequency	50 Hz
vi)	Nos. of Phase	THREE
vii)	Vector Group & Neutral earthing	As per system requirement
viii)	Cooling	ONAN
ix)	Tap Changer	As per system requirement OCTC +/- 5% (min.)
x)	Impedance at75°C	
	a) Principal Tap	As per system requirement and SLD* & as per Inverter manufacturer recommendation.
	b) Other Taps	
xi)	Permissible Temperature rise over an ambient of 50 deg C (irrespective of tap)	
	a) Top Oil	50 deg.C
	b) Each Individual Winding	55 deg.C
xii)	SC withstand time (thermal)	2 sec.
xiii)	Fault Level & Bushing CT	As per system requirement
xiv)	Termination	As per system requirement
xv)	Bushing rating, Insulation class (Winding & bushing)	As per relevant IS/IEC (However Inverter Transformer LV side winding & bushing insulation class shall be of at least 3.6 kV) Creepage distance : 31 mm/kV
xvi)	Noise level	AS PER NEMA TR-1

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xvii)	Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/-10%, also transformer shall be capable of being loaded in accordance with IS: 6600/ IEC60076-7. As minimum requirement, Transformers shall be designed with 110% continuous thermal overloading capability. The same shall be tested during Temp Rise Type test.
xviii)	Flux density	Not to exceed 1.7 Wb/sq.m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over fluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating. b) 125% for at least one minute. c) 140% for at least five seconds. Bidder shall furnish over fluxing char. up to 150%
xix)	Air Clearance	As per CBIP
xx)	Foundation	All the foundation shall be designed as per highest rating Transformer in case different capacity transformer are offered.

Note (common for Oil filled and dry type transformer):

- Inverter Transformer shall have copper/Aluminum Shield winding between LV & HV windings. Each LV winding must be capable of handling **non-sinusoidal voltage with voltage gradient as per relevant applicable standards and Inverter manufacturer recommendation**. Also each shield winding shall be taken out to tank with two separate connection from shield to bushing with proper support with 2 nos. 3.6 kV shield bushings and same shall be brought down along with support insulator from tank & copper flat up to the bottom of the tank for independent grounding.
- If Inverter transformer is provided indoor, it shall be necessarily dry type.
- Harmonic Factor as per Inverter manufacturer recommendation must be taken into account while designing the transformer. The extra no load loss due to voltage harmonics and load and stray load loss due to current harmonics (as applicable) and must be taken into consideration in transformer design. In addition, the dc bias component of 0.5% of rated Inverter output current is to be accounted for its effect on the transformer design.
- The adverse effect on life of transformer due to cloud intermittency and BESS operating cycle must be compensated through suitable design (as applicable).
- The thermal design of Inverter Transformer needs to consider the temperature dependent performance of the Inverter. It is to in accordance

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with Inverter output and under worst condition it should not limit Inverter output.

1. The multi-winding transformer needs to be designed for long term operating conditions with asymmetrical load on LV side i.e., in case three winding design, the transformer needs to operate reliable with only one Inverter supplying power to only one LV winding.
2. For multi winding transformer, it is recommended to have close coupling and equal impedances on each of LV winding to HV winding and to have high enough impedance (8% min. based on one LV winding rating) between two LV windings in order to decouple these windings.
3. In case of inverter transformer, it shall be proven and of successfully type tested design
4. Contacts from Inverter transformer fittings/protection devices shall be wired for tripping of Inverter transformer Circuit Breaker. Detailed scheme regarding same shall be finalized during detailed engineering.
5. Single Line Diagram (SLD) will be finalized during detailed engineering however kVA rating of inverter transformer shall not be less than kVA capacity of respective Inverters connected to it.

CODES AND STANDARDS

Transformers	IS:2026, IS:6600, IEC:60076
Bushings	IS:2099, IEC:60137, IS 3347, IS 12676
Insulating oil	IEC 60296, IEC 61099/IS16081
Bushing CTs	IS:2705, IEC 60185
Indian Electricity Act 2003, BEE Guideline & CEA notifications	

General Construction

Transformer shall be constructed in accordance to IS: 2026 and IS: 3639 or equivalent to any other international standard. Transformer shall be complete & functional in all respect and shall be in scope of supplier.

The other important construction particulars shall be as below.

6. The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the cover shall be of welded construction and there should be provision for lifting by crane.
7. A double float type Buchholz relay conforming to IS: 3637 shall be provided.
8. Suitable Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
9. All bolted connections to the tank shall be fitted with suitable oil-tight gaskets which shall give satisfactory service under the operating conditions for complete life of the transformer if not opened for maintenance at site
10. The transformer shall be provided with conventional single compartment conservator. The

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top of the conservator shall be connected to the atmosphere through indicating type cobalt free silica gel breather (in transparent enclosure). Silica gel shall be isolated from atmosphere by an oil seal.

11. Transformer shall have adequate capacity Conservator tank to accommodate oil preservation system and volumetric expansion of total transformer oil.
12. Transformer shall have Oil Temperature Indicator and Winding temperature Indicator with accuracy class of +/-2 deg.
13. Radiators shall be detachable type, mounted on the tank with shut off valve at each point of connection to the tank, lifts, along with drain plug/valve at the bottom and air release plug at the top.
14. M. Box shall be of sheet steel, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. Also Marshalling Box, shall be at least 450 mm above ground level. Wiring scheme (TB details) shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.

Windings

- a) The Bidder shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere.
- b) The conductors shall be of electrolytic grade copper/electrolytic grade Aluminum free from scales & burrs.
- c) All windings of the transformers shall have uniform insulation.
- d) Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratio.

Core

- a) The core shall be constructed from non-ageing, cold rolled, super grain oriented silicon steel laminations equivalent to M4 grade steels or better.
- b) Core isolation level shall be 2 kV (rms.) for 1 minute in air.
- c) Adequate lifting lugs will be provided to enable the core & windings to be lifted.

Insulating Mineral oil

No inhibitors shall be used in the transformer oil. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters.

S.No.	Property	Permissible values
1.	Kinematic Viscosity, mm ² /s	12 at 40 °C 1800.0 at (-)30 °C
2.	Flash Point, °C	140 °C
3.	Pour point, °C	(-)40 °C

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification **Group : BESS system**

DOC. NO: SPV-BESS - 01-2025-00

REV. 00

JOB NO.- STD.

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4.	Appearance	Clear , free from sediment and suspended matter
5.	Density kg/dm ³ at 20 °C	≥0.895
6.	Interfacial Tension N/m at 25° C	≥0.04
7.	Neutralisation value, mgKOH/g	≥0.01
8.	Corrosive sulphur	Non Corrosive
9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply
10.	Anti-oxidants additives	Not detectable
11.	Oxidation Stability -Neutralization value, mgKOH/g -Sludge, % by mass	≥1.2 ≥0.8
12.	Breakdown voltage As delivered, kV After treatment, kV	≥30 ≥70
13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≥0.005
14.	PCA content	≤1%
15.	Impulse withstand Level, kVp	≥145
16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤5

Subsequently oil samples shall be drawn at:

Sr. No.	Parameters	Before filling in main tank & tested for	Prior to energization for following properties & acceptance norms:	Applicability
i)	BDV	60 kV (min)	60 kV (min)	Applicable for all Transformers.
ii)	Moisture content	10 ppm (max.)	10 ppm (max.)	

Bushings

- Bushing below 52 kV shall be oil communicating type with porcelain insulator.
- LV Bushing below 3.6 kV used within transformer cable box, epoxy type bushing confirming to IS 2099/IEC 60137 also allowed as alternate to porcelain type
- No arcing horns to be provided on the bushings.
- Inverter Transformer LV bushing palms shall be silver/tin plated.

Bushing CTs

Shall be of adequate rating for protection (differential and others if any) as required, WTI etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

All CT terminals shall be provided as fixed type terminals on the M. Box to avoid any hazard due to loose connection leading to CT opening. In no circumstances Plug In type connectors shall be used for CT.

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Valves

All valves up to and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies.

Sampling & drain valves should have zero leakage rate.

Gaskets

1. Gasket shall be fitted with weather proof, hot oil resistant, nitrile rubber based gasket.
2. If gasket is compressible, metallic stops shall be provided to prevent over compression
3. The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.

PAINTING

PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
Inside of tank and accessories (except M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron
External surface of transformer and accessories including M Box (except radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue) or (RAL6018 yellow green for ester filled)	One coat each	Atleast 100 micron
External Radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue) or (RAL6018 yellow green for ester filled)	Two coats each	Atleast 100 micron
Internal Radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil	---	---
Internal surface of M Box	Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint	Two coats each	Not less than 100 micron

Neutral Earthing Arrangement

Neutral earthing shall be done as per system requirement and SLD. In case of solidly earthed neutral of Transformers, it shall be brought through insulated support from tank to the ground level at a convenient point with 2 nos. copper flat, for connection to ground network (as applicable). Neutral of Transformer if not used should be taken out through bushing and covered by insulating cap.

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Cable boxes & disconnecting chamber (Disconnecting chamber applicable 3.3 kV and above & for Inverter Transformer both side)

- (a) HV Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination. Phase segregation shall be achieved by insulating barriers (for 3.3 kV and above side)
- (b) Cable boxes shall have bus bars / suitable terminal connectors of adequate size & bolt holes to receive cable lugs. The degree of protection of cable boxes shall be IP 55.
- (c) A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box
- (d) The support from base for the cable box (for 3.3 kV and above side) shall be of galvanized iron
- (e) The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat.
- (f) The minimum length provided for terminating 33 kV, 11KV & 3.3 KV XLPE cable shall be 1000 mm (for 33 kV) 650 mm (for 3.3 kV and 11 kV) from cable gland plate to the cable lug) for the cable boxes, for 433V side suitable length shall be provided (shall be discussed during detail engineering). The final cable size, number & length of terminating XLPE cable shall be furnished during detailed engineering.
- (g) Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports (as applicable).
- (h) Cable boxes shall have removable top cover (for transformer above 100 KVA) & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

FITTINGS

Following fittings shall be provided with Transformers covered under this sub section.

a)	-Conservator for main tank shall be provided with MOG with low oil level alarm contact, drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above ground level) etc.
b)	- Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting arrangement.
c)	- It shall be provided with minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided.
d)	OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device (maximum height 1500 mm above ground level). For Inverter Transformers, WTI shall be provided at least for all LV windings.
e)	Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank.
f)	Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable).

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- | | |
|----|--|
| g) | Prismatic/toughened glass oil gauge for transformers. |
| h) | Bi-directional wheel/skids, M.Box, OCTC, Bushing CTs (as applicable), Insulating Oil, Cooling equipment. |
| i) | Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, inspection cover, Bilingual R&D Plate, Terminal marking plates, two nos. earthing terminals etc. |
| j) | Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS. |
| k) | Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed. |

ings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers are deemed to be included.

DRY TYPE PCS (INVERTER) TRANSFORMER

Sr. No.	PARAMETERS	INVERTER TRANSFORMER
i)	Type	Epoxy cast resin/resin encapsulated
ii)	Duty, Service & Application	Continuous Bidirectional Inverter application and converter duty (Indoor)
iii)	MVA & Voltage ratio	As per system requirement and SLD.
iv)	Vector group	
v)	Termination & Bushing CT	
vi)	Fault Level & Earthing	
vii)	Tap changer type & range	As per system requirement and SLD. OCTC +/-5% (min.)
viii)	Impedance	As per system requirement and SLD & as per Inverter manufacturer recommendation.
ix)	Number of phases	Three (3)
x)	Type of cooling	AN Transformer shall be provided with suitable ventilation system to ensure the temperature rise limits under most severe condition while in service however all tests and performance guarantee shall correspond to air natural (AN) cooling.
xi)	Bushing rating, Insulation class (Winding & bushing)	As per relevant IS/IEC (However Inverter Transformer LV side winding & bushing insulation class shall be of at least 3.6 kV)
xii)	Maximum Temperature rise of winding over 50 deg. C ambient. (by resistance method) with Air Natural (AN) cooling.	90 deg.C. (class F) 115 deg.C. (class H)
xiii)	SC withstand time (thermal)	2 sec

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xiv)	Noise Level	Not to exceed values specified in NEMA TR-1.
xv)	PD Level (max. Allowable)	10 pc
xvi)	Loading Capability	Continuous operation at rated KVA on any tap with voltage variation of +/-10% corresponding to the voltage of the tap as well as in accordance with IEC60076-12/IS: 6600.
xvii)	Flux Density	Not to exceed 1.9 Wb/sq.m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over fluxing conditions due combined voltage and frequency fluctuations: a) 110% for continuous rating. b) 125% for at least one minute. c) 140% for at least five seconds.

CODES AND STANDARDS

Dry type transformers	IS : 11171, IEC 60076-11
Indian Electricity Act 2003 and Indian Electricity Rules, BEE notification & CEA guidelines	

DESIGN AND CONSTRUCTIONAL FEATURES

1. The core shall be constructed from high grade non-ageing cold rolled grain oriented silicon steel laminations of M4 grade or better quality. The insulation of core to clamp-plates shall be able to withstand a power frequency voltage of 2 kV (rms) for one (1) minute.
2. The transformers shall be housed in a metal protective housing, having a degree of protection of IP-23. In case it is placed outdoor, IP for enclosure shall be minimum IP-42 or higher. Enclosure shall be of a tested quality sheet steel of minimum thickness 2mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting. Suitable bi-directional skids with pre-drilled holes shall be provided integral with the enclosure or bi-directional rollers shall be provided with suitable locking arrangement.
3. Winding conductor shall be electrolytic grade Copper/ Aluminum. Windings shall be of class F insulation or better. All windings are to be uniformly insulated.
4. Transformer HV bushings and LV bushings can be either solid porcelain or epoxy type. Bushing shall be suitable for satisfactory operation in the high ambient temperature inside Bus Duct enclosure (if applicable). LV flange area shall be of non-magnetic material.
5. Bushing CTs shall be provided in the LV neutral side of adequate rating for REF protection, WTI, etc (as applicable).
6. For Marshalling Box the sheet steel used shall be at least 1.6 mm thick cold rolled. The box shall be tank mounted type. The degree of protection shall be IP- 54 in accordance with IS-13947. Wiring Scheme shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.
7. Transformer shall be provided with suitable ventilation system to ensure the temperature

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rise limits under most severe condition while in service however all tests and performance shall correspond to air natural cooling.

PAINTING

The inside of enclosure and accessories (except M. Box) shall be painted with two coats of fully glossy white colour with total DFT of 25 to 60 microns. The external paint colour of transformer & accessories shall be blue corresponding to RAL 5012. The external surface of transformer & accessories shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of polyurethane finish paint with total DFT of 80 to 150 microns. The internal surface of M.Box shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of chemical & thermal resistant epoxy enamel white paint with total DFT of 80 to 150 microns.

FITTING

Winding temperature indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb. Single Indicating meter may be provided for display of temperature of all limbs. Accuracy class of Indicating meter shall be +/- 1% or better and it shall have least count of 0.1 °C or better. 1 no. 4-20 mA signal shall be provided for remote monitoring of winding Temperature.
RTD/Thermistors	1 No. PT-RTD shall be embedded in each limb with alarm and trip contacts for remote annunciation. Additional 1 No. thermistor/RTD shall be embedded in each limb.

Fittings which are generally required for satisfactory operation of the transformers are deemed to be included, in the scope of supply of the Contractor.

TESTS AND INSPECTION

In case the bidder/contractor has conducted type test(s) within last ten years, he may submit the type test reports to the owner for waiver of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

In case the Bidder is not able to submit report of the type test(s) conducted within last ten years from the date LOA by BHEL/NTPC , or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract at no additional cost to the Employer and submit the reports for approval

Short Circuit Test:-

In case short circuit test has not been conducted or the test report not meeting the specification requirement for the offered transformer manufacturer, Bidder /Sub-vendor shall establish "Ability to withstand the dynamic effects of short circuit "for the offered transformer as per latest IEC 60076-5. The ability to withstand the dynamic effects of short circuit can be established either by performing actual short circuit test or by method of calculation with reference to short circuit tested reference transformer as per IEC-60076-5/Annexure-A&B. Bidder shall choose any one the two options mentioned below;

Option-1:- Performing actual short circuit test as Type Test. In order to meet project schedule,

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Bidder/Sub vendor shall take suitable steps quite in advance to ensure successful conduction of short circuit test within three months time from date of LOA failing which the offered make of the transformer shall not be considered.

Option-2: By theoretical evaluation of the ability to withstand dynamic effect of short circuit based on 'Calculation and Design and Manufacture Consideration'. In this regard the guidelines given in Annexure-A with applicable tables of the IEC 60076-5 is to be followed. The reference transformer chosen shall be of same application, winding configuration, conductor current density and as per Annexure-B of latest IEC-60076-5. Necessary Design document and reference test reports related to theoretical comparative evaluation must be submitted by Manufacturer/Bidder as required by Employer in this case.

S.N.	ROUTINE TESTS	
1.	All routine test shall be carried out in accordance with IEC 60076.	√
2.	Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)	√
3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)	√
4.	Vector group and Polarity Check (as per IEC 60076-1)	√
5.	Magnetic Balance and Magnetising Current Test	√
6.	Measurement of no load current with 415 V, 50 Hz AC supply	√
7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)	√
8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps	√
9.	IR measurement (As per IEC 60076-1)	√
10.	Measurement of capacitance & tan delta to determine capacitance between winding & earth.	√
11.	Separate Source Voltage Withstand Test /Applied voltage test (as per IEC 60076-3)	√
12.	Induced overvoltage test/Induced voltage withstand(IVW) test as per IEC60076 part 3	√
13.	Repeat no load current/loss & IR after completion of all electrical test	√
14.	Oil leakage test on completely assembled transformer along with radiators	√
15.	Jacking test followed by D.P. test	√
16.	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	√
17.	IR measurement on wiring of Marshalling Box.	√

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S. N.	TYPE TESTS # (To be carried out on one transformer of each rating)	
1.	Lightning impulse(Full and chopped wave) test on windings(as per IEC 60076-3) (Not applicable for LV)	√
2.	Short circuit test (special test) as per IEC 60076-5 (if applicable).	√
3.	Temperature Rise test at a tap corresponding to maximum losses as per IEC 60076. Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599).	√
4.	Measurement of harmonics of no load current (special test)	√
5.	Measurement of acoustic noise level as per NEMA TR-1 (special test)	√
6.	Tank Vacuum & Pressure Test (as per CBIP norms)	√

(#) **NOTE:-**

- All the type and special tests shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test.
- Inverter Transformer LV winding Di-electric tests (except for lightning impulse test for LV winding) shall be carried out corresponding to levels (as per IEC 60076) for 3.6 kV class.
- All Type tests should be done as per Employer's approved procedure.

Leakage test on assembled Oil filled Transformer (ROUTINE TEST)

All tank & oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature & applying pressure equal to the normal pressure plus 35 KN/sq. m measured at the base of the tank. The pressure shall be maintained for a period of not less than 6 hours during which time no sweating shall occur. Bidder can perform this test at site depending upon urgency subject to BHEL/NTPC approval.

Suitable Fire Fighting arrangements for Oil filled Transformers shall be provided if applicable as per Tariff Advisory Committee (TAC)/statutory requirements. In case Nitrogen based fire protection system is used, CBIP manual shall be followed for compliance. Firewall & soak pit as applicable (as per statutory requirement/TAC/IS 10028 / IS 1646) shall be provided of minimum 230 mm thickness of RCC wall or 355 mm thick fire resisting brick wall subject to BHEL/NTPC approval. However for all oil filled outdoor a pit shall be provided all around at a distance of 1.0 meter (min.) from transformer outer edge, a sump pit shall be provided for each pit. Transformer efficiency shall be as per Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electrical Lines) regulation, 2010.

Routine / Type Tests (Dry Type Transformers)

Transformer shall be short circuit tested after conducting the routine tests. Rest of the type tests shall be conducted after successful short circuit testing.
All routine tests in accordance with IS: 11171 / IEC 60076-11 shall be carried out on each transformer.

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And All Type tests should be done as per Employer's approved procedure.

Routine / Type Tests (Dry Type Transformers)		
a.)	Measurement of winding Resistance for each tap position.	Routine
b.)	Measurement of voltage ratio at each taps position.	Routine
c.)	Vector group and polarity check	Routine
d.)	Measurement of impedance voltage/short circuit impedance & load loss at principal tap and extreme taps	Routine
e.)	Measurement of no load losses and magnetising current at rated frequency and 90%, 100% and 110% rated voltage.	Routine
f)	Measurement of insulation resistance	Routine
g)	Measurement of capacitance and tan delta	Routine
h)	Dielectric Tests	
1)	PF/Separate source AC withstand voltage test.	Routine
2)	Chopped wave lightning impulse voltage test on windings(as per IEC 60076-3) (Not applicable for LV)	Type
3)	Induced over voltage withstand test	Routine
i)	Partial discharge measurement	Routine
j)	Measurement of iron loss & IR (repeat after induced voltage test)	Routine
k)	Short Circuit test as per IEC (if applicable)	Type
l)	Noise Level Measurement	Type
o)	Temperature rise test as per IEC (HV & LV winding)	Type

6.07 AUXILIARY TRANSFORMER

TECHNICAL REQUIRMENTS (OIL FILLED TRANSFORMER)

Sr. No.	DESCRIPTION	AUXILIARY TRANSFORMER (AT)
i)	VA Rating & Quantity	As per system requirement and /or SLD*
ii)	Voltage Ratio (KV)	As per system requirement and / or SLD*
iii)	Duty, Service & Application	Continuous application (Outdoor)
iv)	Winding	TWO
v)	Frequency	50 Hz
vi)	Nos. of Phase	THREE
vii)	Vector Group & Neutral earthing	As per system requirement and /or SLD*
viii)	Cooling	ONAN
ix)	Tap Changer	As per system requirement and /or SLD*
x)	Impedance at/50C	
	a) Principal Tap	As per system requirement and /or SLD*.
	b) Other Taps	
	Permissible Temperature rise over an ambient of 50 deg C (irrespective of tap)	a) Top Oil -35 degree b) Winding -40 degree
xii)	SC withstand time (thermal)	2 sec.
xiii)	Fault Level & Bushing CT	As per system requirement and SLD*

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xiv)	Termination	As per system requirement /cable box
xv)	Bushing rating, Insulation class (Winding & bushing)	As per relevant IS/IEC Creepage distance : 31 mm/kV
xvi)	Noise level	AS PER NEMA TR-1
xvii)	Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/-10%, also transformer shall be capable of being loaded in accordance with IS: 6600.
xviii)	Flux density	Not to exceed 1.7 Wb/sq.m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over fluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating. b) 125% for at least one minute. c) 140% for at least five seconds. Bidder shall furnish over fluxing char. up to 150%
xii)	SC withstand time (thermal)	2 sec.
xix)	Air Clearance	As per CBIP

Note (common for Oil filled and dry type transformer):

- d) Auxiliary transformers shall be suitable for 3 phase, 4 wire system with additional LVN bushing for equipment earthing.
- e) Auxiliary Transformer can be either Oil Natural/Synthetic Ester oil) filled or Dry Type (refer relevant specification).
- f) In case Ester Oil filled Transformers are offered, then 50% quantity shall be Natural ester filled and balance 50% quantity shall be of Synthetic Ester oil filled.

CODES AND STANDARDS

Transformers	IS:2026, IS:6600
Bushings	IS:2099,IS 3347
Insulating oil	IS 16659 / IS 16081
Bushing CTs	IS:2705
Indian Electricity Act 2003, BEE Guideline & CEA notifications	

General Construction

Transformer shall be constructed in accordance to IS: 2026 and IS: 3639 or equivalent to any other international standard. Transformer shall be complete & functional in all respect and shall be in scope of supplier.

The other important construction particulars shall be as below.

- g) The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the cover shall be of welded construction and there should be provision for lifting by crane.
- h) A double float type Buchholz relay conforming to IS: 3637 shall be provided.

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- i) Suitable Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
- j) All bolted connections to the tank shall be fitted with suitable oil-tight gaskets which shall give satisfactory service under the operating conditions for complete life of the transformer if not opened for maintenance at site
The transformer shall be provided with conventional single compartment conservator. The top of the conservator shall be connected to the atmosphere through indicating type cobalt free silica gel breather (in transparent enclosure). Silica gel shall be isolated from atmosphere by an oil seal.
- k) Transformer shall have adequate capacity Conservator tank to accommodate oil preservation system and volumetric expansion of total transformer oil.
- l) Transformer shall have Oil Temperature Indicator and Winding temperature Indicator (WTI applicable for transformer above 50 KVA) with accuracy class of +/-2 deg.
- m) For Transformers above 100KVA, radiators shall be detachable type, mounted on the tank with shut off valve at each point of connection to the tank, lifts, along with drain plug/valve at the bottom and air release plug at the top.
- n) M. Box shall be of sheet steel, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. Also Marshalling Box, shall be at least 450 mm above ground level (for transformer above 100 KVA). For transformer above 100 KVA, wiring scheme (TB details) shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.
- o) In case Natural Ester oil (IS 16659) filled transformer, the Transformer should be hermetically sealed and corrugated tank design. It should fitted with monitoring equipment like DGPT etc. for accessing the healthiness of Natural ester oil. As transformer becomes hermetically sealed, fitting, valves and accessories shall be decided during detail engineering but all other part of tender specification related to design of transformer active part and testing requirement shall remain same. HV/LV Bushing shall be fitted vertically on tank cover and all necessary measures to be taken to make the transformer leakage proof. Suitable nitrogen capping system shall be provided for preserving Natural ester oil for O&M.

Windings

- a) The bidder shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere.
- b) The conductors shall be of electrolytic grade copper free from scales & burrs.
- c) All windings of the transformers shall have uniform insulation.
- d) Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratio.

Core

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- e) The core shall be constructed from non-ageing, cold rolled, super grain oriented silicon steel laminations equivalent to M4 grade steels or better.
f) Core isolation level shall be 2 kV (rms.) for 1 minute in air.
g) Adequate lifting lugs will be provided to enable the core & windings to be lifted.

Insulating Mineral oil

No inhibitors shall be used in the transformer oil. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters.

S.No.	Property	Permissible values
1.	Kinematic Viscosity, mm ² /s	12 at 40 °C 1800.0 at (-)30 °C
2.	Flash Point, °C	40 °C
3.	Pour point, °C	(-)40 °C
4.	Appearance	Clear , free from sediment and suspended matter
5.	Density kg/dm ³ at 20 °C	0.895
6.	Interfacial Tension N/m at 25 °C	0.04
7.	Neutralisation value, mgKOH/g	0.01
8.	Corrosive sulphur	Non Corrosive
9.	Water content mg/kg	30 in bulk supply 40 in drum supply
10.	Anti-oxidants additives	Not detectable
11.	Oxidation Stability -Neutralization value, mgKOH/g -Sludge, % by mass	1.2 0.8
12.	Breakdown voltage As delivered, kV After treatment, kV	30 70
13.	Dissipation factor, at 90 °C And 40 Hz to 60 Hz	0.005
14.	PCA content	1%
15.	Impulse withstand Level, kVp	145
16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	5

Subsequently oil samples shall be drawn at:

Sr. No.	Parameters	Before filling in main tank & tested for	Prior to energization for following properties & acceptance norms:	Applicability
i)	BDV	60 kV (min)	60 kV (min)	Applicable for all Transformers.
ii)	Moisture content	10 ppm (max.)	10 ppm (max.)	

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For ester filled oil, relevant IS/IEC shall be followed for relevant oil parameters for type/routine test.

Bushings

- a) Bushing below 52 kV shall be oil communicating type with porcelain insulator.
- b) No arcing horns to be provided on the bushings.

Bushing CTs

Shall be of adequate rating for protection as required, WTI (WTI CT applicable for transformer above 50 KVA) etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

All CT terminals shall be provided as fixed type terminals on the M. Box to avoid any hazard due to loose connection leading to CT opening. In no circumstances Plug In type connectors shall be used for CT.

Valves

All valves up to and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies.

Sampling & drain valves should have zero leakage rate.

Gaskets

- a) Gasket shall be fitted with weather proof, hot oil resistant, rubberized cork gasket.
- b) If gasket is compressible, metallic stops shall be provided to prevent over compression. The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.

PAINTING

PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
Inside of tank and accessories (except M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron
External surface of transformer and accessories including M Box (except radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue) or (RAL6018 yellow green for ester filled)	One coat each	Atleast 100 micron
External Radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue) or (RAL6018 yellow green for ester filled)	Two coats each	Atleast 100 micron

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Internal Radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil	---	---
Internal surface of M Box	Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint	Two coats each	Not less than 100 micron

Neutral Earthing Arrangement

Neutral earthing shall be done as per system requirement and SLD. In case of solidly earthed neutral of Transformers, it shall be brought through insulated support from tank to the ground level at a convenient point with 2 nos. copper flat, for connection to ground network (as applicable). Neutral of Transformer if not used should be taken out through bushing and covered by insulating cap.

Cable boxes & disconnecting chamber (Disconnecting chamber applicable 3.3 kV and above)

- HV Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination. Phase segregation shall be achieved by insulating barriers (for 3.3 kV and above side).
- Cable boxes shall have bus bars / suitable terminal connectors of adequate size & bolt holes to receive cable lugs. The degree of protection of cable boxes shall be IP 55.
- A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box
- The support from base for the cable box (for 3.3 kV and above side) shall be of galvanized iron
- The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat.
- The minimum length provided for terminating 33 kV, 11KV & 3.3 KV XLPE cable shall be 1000 mm (for 33 kV) 650 mm (for 3.3 kV and 11 kV) from cable gland plate to the cable lug) for the cable boxes, for 433V side suitable length shall be provided (shall be discussed during detail engineering). The final cable size, number & length of terminating XLPE cable shall be furnished during detailed engineering.
- Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports (as applicable).
- Cable boxes shall have removable top cover (for transformer above 100 KVA) & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

FITTINGS

Following fittings shall be provided with Transformers covered under this sub section.

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification Group : BESS system

DOC. NO: SPV-BESS - 01-2025-00

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- | | |
|----|--|
| a) | -Conservator for main tank (transformer above 100 KVA shall be provided with MOG with low oil level alarm contact), drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above ground level) etc. |
| b) | - Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting arrangement (Gas collecting arrangement applicable for transformer above 100 KVA). |
| c) | - For Auxiliary transformers below 2 MVA, diaphragm type explosion vent shall be provided. |
| d) | OTI & WTI shall be 150 mm dial type with alarm (WTI only for transformer above 50 kVA) and trip contacts with max. reading pointer & resetting device (maximum height 1500 mm above ground level). |
| e) | For transformer above 100 KVA:
Top & bottom filter valves with threaded male adapters, bottom sampling valve, and drain valve/sludge removal valve at the bottom most point of the tank.
For Transformer upto 100 KVA:
common drain cum sampling cum bottom filter cum sludge removal valve and top filter valve can be provided. |
| f) | Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable). |
| g) | Prismatic/toughened glass oil gauge for transformers. |
| h) | Bi-directional wheel/skids, M.Box, OCTC, Bushing CTs (as applicable), Insulating Oil, Cooling equipment. |
| i) | Cover lifting eyes, transformer lifting lugs, jacking pads(jacking pad applicable for transformer above 100 KVA), towing holes and core and winding lifting lugs, inspection cover, Bilingual R&D Plate, Terminal marking plates, two nos. earthing terminals etc. |
| j) | Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS. |
| k) | Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed. |

The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers are deemed to be included.

Tests and Inspection

S.N.	ROUTINE TESTS	
1.	All routine test shall be carried out in accordance with IEC 60076.	√
2.	Measurement of Voltage Ratio & phase displacement	√
3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)	√
4.	Vector group and Polarity Check	√
5.	Magnetic Balance and Magnetising Current Test	√
6.	Measurement of no load current with 415 V, 50 Hz AC supply	√
7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage	√
8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps	√
9.	IR measurement (As per IEC 60076-1)	√
10.	Separate Source Voltage Withstand Test /Applied voltage test.	√

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11.	Induced overvoltage test/Induced voltage withstand (IVW) test .	√
12.	Repeat no load current/loss & IR after completion of all electrical test	√
13.	Oil leakage test on completely assembled transformer along with radiators	√
14.	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	√
15.	IR measurement on wiring of Marshalling Box.	√
S.N.	TYPE TESTS#	
1.	Temperature Rise test at a tap corresponding to maximum losses as per IS 2026.	√
2.	Tank Vacuum & Pressure Test (as per CBIP norms)	√

Leakage test on assembled Oil filled Transformer (ROUTINE TEST)

All tank & oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature & applying pressure equal to the normal pressure plus 35 KN/sq. m measured at the base of the tank. The pressure shall be maintained for a period of not less than 6 hours during which time no sweating shall occur. Bidder can perform this test at site depending upon urgency subject to BHEL/NTPC approval.

Fire Fighting

Fire Fighting arrangements for Transformers shall be provided if applicable as per Tariff Advisory Committee (TAC)/statutory requirements. Firewall & soak pit as applicable (as per statutory requirement/TAC/IS 10028 / IS 1646) shall be provided of minimum 230 mm thickness of RCC wall or 355 mm thick fire resisting brick wall subject to BHEL/NTPC approval. However for all outdoor transformer at a distance of 1.0 m (min.) from transformer outer edge. A sump pit shall be provided for each pit. Transformer efficiency shall be as per Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electrical Lines) regulation, 2010.

DRY TYPE AUXILIARY TRANSFORMERS:

Dry Type Transformer shall be constructed in accordance to IS: 2026, IS: 11171 or equivalent to any other international standard, Indian Electricity Act 2003, BEE Guideline & CEA notifications. Transformer rating and all related technical parameters including tap changer (if applicable) shall be as per system requirement/SLD and relevant standards. Transformer shall be suitable for continuous **indoor** duty application. Transformer shall be complete & functional in all respect. The other important construction particulars shall be as below.

- The transformers shall be housed in a metal protective housing, having a degree of protection of IP-23. The enclosure shall be provided with suitable hardware (as required).
- The conductors shall be of electrolytic grade copper free from scales & burrs.
- Dry Type Transformer windings shall be of class F insulation or better. Cooling shall be AN.
- The core shall be constructed from non-ageing, cold rolled, grain oriented silicon steel laminations (M4 or better).

The fittings/accessories including protection/monitoring device (temperature scanner) generally

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required for satisfactory operation of the transformer, are to be provided.

6.08 AC CABLES

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS:7098 (Part -II)	Cross linked polyethylene insulated PVC sheathed cable for (Part -II) working voltage from 3.3 KV upto & including 33 KV
IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332 Part-3:	Tests on electric cables under fire conditions. Tests on bunched wires or cables (Category-B).
IEEE-383	Standard for type test of Class IE Electric Cables
IS : 4905	Methods for random sampling.
IS : 10418	Specification for drums for electric cables.

General Requirements:

The cables shall be suitable for laying on racks, in ducts, trenches, conduits, overground cabling and underground (buried) installation with chances of flooding by water.

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All cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.

- Cables shall be armored type if laid in switchyard area or directly buried.
- Cable lengths shall be considered in such ways that straight through cable joints are avoided.
- If cables are to be laid underground, laying shall be as per latest relevant IS code.
- If cables are to be laid overground (eg on RCC/concrete pedestals etc), the cables shall be UV-resistant supported by test reports.

CONDUCTOR

Copper/aluminium conductor used in power cables shall have tensile strength as per relevant standards. Conductors shall be stranded.

INSULATION

XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

ARMOUR

For single core armoured cables, armouring shall be of copper/aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows:

Calculated nominal dia.of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire

OUTERSHEATH

Outer sheath shall be of PVC as per IS: 5831 & black in colour for power cables. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

Oxygen index of min. 29 (as per IS 10810 Part-58). Acid gas

emission of max. 20% (as per IEC-754-I).

Smoke density rating shall not be more than 60 % (as per ASTM-D-2843).

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In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

Cable size and voltage grade - To be embossed Word 'FRLS' at every 5 metre - To be embossed

Screen Fault current ___KA for ___ Sec. (Value of current & time shall be indicated) (If applicable)

Sequential marking of length of the cable in metres at every one metre -To be embossed / printed

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

All cables shall meet the fire resistance requirement as per IEEE - 383 with cable installations made in accordance with 'Flammability Test' and as per Category-B of IEC 332 Part -3.

Allowable tolerances on the overall diameter of the cables shall be +\ -2 mm maximum, over the declared value in the technical data sheets.

Repaired cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

CABLE SELECTION & SIZING

Cables shall be sized based on the following considerations: Rated current of the equipment

The Maximum Overall Voltage Drop: As per relevant standards

Short circuit withstand capability

Fault current- As per system fault current.

Time-As per protection time grading requirement subject to the minimum value mentioned at CI 1.0 (I) Cable sizing criteria of Chapter 2-A.

DERATING FACTORS

De rating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

- a) Variation in ambient temperature for cables laid in air
- b) Grouping of cables
- c) Variation in ground temperature and soil thermal resistivity for buried cables.

HT POWER CABLES

For single-core armoured cables, the armouring may constitute the metallic part of insulation screening

In case of single core cables where there are both metallic screening and armouring, there shall be extruded inner sheath between them.

Distinct extruded PVC inner sheath of black col

our as per IS:5831 shall be provided for the cables as follows:

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- a) For all multicore cables.
b) For single core armoured cables, where armoring is not being used as metallic screen

Cores of the cables of upto 3 cores shall be identified by coloring of insulation or by providing colored tapes helically over the cores with Red, Yellow & Blue colors.

The cross-sectional area of the metallic screen strip/tape shall be considered in design calculations.

The eccentricity shall be calculated as

Eccentricity	Ovality
$\frac{t_{\max} - t_{\min}}{t_{\max}} \times 100$	$\frac{d_{\max} - d_{\min}}{d_{\max}} \times 100$
T	

Where t-max/t-min is the maximum/minimum thickness of insulation and d-max/d-min is the maximum / minimum diameter of the core

eccentricity of the core shall not exceed 10% and ovality not to exceed 2% Cables shall conform to IS: 7098 Part - II. These cables shall have multi-stranded, compacted circular, aluminium conductors, XLPE insulated, metallic screened suitable for carrying the system earth fault current, PVC outer sheathed. The conductor screen and insulation screen shall both be of extruded semiconducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth interfaces. Method of curing for cables shall be “dry curing / gas curing”.

The metallic screen of each core shall consist of copper tape with minimum overlap of 20%. However for single core armoured cables, the armoring shall constitute the metallic part of the screening.

The standard length for HT power cables shall be 1000 meter for all single core cables and 750 meters for 3 core cables. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. One drum length of each cable size can be of non standard length (not less than 250 meter) so as to match the ordered quantity. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/-2% and the payment shall be made based on the actual cable length supplied within this limit.

LT POWER CABLES

LT Power & control cables shall be of minimum 1100 volts grade XLPE /PVC insulated conforming to IS 1554 / IS 7098 (Part-I) for utilization voltages less than equal to 415 V.

For cable connecting central inverter and inverter transformer, no. of runs and interconnecting trench, bus bar terminations, lugs shall be provided in such a manner so that no overheating of contacts & terminals encountered. Sufficient space for cabling & termination shall be kept.

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The sizing of the cable will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the let out energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.

Single core cables shall have no Inner sheath as per IS: 7098 Part-I

All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated.

1.1 KV grade XLPE power cables shall have compacted aluminium/ copper conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I). Cables which are directly buried shall be armoured.

1.1KV grade PVC power cables shall have aluminium/copper conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I).

LT CONTROL CABLES

Conductor of control cables shall be made of stranded, plain annealed copper. Outer sheath shall be of PVC as per IS: 5831 & grey in colour for control cables. Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:

1 core - Red, Black, Yellow or Blue

2 core- Red & Black

3 core-Red, Yellow & Blue

4 core-Red, Yellow, Blue and Black

For control cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.

CABLE SELECTION & SIZING:

Control cables shall be sized based on the following considerations:

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(a) The minimum conductor cross-section shall be 1.5 sq.mm.

(b) The minimum number of spare cores in control cables shall be as follows:

No. of cores in cable	Min. No. of spare cores
2C, 3C	NIL
5C	1
7C-12C	2
14C & above	3

1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC or XLPE insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).

TESTS

Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of power and control cables enclosed at relevant section.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. All cables to be supplied shall be of type tested design.

During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client /owners representative and submit the reports for approval.

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of B H E L / N T P C , an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

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The reports for following type tests shall be furnished:

Sl	Type Test	Remarks
	Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Resistance test	
5.	Wrapping test	
6.	Torsion test	For GS round wires only
7.	Elongation test	For GS wire only
8(a)	Mass& uniformity of Zinc Coating tests	For GS wires/formed wires only.
8(b)	Adhesion test	For GS wires/formed wires only
For XLPE insulation & PVC Sheath		
9.	Test for thickness	
10.	Tensile strength and elongation test before ageing and after ageing	
11.	Ageing in air oven	
12.	Shrinkage test	
13.	Hot set test	For XLPE insulation only
14.	Water absorption test	For XLPE insulation only
15.	Loss of mass test	For PVC outer sheath only.
16.	Hot deformation test	For PVC outer sheath only.
17.	Heat shock test	For PVC outer sheath only
18.	Thermal stability test	For PVC outer sheath only
19.	Oxygen index test	For PVC outer sheath only
20.	Smoke density test	For PVC outer sheath only
21.	Acid gas generation test	For PVC outer sheath only
22.	Flammability test as per IEC-332 Part-3 (Category -B)	For completed cable only
23.	Insulation resistance test (Volume Resistivity method)	
24.	High voltage test	
25. *	Partial discharge test	For HT cables only
26. *	Bending test	
27. *	Dielectric power factor test	
	a) As a function of voltage	
	b) As a function of temperature	
28. *	Heating cycle test	
29. *	Impulse withstand test	

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CABLE DRUMS

- Cables shall be supplied in wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. However, For Single core cables upto 6 Sq. mm size, supplier can do alternative packaging of whole Drum/Spool to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.
- Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled

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10.09 CABLE INSTALLATION METHODOLOGY

Erection in BHEL scope. Bidder has to provide cables as per NTPC requirement , installation methodology.

CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification **Group : BESS system**

DOC. NO: SPV-BESS - 01-2025-00

REV. 00

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IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
IEEE:80 Grounding of Industrial & commercial power systems compression joints for	IEEE guide for safety in AC substation grounding IEEE:142 DIN 46267 (Part-II)Non tension proof Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables. Indian Electricity Act. Indian Electricity Rules.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA 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 standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

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DESIGN AND CONSTRUCTIONAL FEATURE

Inter Plant Cabling

Interplant cabling for main routes shall be laid in Cable trenches/cable trays/buried/duct banks. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. All buried cables shall be of armoured type. Bidder can propose overground cabling methodology (e.g. on RCC/concrete pedestals etc.). In such cases, the cables shall be UV-resistant supported by test reports.

Cable Sizing Conditions

All cables shall be suitably derated as per the laying conditions for carrying the required load current and fault current. For derating, the ambient temperature for directly buried cables shall be taken as 40° C and 50° C for cables laid in air.

All XLPE cables shall be rated at 90° C conductor temperature for AC Voltage drop calculation and 80° C for DC Voltage calculation. However, for Voltage drop calculation in DC Cable, actual conductor temperature as per loading can be used

Trenches

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

General

The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.

Sizing criteria, derating factors for the cables shall be met as per respective chapters. However, for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminum conductor and 2.5 sq.mm. for copper conductor cable.

Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:

- Meet all safety requirements.
- Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc

EQUIPMENT DESCRIPTION

Cable trays, Fittings & Accessories

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Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.

Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 meter. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.

Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm

Support System for Cable Trays

Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder:

Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanized.

The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminum paint shall be applied

All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.

Support system shall be able to withstand

- weight of the cable trays
- weight of the cables (75 Kg/Meter run of each cable tray)
- Concentrated load of 75 Kg between every support span.
- Factor of safety of minimum 1.5 shall be considered.

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Pipes, Fittings & Accessories

Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

GI Pipes shall be of medium duty as per IS:1239

Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

Hume pipes shall be NP3 type as per IS 458

Junction Boxes

Junction Boxes with IP:55 degree of protection, shall comprise of a case with hinged door constructed from cold rolled sheet steel of thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanized as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

Terminal blocks shall be 1100V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non- ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded copper conductors of size upto 2.5 sq mm each. All internal wiring shall be of minimum 1.5 sq. mm cu. Conductor PVC wire.

Terminations & Straight through Joints

Termination and jointing kits for 33kV, 11kV, 6.6 kV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre- moulded type, taped type or heat shrinkable type. 33kV, 11kV and 6.6 kV grade joints and terminations shall be type tested as per IS:13573. 3.3kV grade joints and terminations shall be type tested as per VDE0278. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solderless crimping type cable lugs & ferrule as per DIN standard.

Straight through joint and termination shall be capable of withstanding the fault level for the system.

1.1 KV grade Straight Through Joint shall be of proven design.

Cable glands

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS:6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less

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than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. Cable lugs and ferrule shall conform to relevant standard.

Trefoil clamps

Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the peak value of maximum system short circuit current.

Cable Clamps & Straps

The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.

Receptacles

Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped galvanized or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break, AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity.

Galvanizing

Galvanizing of steel components and accessories shall conform to IS:2629, IS4759 & IS:2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots.

The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

Welding

The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595.

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INSTALLATION

Cable tray and Support System Installation

Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.

Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with relevant standard.

The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.

The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval.

All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.

In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

Conduits/Pipes/Ducts Installation

The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/ roof/ wall/ cable tunnel/ cable trenches made for conduit installation shall be sealed and made water proof by the Contractor **either with any proven fire sealing system rated for one hour or** Modular multi-diameter cable sealing system consisting of frames, blocks, Compression wedge and its accessories. **The Cable sealing system should have been tested for fire insulation for min. 1 hr as per BS 476 and shall also provide water sealing. System shall be anti- rodent and anti- termite.**

GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All

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conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material

Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	Spacing
---------------------------	---------

Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

Junction Boxes Installation

Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

Cable Installation

Cable installation shall be carried out as per IS:1255 and other applicable standards.

For Cable unloading, pulling etc following guidelines shall be followed in general :

- Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.
- While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.

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Cables shall be laid on cable trays strictly in line with cable schedule
Power and control cables shall be laid on separate tiers in line with approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two meter. All multi core cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with self-locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multi core power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multi core power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.

Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.

Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.

No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.

In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

Wherever few cables are branching out from main trunk route troughs shall be used.

Wind loading shall be considered for designing support as well Cable trays wherever required.

Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.

The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

Separation

At least 300mm clearance shall be provided between :

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

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No. of cores in cable

No. of spare cores

2C,3C

NIL

5C

1

7C-10C

2

14C and above

3

Directly Buried Cables

Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255.

RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags

While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

Cable Terminations & Connections

The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.

The equipment will be generally provided with undrilled gland plates for cables/conduit entry.

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The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.

Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self-locking type nylon cable ties with de interlocking facility to keep them in position.

All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections

6.1 ENERGY MANAGEMENT SYSTEM AND SCADA

GENERAL

Energy Management System (EMS) system of individual plants shall be a computerized system for real time monitoring, operation, control, reliable & efficient operation and optimization of performance of the BESS Plant. **SCADA system shall be part of EMS system.** EMS shall be able to acquire real time data of various equipment of BESS system, have in built logic/programming to monitor, control, and optimize the performance of BESS as per specification.

Also, parameter visualization at 100% capacity level is also required for performance measurement of total BESS Plant.

Suitable provision Remote control and monitoring facility EMS should be provided in addition to local control and monitoring so that all trouble-shooting and subsequent action can be taken from BHEL/NTPC corporate center. Necessary software at remote and local end shall be under scope of Bidder.

Contractor shall provide complete EMS system with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation of entire BESS Plant and its auxiliary systems. Contractor shall include in his proposal all the Industrial Grade Hardware, Software, Panels, Power Supply, HMI, Laser Printer, Gateway, Networking equipment and associated Cable etc. needed for the completeness even if the same are not specifically appearing in these specifications.

EMS system includes the supply and integration redundant Power Quality Meters (02 nos) at suitable points. Interconnection with optical fiber communication cables through IEC 61850 to EMS shall also be in Bidder's scope. Also Supply of necessary switches at HT switchgear and communication cable from EMS to individual numerical relays and its integration with required accessories is under Bidder's scope.

Bidder to supply Porta-Cabin/Container based Control room for Installing EMS Panels and

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EWS/OWS systems located within BESS plant

EMS System shall have the provision to perform the following functions:

- Provision to operate the BESS as per following minimum application requirement including Ancillary services but not limited to; Integrated control with solar power plant at Ramagundam for smoothening and energy Time shifting application
- VAR support to Grid / voltage Regulation
- Black Start application
- Frequency Regulation /Grid support
- Energy Arbitrage/energy shifting operation
- Ramp rate support
- Power Quality Application to Grid
- Interaction on real-time with IEX for schedule of charging and discharging.
- Inertia Support to Grid as virtual Synchronous Generator

- ii. Remote control of all the HT Breakers either in hard or soft signal
- iii. Remote control of PCS active and reactive power as per requirement mentioned in respective chapter.
- iv. SCADA shall also be able to acquire, display and store real time data, status and alarm signal from following equipment included but not limited to as required or offered under the scope of this specification:
 - a) Battery containers with Aux system and BMS
 - b) All the HT Switchgear/RMU equipment
 - c) PCS duty Transformers
 - d) Incomer and bus coupler breaker of LT Panel.
 - e) Power conditioning System (PCS)
 - f) UPS and Battery charger as per requirement/ Auxiliary supply systems
 - g) TEM/ABT/MFM meter, numerical relay, fire alarm panel, GPS time synchronization unit and Aux. transformers.
 - h) SCADA Hardware, Accessories and Communication link
 - i) Any other equipment required to complete monitoring of BESS plant upto 33kV

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level.

- v. Display of status of major equipment in Single Line/Mimic Diagram. Mimic Diagram colour shall comply to IS 11954: Guide for colour coding of electrical mimic diagrams
- vi. Display and storage of derived/calculated/integrated values
- vii. Generate, store and retrieve user configurable periodic reports. EMS/SCADA shall have facility to generate report in MS Excel file type.
- viii. Remote monitoring of essential parameters of plant on the web using popular web browser without requirement of additional software. Same shall be authorised with user id and password using standard modem. User ID and password for remote view can only be changed by EMS/SCADA Administrator. Internet connection for transferring data to web shall be taken by Contractor in the name of BHEL/NTPC Site for O & M period.

Please refer Chapter-2-A for Nos. of Web Client Licenses for remote monitoring, Nos. of OWS/EWS/Historian with location.
- ix. Performing self-monitoring and diagnostic functions.

The contractor shall provide at least one GPS clock at each Thermal Plant, which shall be synchronized with the SCADA/EMS system. All devices having real-time clock (RTC) with time synchronization facility and are communicating with BESS EMS/SCADA shall be synchronized with GPS Clock through SCADA or directly with GPS Clock. The technical details of GPS have been specified elsewhere in the specification

Type of signal from equipment (Hard wired or Soft) shall be as per specification of the equipment mentioned in the respective chapter and approved during detail engineering.

SCADA shall provide real time performance monitoring according to IEC 61724 standard. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail.

The control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is affected. Control system shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit. On any of these failures the controlled equipment/parameter shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalized during detailed engineering. System shall be designed such that there will be no upset when power is restored. These operation shall be demonstrated by vendor during Factory Accepted Test (FAT) in the presence of BHEL/NTPC Representative.

All the power supply module, Ethernet switches and network accessories for non- air conditioned area shall be suitable for operating in ambient temperature of 50 Deg C minimum.

Power plant controller (PPC) shall be provided with two processors (main processing unit and memories), one for normal operation and one as hot standby. In case of failure of working PPC processor, there shall be an appropriate alarm and simultaneously the hot standby PPC processor shall take over the plant control function automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant

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disturbance whatsoever. It shall be possible to keep any of the PPC processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor. The BESS plant SCADA and PPC networks shall be suitably designed, so that PPC shall directly and independently able to control the individual PCS. Detailed control logic in the PPC shall be finalized during detailed engineering stage as per grid requirement to support voltage and frequency with suitable droop characteristic as per CEA standard.

Performance Monitoring :-

As part of the performance monitoring, the following shall be carried out:

a) The **Contractor** must install necessary equipment to continuously measure BESS operating parameters (including but not limited to voltage, current, ambient conditions etc.) as well as energy input into and energy output from the BESS along with Metering arrangement in accordance with extant regulations. They will be required to submit this data to **Employer**, CTUIL and Grid -India on line and/or through a report on regular basis every month for the entire duration of contract.

b) The plant SCADA should be OPC version 2.0a (or a later version including OPC UA) compliant and implement appropriate OPC-DA server as per the specification of OPC Foundation. All data should be accessible through this OPC server for providing real time online data (BESS parameters) to MNRE. This time series data shall be available from the Project SCADA system to facilitate monitoring and should include among others as stated before, below parameters to facilitate daily, monthly and annual Report for performance monitoring.

Web-based monitoring should be available, which should not be machine dependent. The web-based monitoring should provide the same screens as available in the plant. Also, it should be possible to download reports from a remote web-client in PDF or Excel format.

SCADA CONTROLLER SYSTEM:

The redundant controller of SCADA/EMS at control room shall be of PLC based as per specification given hereunder. For other locations such as Inverter/Battery containers Room, PLC/ IO modules/RTUs are acceptable

Main control room SCADA shall have the following feature:

- i. Facility for implementation of all logic functions for control, protection and annunciation of the equipment and systems.
- ii. Main control room SCADA shall be provided with two processors (main processing unit and memories), one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor.
- iii. The memory shall be field expandable. The memory capacity shall be sufficient for the

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complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in nonvolatile semiconductor memories like EPROM. All dynamic memories shall be provided with buffer battery backup for at least 360 hours. The batteries shall be lithium or Ni-Cd type.

A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.

DATA COMMUNICATION SYSTEM (DCS)

The Data Communication System shall include a redundant Main System Bus with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non- redundant.

The DCS shall have the following minimum features:

i) Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station.

ii) The design shall be such as to minimize interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module.

iii) If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility

iv) Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged.

v) The design and installation of the system bus shall take care of the environmental conditions as applicable.

vi) Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion

vii) Cat 6 UTP or fiber optic cables shall be employed.

viii) The Contractor shall furnish details regarding the communication system like communication protocol, bus utilization calculations etc. Contractor shall setup Gigabit Ethernet based Plant Local Area Network (LAN) to connect to different communication nodes at Inverter /Switchgear location etc. with redundant backbone using ring or better topology. Each Modbus cable shall be provided with Surge protection device at SCADA Panel End. Specification of OFC and Modbus cable has been given elsewhere in this specification.

x) Provision of monitoring and event data via the communication interface shall adhere to

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DNP3 AN2011-001 / IEC 61850 to the extent possible and capture at least the following data points:

- Frequency at the AC bus
- AC real power
- Power factor
- Real energy delivered
- Real energy received
- Auxiliary power
- Auxiliary energy
- DC power
- DC voltage
- DC current
- Phase A voltage
- Phase A angle
- Phase B voltage
- Phase B angle
- Phase C voltage
- Phase C angle
- Battery state of charge
- Battery string currents

- Battery temperature

xi) The DAS shall provide unsolicited message capability for reporting critical alarms. The Contractor and the Employer will agree on a list of alarms that are reported the instant they are detected. However, a minimum of following parameters shall be displayed on BESS local control panel, console, or SCADA computer:

- Main temperature Alarm (on system temperature exceeding a predetermined threshold)
- Smoke/fire Alarm (on system detection of smoke/fire)
- DC leakage current (battery leakage current to ground exceeding a predetermined threshold)
- Breaker status (connect/disconnect switch)

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- AC voltage OK (system ac voltage exceeding a predetermined threshold)
- Battery temperature alarm (battery temperature exceeding a predetermined threshold)
- Synchronization error shutdown
- PCS fault
- Weak Unit Battery Alarm
- AC system fault
- Control logic problem (problem with the BESS control logic)
- DC fuse blown
- Container door open (BESS container door opening)

HUMAN MACHINE INTERFACE SYSTEM (HMIS)

- i. HMIS configured around latest state-of-the art servers/Workstations with open architecture supporting OPC /TCP/IP protocols, etc.
- ii. The SCADA shall be OPC version 2.05a compliant and implement a OPC- DA 2.05a server as per the specification of OPC Foundation. All data should be accessible through this OPC server.
For communicating the generation data of plant in BHEL/NTPC , the SCADA system shall be interfaced/ connected with PI server of BHEL/NTPC on OPC Protocol. The details of B H E L / N T P C PI server shall be furnished during the detailed engineering.
- iv. Graphical Interface Unit (GIU) / Operator work station (OWS) shall perform control, monitoring and operation (as applicable) for plant equipment's connected with SCADA system.
- v. Engineering workstation (EWS) shall work as a programming station both for controller and SCADA. It shall be possible to use same EWS as programming station and the Human Machine Interface System.
- vi. SCADA System shall be provided with redundant OWS. Operator shall be able to access all control/information related data under all operating conditions including a single processor and computer failure/hardware failure at Control room in the HMIS.
- vii. In addition to a desktop based EWS, vendor shall also provide dedicated portable (laptop) based EWS.
- viii. All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions.
- ix. The mimic shall be configured on the HMI and it shall be possible to control, monitor and operate the plant from the same.

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- x. The SCADA System shall have ability to perform operator functions for each OWS / GIU as a minimum, include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering.
- xi. The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.

The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.
- xiii. The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator).
- xiv. Wherever Graphical Interface Unit is envisaged, it shall meet the minimum functional requirements of monitoring, operating & controlling the process and displaying information related to process locally. GIU shall be provided with TFT active matrix or LED display and keypad for operation. GIU shall be ruggedly designed to withstand hard environments like high temperature, shock and vibration.
- xv. Bidder has to provide suitable hardware DMZ network firewall to restrict unauthorized access to HMI/ SCADA system. Details specification of hardware firewall is provided elsewhere in the specification.
- xvi. SCADA shall have facility to provide real time reporting of alarms and statistical data through SMS and e-mails.
- xvii. Programming of the PLC Processor/controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized language.
- viii. The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc.
- xix. All programming functionalities shall be password protected to avoid unauthorized modification.

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PROGRAMMING FUNCTIONALITIES

Programming of the PLC Processor/controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized language. For example, the programming of PLC shall use either of the following:

- Flow-chart or block logic representing the instructions graphically
- Ladder diagrams

The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc.

All programming functionalities shall be password protected to avoid unauthorized modification.

SOFTWARE REQUIREMENT

- i. All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.
- ii. The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.
- iii. Industry standard operating system like WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry.
- iv. SCADA system shall include the following standard protocols as a minimum:
 - a) Modbus (TCP/IP, RTU, ASCII).
 - b) Sub Station Protocol (IEC-61850 and IEC 60870 -5-101/104).

Any other protocol on which the offered equipment (by Contractor) will communicate with SCADA

The system shall have user friendly programming language & graphic user interface.

- vi. All system related software including Real Time Operating System, File management software, screen editor, database management software, On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software, Antivirus software and latest WINDOWS based packages (MS Word, Excel and PowerPoint) etc. and any other standard language offered shall be furnished as a minimum.

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- vii. All application software for SCADA system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided.
- viii. The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.
- ix. The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g. organization or site license) and shall not be hardware/machine- specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to up gradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant.
- x. All the SCADA Software with license Key shall be handed over to BHEL/NTPC on the DVD/CD media. All the hardware and software shall be licensed to BHEL/NTPC .

PARAMETRIC REQUIREMENTS

The control system shall be designed such that under worst case loading conditions the response time shall not be worse than the following:-

- i) On/Off Command:- The response time for screen update after the execution of the control command from the time the command is issued shall be one second (excluding the drive actuation time).
- ii) Adjustment Command:- 0.5 to 1 second.
- iii) On screen Updating and All Control related displays:- 1 second.
- iv) Bar Chart displays, Plant Mimic displays, Group review displays, X-T Plot Displays and Plant Summary Displays :- 1 to 2 seconds.

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All the Analog data shall be scanned at the resolution of 1(one) second and refreshed on screen however, recording of data shall be as finalized during detail engineering

INPUT/OUTPUT MODULES

- i) The SCADA system should be designed according to the location of the input/output cabinets as specified.
- ii) Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, non-changeover/change over type of contact inputs etc.) and outputs from the control system (non changeover/change over type of contact, output signals for energizing interface relays at suitable DC voltage as decided during detail engineering, 4-20 mA output etc.) are to be provided by the Contractor.
- iii) Electrical isolation of 1.5kV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal- operate the internal processing equipment.
- iv) The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.
- v) Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator.
- vi) The I/O Module shall have the following features:
 - a) Power supply monitoring
 - b) Contact bounce filtering
 - c) Optical isolation between input and output signals with the internal circuits.
 - d) In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be finalized during detailed engineering.
- vii) Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA. Analog output modules shall be able to drive a load impedance of 500 Ohms minimum.
- viii) Electrical isolation of 1.5kV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal- operate the internal processing equipment.
- ix) Requirement of Nos. of channel in each type of Module (Analog Input, Analog Output, Binary Input, Binary Output, RTD) and Modbus link at Inverter and main control room shall be calculated based on the Input/output signal list to be submitted by the contractor for approval during detail engineering

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SYSTEM SPARE CAPACITY

Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site.

- i) 10 % spare channels in input/output modules fully wired up to cabinets TB.
- ii) Wired-in "usable" space for 10% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets.
- iii) Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules.
- iv) Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 10 % blank space
- v) Each processor / controller shall have 20% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 20% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.

The Data communication system shall have the capacity to handle the additions mentioned above

- vii) Ten (10) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.
- viii) The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.

OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS

- i) Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalized during detailed Engineering stage.
- ii) Minimum quantities shall be as follows:-

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Various displays on the OWS shall as a minimum include P&ID displays or mimic, bar chart displays, X-Y & X-T plot (trend) displays, operator guidance message displays, group displays, plant start-up/shutdown message displays, system status displays etc. Number of displays and the exact functionality shall be on as required basis and as finalized during detailed engineering subject to the minimum quantities as given. For X-T & X-Y plots, the facility of providing a background grid on operator request shall be variable with adequate no. of divisions in both co-ordinates.

viii) The minimum quantity of major types of displays per unit shall be as follows:

SI	Display	Minimum Qty for Plant capacity of 50 MW or Less	Additional Qty for each 10 MW or part above 50 MW
a)	Control displays (group/sub-group/ sequence/loop)	(On as reqd. basis subject to 100 minimum)	(On as reqd. basis subject to 100 minimum)
b)	P&ID/ mimic display	25	5
c)	X-Y Plot (with superimposed operating curves + using user selectable stored data)	25+25	5+5
d)	Group displays	30	5
e)	Operator guidance message	20	NIL
f)	System status & other diagnostic display	on as required basis	on as required basis

The assignment for the above will be done by the contractor as per the requirement of operation of contractor's system as well as for maintenance. The balance displays shall be left as spare for future modification/addition.

HISTORICAL STORAGE AND RETRIEVAL SYSTEM (HSRS)

- The HSRS shall collect, store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to non-erasable long term storage media once in every 30 Days periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full.
- The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports.
- The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same.
- In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration on portable external long term storage media. Bidder shall

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provide two numbers of portable external hard drive of 2TB each.

- vi) For long term plant performance analysis, the following plant data as a minimum with time stamping and interval as indicated in below table but not limited to shall be stored daily on historian.

Important plant data for a very long duration (plant life) Storage on Historian

Sl.	Parameter	Time Interval
1	Power Conditioning System (PCSs):- DC Voltage, DC Power, DC Current,, AC Active & Reactive Power, Power factor, AC Current & Voltage, Energy, PCS room temp, PCS Cabinet temp and Modules Temp	1 (One) Minute
2	MFM, Energy meter and Numerical Relay data:- Active & Reactive Power, Energy (day), Current and Voltage	1 (One) Minute
3	Export feeder/s Energy Meter Data:- Active & Reactive Power, Energy import and export, Current and Voltage and Grid Frequency.	1 (One) Minute
4	Daily energy export from each PCS	24 (Twenty Four) Hours
5	Total sum of daily energy export from all PCS	24 (Twenty Four) Hours
6	BESS Parameter for different application function assessment: (i) Active & Reactive Power for solar feeders, grid feeders, BESS feeders (33kV level) (ii) SPV 30Minutes moving average value. (iii) Reference Target Active & Reactive power	1(one) second
7	BESS Battery Voltage, SOC (upto Module and String level) and other Important Battery and BMS data.	1(one) second
	Any other parameter as per BHEL/NTPC requirement	

SCADA PANEL/CABINET/CONTROL DESK/FURNITURE

- i) The SCADA cabinets shall be IP-22 protection class.

The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each

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cabinet with proper. Suitable louvers with wire mesh shall be provided on the cabinet.

- iii) The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables for Main control room.
- iv) The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet shall not higher than 2200mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering. Wall mounted cabinet is acceptable for Inverter room/sub- pooling switchgear.
- v) Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
- vi) Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The Preferable finish colors for exterior and interior surfaces shall conform to following shades:
 - Exterior:- As per RAL 9002 (End panel sides RAL 5012),
 - Interior:- Same as abovePaint films which show sags, checks or other imperfections shall not be acceptable. As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
- vii) Control desk shall be free standing table top type with doors at the back and shall be constructed of 2 mm thick CRCA steel plates. A 19 mm thick wooden top shall be provided on the desk to keep the monitors at top and computers inside. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal and vertical directions. ASCII Keyboard shall be capable of being pulled out through a tray.
- viii) Contractor shall provide the two power supply feeders (DC supply or UPS AC) and one raw supply feeder of suitable rating to cater all the load requirements of SCADA panel/cabinet/control desk. System remain in service in case of single power supply failure/power supply module failure. Suitable alarm shall be generated in case of any power supply failure.
- ix) The cabling / wiring between OWS & CPU'S, power supply cables etc. shall be aesthetically routed and concealed from view.
- x) Chairs – Industry standard revolving chairs with wheels and with provision for adjustment

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of height (hydraulically/gas lift) shall be provided for the operators and other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back. Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon.

xi) One Printer Table made of Laminated Wood or Heavy Duty MDF shall be provided for printer.

xii) All the furniture shall be of reputed make (Godrej or Equivalent).

HMIPIS HARDWARE

- viii) The HMIPIS as specified shall be based on latest state of the art Workstations and Servers and technology suitable for industrial application & power plant environment.
- ix) The Workstation/Servers employed for HMIPIS implementation shall be redundant based on industry standard hardware and software which will ensure easy connectivity with other systems and portability of Employer developed and third party software.
- x) Redundant sets of communication controllers shall be provided to handle all the communication between the HMIPIS and redundant system bus and to ensure specified system response time and parametric requirements. Each communication controller shall have message checking facility. Power Fail Auto Restart (PFAR) facility with automatic time update shall be provided.
- xi) All the peripherals shall conform to the following minimum requirement but the exact make & model shall be as approved by Employer during detailed engineering. The LAN to be provided under HMIPIS shall support TCP/IP protocol (Ethernet connectivity) with OPC RDI for interface with PLCs/other systems and shall have data communication speed of min. 100 MBPS. All network components of LAN and Workstations shall be compatible to the LAN, without degrading its performance.

Engineering Workstations/ Operator Workstations/ Historian/ Portable EWS

Sl No.	Features	Industrial Grade Engineering Cum Operator Workstations/ Operator workstations/ Other workstations/ Documentation station
1.	Processor	Engineering Cum Operator Workstations: 64 bit Server Grade (Xeon or Equivalent), Octacore minimum For other Workstation: 64 bit (i5 or Equivalent)
2.	Memory	Engineering Cum Operator Workstations: 16 GB RAM upgradable to 24 GB minimum For other Workstation: 8 GB RAM upgradable to 16 GB
3.	Hard Disk	Engineering Cum Operator Workstations: 1 TB RAID1 For Historian: 1 TB ultra wide RAID1 For other Workstation: 500 GB ultra wide RAID1 for OWS/ 500 GB for Portable EWS

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	Communication port	Engineering Cum Operator Workstations: 2 Serial bus. Expansion slot=2 For other Workstation: 4 Serial bus, Expansion slot=2 Portable EWS: 2 Serial bus.
4.	Monitor (color)	Min 22" TFT Flat Monitor with non-interfaced refresh rate min. 75 Hz, Graphic Memory = 16 MB
5.	Removable bulk storage drive	2 TB (minimum)
6	Network Connectivity	Engineering Cum Operator Workstations: 4 Nos. Built-in Ethernet Network Port
		For other Workstation: 2 Nos. Built-in Ethernet Network Port Portable EWS: 1 No. Built-in Ethernet Network Port and 1 No. Wifi
7.	DVD RW	16x or higher for EWS and OWS
8.	Keyboard	ASCII
9.	Pointing Device	Mouse
10.	Additional general purpose software (for using over network by servers/work stations /P Cs)	Comprehensive disk maintenance utility for disk clean sweep/ crash guard/antivirus, etc.
11.	Software	MS. Windows latest, MS Office Editor (EXCEL,WORD, POWER POINT), Adobe Acrobat, Anti Virus, Network Security, Etc.

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Sr	Features	Networked Color Laser Printer
1	Paper Size	A3
2	Printing Speed (min.)- in normal mode for A4 size paper	6 ppm (Color) 24 ppm (B&W)
3	Type	Heavy duty, at least 50000 pages/month
5	First page out time (with full graphic display)	=<1 min for color, <45 sec for BW
6	Paper input capacity (min.)	500 sheets
7	Additional features	Automatic Duplex Printing
8	Paper sheets (1 ream = 500 sheets) with printer (To be supplied with printer)	10 reams (A3) , 20 reams (A4)

FACTORY ACCEPTANCE TEST (FAT)

FAT procedure shall be submitted by bidder for BHEL/NTPC approval and after approval of FAT procedure, FAT will be witnessed by BHEL/NTPC Engineering or authorized representative of BHEL/NTPC . SCADA shall communicate with all third party devices which are part of BESS System and the same shall be demonstrated during the FAT.

TIME SYNCHRONISATION EQUIPMENT

Time Synchronization equipment shall be provided and shall be located in the Control Room. It shall receive Coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite (GPS) for time synchronization of all components of the SCADA.

It shall be complete in all respects including antenna, all cables, processing equipment, etc.

All auxiliary systems and special cables required for synchronization of the equipment shall be supplied and commissioned by the Contractor.

It shall work from DC supplies only and the Contractor to clarify if any built-in battery backup is provided, in which case, same shall be of long life lithium batteries.

It shall be immune to hostile electrical environment. Suitable protections are to be provided against lightning surges and over-voltages in power supply systems and antenna feeders.

The system shall be fully tested to the relevant international standards such as IEC: 801 and IEC: 255.

All components of the SWYD SAS, including Substation Controllers, Workstations, Bay Control Units (BCU) and Bay Protection units (BPU) and all numeric protection relays, PCS, BMS etc covering all equipments of BESS shall be synchronized with an accuracy of 1ms.

The GPS shall be synchronized with the SCADA system to be supplied under this contract. Necessary software and Hardware (including laying of communication cable) required for time synchronization with SCADA and all other devices shall be in scope of contractor.

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The system should be able to track more than 1 satellite at a time to ensure no interruptions of synchronization signals.

The system shall have provisions for combination of any of the following output signals:

- NTP (network time protocol) 100Mbps Ethernet port
- IRIG-B00x (TTL, pulse width modulated signal)
- 2 x Pulse per half-hour/ Pulse per minute/ Pulse per second outputs via potential free contacts
- Any other output port as may be required for the offered system.
- Alarm status contact indicating healthy status of system

These output ports shall be compatible with the requirement of the equipment to be synchronized i.e. BCUs/ BPUs/Numerical Relays/IEDs etc as per scope of the specification. The master clock in control room shall also be synchronized with the time synchronization system. The actual port requirements (no./type) in line with the system offered shall be finalized during detailed engineering.

The equipment should have a periodic time correction facility of one-sec. periodicity. The equipment shall also have real time display in hour, minute, second (24 hour mode) and have a separate time display, having display size of approx. 144mm height.

POWER QUALITY METER

Class-A Power Quality Meter, which is fully compliant to IEC61000-4-30, shall be provided and shall be located at the indicated metering points.

- It shall have a facility for time synchronization on the NTP protocol from the existing GPS clock in the BESS SCADA network.
- PQM at the minimum shall measure three-phase voltage & current, power factor, active power, reactive power, harmonics (amplitude and phase), voltage Sag and swell, flicker, disruptions. It should have capability of recording 10 second fault recording during LVRT and HVRT phenomenon as per CEA regulation
- It shall be able to communicate with PPC on Modbus TCP/IP protocol
- Selected PQM shall be able to measure grid frequency with a minimum of two- digit after the decimal point.
- All associated software to be supplied for configuration, monitoring & maintenance of PQM to be installed on the EWS cum OWS.
- Relay shall monitor power quality parameter including DC Injection, create automated daily /event wise reports as per CEA, Grid India, SERC's compliance i.e. IEEE519-2014, EN50160, LVRT/HVRT etc. and provide real time alarms for all power quality measuring parameters.
- The PQM supplied shall be in compliance to RLDC requirement of daily/monthly automatic generation of Power Quality Report as per IEEE/IEC formats. These reports need to be submitted weekly to RLDC. Bidder to refer the WRLDC/SRLDC website of required format of the various power Quality reports for renewable plants.

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A. EMS functionality for the BESS Control: -

The following operation modes of BESS can be set from the EMS system:-

- Automatic mode: This means that a part of the power quantity of the BESS behaves according to the selected operation mode.
- HMI mode or manual mode: in this mode, the operator has the possibility to:
 - Select the operation point
 - Direct control of active and reactive setpoints of the PCS.
 - Command of balance of Plant
- OFF-mode: A BESS is not producing any power. The system is disconnected from the grid.
- STANDBY-mode:- the BESS is connected to the grid, but the IGBT's in the PCS system are in an off-state (i.e. open switching).
Also, the performance of every application mode will be controlled and adaptable by this system. This energy management strategy will be operated by the SCADA in Main Control Room. Any failure in the process or the control system including instrumentation must be detected and logged. This means that the instrumentation, electronic and electrical equipment shall include those failure detections.

A communication with the SCADA system must be possible to receive set points and transmit set points for each application mode. The SCADA should be able to remotely control the BESS. The EMS should allow the SCADA at least the following

- Change the operation mode of each BESS independently
- Start/Stop each application mode appointed to a BESS.
- Change the application mode of each BESS (multiple modes can be selected together)
- Select the amount of power dedicated to each selected application mode.
- Control of control modes based on application for BESS use separately for capacity at each Thermal plant.
- Adapt the parameters needed for the operation of every application mode

The Communication protocol may be IEC 61850 or MODBUS over a serial or Ethernet connection (Modbus RTU or MODBUS TCP). Other solutions can be proposed but are subjected to the approval of the client.

B. EMS functionality for the Plant Control: -

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B.1 The EMS monitors grid and Plant facility variables and should be programmable for selecting the optimum-operating mode of the whole plant through PPC or directly w.r.t. active and reactive power, grid voltage, grid frequency, etc. Additionally, it can receive external set points and automatically adapt the Plant Facility behaviour to the new settings.

The EMS shall perform following functionality to Control the Plant facilities: -

- Communication with grid or SCADA
- Communications with BESS and other power units
- Measuring and processing of the electrical magnitudes at EMS (voltage, current, PF)

Control capability of BESS Inverters, BESS and other power units

The EMS shall allow following operation modes for the Plant facilities:

- Reactive Control (Q Control, setting point of reactive power Q at EMS)
- Power Factor Control (PF Control, setting point of $\cos(L)$ at EMS)
- Voltage Control (V closed loop control, setting point of V at EMS)
- Voltage Droop (Reactive power vs Voltage programmable curve or droop)
- Apparent Power Control (S Lim, setting point of S Lim at EMS)
- Active Power Limitation (P Lim, setting point of P Lim at EMS)
- Power Ramp Rate Control (setting point of maximum %Pn/min)
- Frequency Regulation (Power vs Frequency programmable curve or droop)

B.2 In addition to these operating modes, the EMS shall be prepared to work under voltage dips, allowing the PCS to inject the corresponding reactive power to provide the corresponding voltage support at the EMS. The EMS can receive the target values specified by grid operators using a standard protocol (i.e. Modbus TCP/IP) and over different communication media.

C. Measurements

To perform the application modes described above, measurements are needed at the Point of Common Coupling (PCC). The measurements are (but not limited to):

- Voltage measurement: This is needed to perform voltage regulation and reactive power compensation.
- Output power (Active and Reactive): This will be measured with an accuracy précised by the supplier. The measurement equipment should be class 0.2s.
-

D. Control & Power Supply Scheme

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Contractor shall provide the UPS/ DC Power supply of suitable rating to cater all the load requirements of EMS system and its auxiliaries..

E. Software Documentation & Listings

All technical manuals, reference manuals, user's guide etc. in English required for modification/editing/addition/deletion of features in the software of the EMS System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system organization for Employer's review and approval. All The software listings for application software, Project data files etc. shall be submitted by the Contractor. All the EMS Software with license Key shall be handed over to the Owner on the DVD/CD media. All the hardware and software shall be licensed to BHEL/NTPC .

Next Generation Firewall (NGFW) Specification:

General Requirements: -

Contractor shall provide NGFW having electrical ethernet interfaces/ports and placed between FOTE & SAS gateway/s at the substation. All ethernet based applications shall be terminated in the firewall ports directly (e.g. PMU, AMR, VOIP, SAS/SCADA etc.). Each port of firewall shall work as a separate zone. Firewall shall be hardware based with features of Block/Allow/drop and IPSec VPN (network encryption).

The number of ports/interfaces in each firewall (i.e. Main/Standby) shall be minimum 5 nos. TSP shall provide either single firewall or multiple firewalls to meet this interfaces requirement, each for main as well as standby firewall. Minimum throughput of firewall shall be 200 Mbps.

The Firewall shall be managed/ configured as standalone at present and shall also have compatibility to manage/configure through Centralized Management Console (CMC) remotely in future.

Firewall shall be tested and certified for ISO15408 Common Criteria for least EAL4+.Further, the OEM must certify that it conforms to Secure Product Development Life Cycle requirements as per IEC62443-4-1. The firewall shall generate reports for NERC-CIP Compliance.

Detail Specifications of Next Generation Firewall (NGFW)

1. NGFW shall have following features including but not limited to:

2. Encryption through IPSec VPN (Virtual Private Network), Deep Packet Inspection (DPI), Denial of service (DoS) & Distributed Denial of Service (DDoS) prevention, Port Block/ Allow, rules/ policies for block/allow, IP (Internet Protocol) & Media Access Control (MAC) spoofing protection, threat detection, Intrusion Prevention System (IPS), Anti-Virus, Anti-Spyware, Man In The Middle (MITM) attack prevention The proposed firewall shall be able to handle (alert, block or allow) unknown/unidentified applications e.g. unknown TCP & UDP packets. It shall have the provision to define application control list based on application group and/or list.

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3. Firewall shall have feature and also have capability to update the definition/ Signatures of Anti-Virus online as well as offline. Firewall shall also be compatible to update the definitions/signatures through CMC. There shall be a defined process for security patching and firmware up-gradation. There shall be a feature to field validate firmware checksum. The same shall also be validated before using the OEM provided file/binary in the process of firmware up- gradation and security patching.

4. Firewall shall have Management Console port to configure remotely.

5. Firewall shall be EMI/EMC compliant in Substation environment as per IEC 61850-3.

6. Firewall shall be rack mounted in existing standard equipment cabinets.

7. Firewall shall have support of SCADA applications (IEC-60870-5-104), ICCP, PMU (IEEE C37.118), Sub-Station Automation System (IEC 61850), Ethernet and other substation environment protocols.

8. Client based Encryption/ VPN must support different Operating System platforms e.g. Windows, Linux & Mac.

9. The solution must have content and comprehensive file detection policies, blocking the files as function of their types, protocols and directions.

10. Firewall shall have logging facility as per standard logs/events format. Firewall shall have features to export the generated/stored logs/events in csv (Comma Separated Value) and also any other standard formats for offline usage, analysis and compliance. Firewall shall have suitable memory architecture and solution to store and be enable to export all logs/events for a period of last 90 days at any given time.

11. Firewall shall have features and be compatible with local as well as central authentication system (RADIUS, LDAP, or TACACS+) for user account and access right management. It shall also have Role Based User management feature.

12. Firewall shall have the capability to configure sufficient number of VLANs.

13. Firewall shall have the capability to support sufficient number of sessions.

14. Firewall shall have provision to configure multiple IP Sec VPNs, at least 100 nos., (one-to-many or many-to-one). Shall support redundant operation with a similar router after creation of all the IP Sec VPN. IPSec VPN shall support encryption protocols as AES128, AES256 and hashing algorithms as MD5 and SHA1. IPSec VPN throughput shall support at least 200 Mbps.

15. Firewall shall be capable of SNMP v3 for monitoring from Network Management system. It shall also have SNMPv3 encrypted authentication and access security.

16. Firewall shall support in Active/Passive or Active-Active mode with High Availability features like load balancing, failover for firewall and IPsec VPN without losing the session connectivity.

17. Firewall should have integrated traffic shaping (bandwidth, allocation, prioritisation,

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etc.) functionality.

18. Shall support simultaneous operation with both IPv4 and IPv6 traffic.

19. Firewall shall be compatible with SNTP/NTP or any other standards for clock synchronization.

20. Firewall shall have the features of port as well as MAC based security.

21. Firewall shall support exporting of logs to a centralized log management system (e.g. syslog) for security event and information management.

22. Firewall time shall be kept synchronised to official Indian Timekeeping agency, time.nplindia.org.

Firewall product shall be provided with all applicable updates at least until 36 months since the applicable date of product shipping to the concerned utility.

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INSTRUMENTATION AND COMMUNICATION CABLE

COMMUNICATION CABLE (Optic Fibre Cable)

Optic Fiber cable shall be **8/12** core, galvanized corrugated steel taped armored, fully water blocked with dielectric central member for outdoor /indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multimode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturing, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.

The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Steel central number, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum & crush resistance 4000 N minimum. The operating temperature shall be -20 deg. C to 70 deg. C.

All testing of the optic fiber cable being supplied shall be as per the relevant IEC, EIA and other international standards.

Bidder to ensure that minimum 50% (but not less 4) cores are kept as spare in all types of optical fiber cables.

Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground buried installation.

Spliced/ Repaired cables are not acceptable.

Penetration of water resistance and impact resistance shall be as per IEC standard.

Communication Cable (Modbus)

Data (Modbus) Cable to be used shall be shielded type with stranded copper conductor based on VDE 0881. Cable shall have minimum 2 pair each with conductor size of 0.5 SQMM and core identification shall comply with DIN 47100. Cable shall be flame retardant according to IEC 60332-1-2. or equivalent Standard Surge protection device to be provided shall be approved from UL/CSA or any national/international approved lab.

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6.11 INSTRUMENTATION CABLES

Common Requirement

S No.	Property	Requirement
1.	Voltage grade	225 V (peak value)
2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.
3.	Continuous operation suitability	At 70 deg. C for all types of cables
4.	Progressive automatic on-line sequential marking of length in meters	To be provided at every one meter on outer sheath.
5.	Marking to read 'FRLS	To be provided at every 5 meters on outer sheath
6.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet
7.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
8.	Ovality at any cross-section	Not more than 1.0 mm
9.	Others	a) Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided. b) Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground-buried installation c) Repaired cables shall not be acceptable.
10.	Color	The outer sheath shall be of blue Blue

Specific Requirement

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S No.	Property	Requirement
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	Type of Cable	F and G Type cables
A. Conductors		
1.	Cross section area	0.5 sq. mm
2.	Conductormaterial	HighconductivityAnnealed bare copper
3.	Colour code	As per VDE-815
4.	Conductor Grade	Electrolytic
5.	No & dia of strands	7x0.3 mm (nom)
6.	No. of Pairs	4,8,12,16,24,48
7.	Max. conductor resistance per Km (in ohm) at 20 deg. C	73.4 (loop)
8.	Reference Standard	VDE 0815
B. Insulation		
1.	Material	Extruded PVC type YI 3
2.	Thickness in mm (Min/Nom/Max)	0.25/0.3/0.35
3.	Volume Resistivity (Min) in ohm-cm	1 x 10 ¹⁴ at 20 deg. C & 1x10 ¹¹ at 70 deg. C.
4.	Reference	VDE 0207 Part 4
5.	Core diameter above insulation	Suitable for cage clamp connector
C. Pairing & Twisting		
1.	Single layer of binder tape on each pair provided	Yes
2.	Bunch(Unit formation) for more than 4P	To be provided
3.	Conductor /pair identification as per VDE081	To be provided
D. Shielding		
1.	Type of shielding	Al-Mylar tape
2.	Individual pair shielding	To be provided for F-type cabl
3.	Minimum thickness of Individual pair shielding	28 micron
4.	Overall cable assembly shielding	To be provided
5.	Minimum thickness of Overall cable assembly shielding	55 micron
6.	Coverage Overlapping	100% coverage with 20% overlapping
7.	Drain wire provided for individual shield	Yes (for F-type) Size=0.5 mm ² ,No.ofstrands=7, Dia of strands =0.3 mm ,Annealed Tin coated copper
8.	Drain wire provided for	Yes. Size=0.5 mm ² , No.of

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		overall shield	strands=7,Dia of strands=0.3mm Annealed Tin coated copper
	E. FILLERS		
1.		Non-hygroscopic, flame retardant	To be provided
	F. Outer Sheath		
1.		Material	Extruded PVC compound YM1 with FRLS properties
2.		Minimum Thickness at any point	1.8 mm
3.		Nominal Thick-ness at any point	>1.8 mm
4.		Resistant to water, fungus, termite & rodent attack	Required
5.		Minimum Oxygen index as per ASTMD-2863	29%
6.		Minimum Temperature index as per ASTMD- 2863	250 deg.C
7.		Maximum acid gas generation by weight as per IEC-60754-1	20%
8.		Maximum Smoke Density Rating as per ASTMD- 2843	Maximum 60% To be provided (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)
9.		Reference standard	VDE207 Part 5,VDE-0816
	G. Electrical Parameters		
1.		Mutual Capacitance Between Conductors At 0.8 Khz (Max.)	120 nF/km for F type 100 nF/km for G-type
2.		Insulation Resistance(Min.)	100 M Ohm/Km
3.		Cross Talk Figure (Min.) At 0.8 Khz	60 dB
4.		Characteristic Impedance (Max) At 1 Khz	320 OHM FOR F-TYPE 340 OHM FOR G-TYPE

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification **Group : BESS system**

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5.		Attenuation Figure At 1 Khz (Max)	1.2 db/km
H. Complete Cable			
1.		Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.
2.		Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification
I. Tests			
1.		Routine & Acceptance tests	Refer Type Test requirement of Specification for C & I System
2.		Type tests	
J Cable Drum			
1.		Type	Wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to the entire drum) or steel drum.
2.		Outermost layer covered with waterproof paper	Yes
3.		Painting	Entire surface to be painted
4.		Length	1000 m + 5% for up to & including 12 pairs 500 m + 5% for above 12 pairs

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6.12 EARTHING SYSTEM

GENERAL REQUIRMENTS

This specification is intended to outline the requirement of earthing (grounding) for Battery System (DC) side and AC Power block side of BESS Project. It is not the intent of the specification to specify all details of design and construction since the bidder has full responsibility for engineering and implementation of earthing system meeting the intent of the specification and functional requirement. Any additional equipment, material, services which are not specifically mentioned herein but are required for successful installation, testing and commissioning of earthing system for safe and satisfactory operation of the plant shall be included under scope of the bidder.

Earthing requirement for outdoor metering yard/Switchyard has been mentioned elsewhere in the specification and hence shall be excluded from scope of this chapter unless earthing requirement of metering yard/Switchyard is specifically mentioned in this chapter.

Electrical Resistivity Test (ERT) of the soil is included in the scope of bidder.

EARTHING DESIGN REQUIRMENT

The object of protective earthing system is to provide as nearly as possible a surface under and around a station which shall be at a uniform potential and as nearly zero or absolute earth potential as possible. The purpose of this is to ensure that, in general, all parts of apparatus other than live parts, shall be at earth potential, as well as to ensure that operators and attendants shall be at earth potential at all times. Also by providing such an earth surface of uniform potential under and surrounding the station, there can exist no difference of potential in a short distance big enough to shock or injure an attendant when short-circuits or other abnormal occurrences take place.

Care must be taken for equipment with functional earthing that its service is not disrupted due to undesired disturbances in protective earthing system.

CODES AND STANDARD

The equipment/product furnished for earthing system shall meet the requirements of all the applicable relevant National/International codes and standards or their latest amendment Codes and Standards. Product certification has to be CE/UL/BIS/TUV or equivalent. The relevant codes and standard for earthing system are tabulated below.

IS: 3043	Code of practice for Earthing.
IEEE: 80	IEEE guide for safety in AC substation grounding
IEEE: 837	Standard for qualifying permanent connections used in substation grounding
IS: 2309	Code of Practice for the protection of building and allied structures against lightning.
IS: 802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.

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SOLAR BUSINESS DIVISION
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IS: 2629	Recommended practice for hot dip galvanizing of iron & steel
IS: 2633	Method for testing uniformity of coating on zinc coated articles
IS: 513	Cold rolled low carbon steel sheets and strips
IS: 6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS 2062	HOT ROLLED MEDIUM AND HIGH TENSILE STRUCTURAL STEEL – SPECIFICATION
IS: 4736	Hot-dip Zinc coating for MS Tubes.
IS: 458	Precast Concrete Pipes (With and Without Reinforcement)
UL-467	Grounding and Bonding Equipment
IEC 62561-7	Requirements for earthing enhancing compounds
	CEA regulations for electrical safety-2010
	Indian Electricity Rules/ Indian Electricity Act.

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standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (codes and standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the above standards/ codes as applicable.

The earthing system includes earth electrode, installation of earth electrode in suitable pit size, construction of earth pit with cover for the installation, connection of earth electrode with equipotential earth bus and connection of equipment to equipotential earth bus.

Earth Electrode

The earth electrode is in direct contact with the ground provides means for conducting earth current with ground. Earth Electrode material should have good electrical conductivity and mechanical strength and should not corrode in wide variety of soil conditions. For an effective earthing system, following type of vertical earth electrodes can be used.

- I. MS Rods
Hot rolled, Medium or High Tensile Steel Rod as per IS 2062 of length not less than 3000 mm.
- II. Copper Bonded Rods
High tensile-low carbon steel rod having diameter not less than 14/17 mm of Length 3000 mm to be selected based on earth fault current. The Rod shall comply with requirements of BS 4360 Grade 43A or EN10025:2-004 S275JR, molecularly bonded by 99.99% pure high conductivity copper on outer surface with copper coating thickness 250 micron or more in conformity to UL-467. Its surface shall be clean, free from mechanical defect and any visible oxide layer or foreign material.

Earthing Enhancement Compound

A low resistance earth electrode system is important to provide a low impedance path for the better dissipation of lightning/fault currents, and to protect personnel and equipment by minimizing and equalizing voltage potential differences. Earthing (ground) enhancement materials shall be used to improve the ground electrode resistance. Earth enhancement material shall be a superior conductive material which improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It shall be tested and should conform to the requirements of IEC 62561-7. It shall have the following characteristics:-

- a) High conductivity, improves earth's absorbing power and humidity retention capability, non-corrosive in nature having low water solubility but highly hygroscopic.
- b) Carbon based with min 95% of fixed carbon content premixed with corrosion resistant cement to have set properties. Cement shall not mix separately & shall not have Bentonite.
- c) Resistivity of less than 0.2 ohms -meter.
- d) It shall not depend on the continuous presence of water to maintain its conductivity and shall be permanent & maintenance free and in its "set form", maintains constant earth resistance with time.
- e) It shall not dissolve, decompose or leach out with time and shall be environmental friendly, suitable for soils of different resistivity and any kind of earth electrode.

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The Earth enhancement material shall be supplied in sealed, moisture proof bags, marked with Manufacturer's name or trade name, quantity etc. The minimum quantity of earth enhancement compound to be used with each earth- pit shall be 25 Kg.

Earthing conductor

Earthing conductor is the conductor for buried below the ground at the depth of 600 mm connecting earth pits to make interconnection of earth pit. To interconnect earth pits, following type of conductor can be used. Application of specific conductor and its size has been mentioned in relevant technical part

- I. Galvanised Steel Flat (GS) Flat
GS/GI Flat (Strip) conductor shall comply to IS 2026 with Galvanization of 85 Micron as per IS. Material shall be clean and free from mechanical defects.
- II. Copper Clad Steel (CCS) Earthing Conductor
The Copper Bonded Steel Grounding Conductor shall be made of steel with the coating of 99.99% pure copper complying to ASTM B 869-96 and ASTM B 452-93 standards. Each strand of CCS shall have continuous, uniform coating and the conductor surface shall be smooth and free from mechanical defects.
- III. MS Rod
Hot rolled, Medium or High Tensile Steel Rod as per IS 2062 of length not less than 3000 mm and diameter of 40 mm.

Earthing Technical and Installation Requirement

Careful consideration should be given to installing an earthing system that meet or exceed statutory requirements. Contractor shall select certified product and ensure good workmanship for installation for satisfactory performance to fulfill the designed parameters all the times. Following care shall be taken while installation of earthing.

Metallic frame/ structure of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and Armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and Armour of single core cables shall be earthed as per requirement mentioned elsewhere in the specification. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable. Metallic column for Inverter/Switchgear shelter/E-house shall be earthed with two distinct connections at minimum two column. All

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the wall cladding section shall be earthed at minimum two location with flexible copper cable of not less than 50 sq. mm.

- II. Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground.
- III. Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.
- IV. The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.
- V. Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti-corrosive paint/compound.
- VI. Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.
- VII. Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding. Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.
- VIII. Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.
- IX. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines steel reinforcement in concrete, it shall be bonded to the same. Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.
- XI. Earth pit shall be constructed as per IS:3043. Electrodes shall be embedded preferably below permanent moisture level. Minimum spacing between electrodes shall be 600mm.
- XII. Earth pits shall be treated with earth enhancement compound if resistivity is more than 20 ohm meter.
- XIII. On completion of installation, continuity of earth conductors and efficiency of all bonds

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and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.

- XIV. Contractor shall obtain all necessary statutory approvals for the earthing system before charging of the plant and electrical equipment.

TECHNICAL DETAILS FOR AC EARTHING SYSTEM

This section outlines the requirements of protective and functional earthing system to discharge AC fault current to earth and provide equipotential bonding for Transformer, HT and LT Switchgear Panel and other similar electrical equipment, Transformer neutral and shield.

The Contractor shall furnish the detailed design and calculations as per IEEE 80/IS 3043 for Employer's approval for equipment earthing.

1. Conductors above ground level and in built up trenches
-Galvanized steel
2. Conductors buried in earth -Mild steel rod of 40 mm dia
(Any alternate proposal by bidder shall be reviewed and decided during detailed engineering based on requirement)
3. Earth electrodes - Mild steel rod of diameter 40mm or
Copper bonded.
steel rod of dia not less than 17 mm
4. Life Expectancy - 25 years
5. Fault Level - Mentioned Elsewhere
6. Min. Steel corrosion - As per IS 3043
7. Soil Resistivity -Actual as per site condition

The sizes of earthing conductors for various electrical equipment shall be as below:

S No.	Equipment	Earth Conductor buried in Earth	Earth conductor above ground level and in built up trenches
1	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	--	65 x 8mm GS flat
2	415 V MCC/ Distribution boards / Transformers	--	50 x 6mm GS flat
3	LT Motors above 125 KW	--	50 x 6mm GS flat
4	LT Motors 25 KW to 125 KW	--	25 x 6mm GS flat
5	LT Motors 1 KW to 25 KW	--	25 x 3mm GS flat
6	Fractional House power motor	--	8 SWG GS wire
7	Control panel & control desk	--	25 x 3 mm GS flat/25 sq mm Cu cable

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8	Push station/Junction Box	--	8 SWG GI wire
9	Columns, structures, cable trays and bus ducts enclosures	--	50 x 6mm GS flat
10	Crane, rails, rail tracks & Other non-current carrying metal parts	--	25 x 6mm GS flat

conductor shall ensure there at least two earth pits each dedicated for earthing of each Transformer, HT/LT Switchgear panel, transformer neutral, Battery Charger/UPS/Control Panel etc. shall be provided. Earth electrode shall be located near to the equipment and all earth electrodes shall be interconnected with parallel conductor buried in earth surrounding the equipment.

Earthing system of different locations such as Inverter room/Pooling Switchgear/Sub pooling switchgear/Inverter shelter etc. shall be interconnected in single network of earthing with buried conductor of the size 65X8 MS Flat laid at 600 mm depth (**if specifically required to achieve the earth resistance value within the acceptable limit based on the soil property of site**). Contractor shall submit the calculation based on the system of earth conductor and electrode connected in single network. Location and manner of interconnection shall be approved during detail engineering.

Bidder shall also interconnect the earthing system of BESS System with BHEL/NTPC existing earthing system wherever available (**applicable for BESS Projects being setup inside existing BHEL/NTPC Projects**).

For functional earthing of electronic component such as SCADA, contractor shall provide 1 no. (Min) isolated earth electrode near to the equipment connected with 2 run of copper cable of size not less than 25 sqmm. Contractor shall comply to the recommendation of OEM (Original Equipment Manufacturer) for electronic earthing and electrode can be connected with other earth electrode as per recommendation of OEM.

Each inverter duty transformer having shield between HV and LV winding shall be provided with 2 nos. Isolated earth electrode connected with each other for functional earthing of transformer shield. Each electrode shall be connected with transformer shield with separate 25X6 Cu flat.

DC EARTHING SYSTEM :

The Battery system and PCS system and DC side shall be earthed as per Manufacturer recommendation and subject to approval during detail engineering.

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6.13 PLANT ILLUMINATION SYSTEM

This chapter covers supply and installation of suitable illumination system along the approach roads to inverter room and inverter room(s), transformer yard and other facilities inside the plant.

DESIGN PHILOSOPHY

A comprehensive illumination system shall be provided in the entire project.

All outdoor lighting system shall be automatically controlled by synchronous timer or photocell. Provision to bypass the timer or photocell shall be provided in the panel.

LIGHTING SYSTEM DESCRIPTION for Main Control room and inverter room

Normal AC Lighting System: AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels Control Board (LPs) which in turn will be fed from the lighting distribution boards (LDBs) of AC Switch board MCC.

Emergency AC Lightning System: The emergency lighting system consisting of 20% of the lights shall be fed from UPS DB or DCDB as per scheme adopted by the EPC bidder. Load of the same has to be considered for UPS/ Battery and charger sizing. Bidder shall provide indoor and outdoor emergency lighting at each inverter room, main control room, security room and main gate.

Lighting Fixture, Lamps & Accessories

- a. All lighting fixtures and accessories shall be designed for continuous operation for its life under atmospheric conditions existing at site.
- b. AC lighting fixtures and accessories shall be suitable for operation on 240 V, AC, 50 Hz supply with supply voltage variation of +/-10%, frequency variation of +/- 5% and combined voltage and frequency variation (absolute sum) of 10% DC lighting fixtures and accessories shall be suitable for operation on 220 V, with variation between 190 V & 240 V.
All lighting fixtures shall be complete with lamp(s), lamp holder(s), LED chip assembly, terminal blocks, clamps, locking arrangements, fixing brackets etc. Driver circuit/Control gears shall be provided as applicable / specified. The fixtures shall be fully wired upto terminal block. The internal wiring of the fixtures shall be done with suitable low smoke halogen free thermo-plastic or silicon rubber insulated or fire retardant PTFE copper conductor wires of suitable size and type. Further fuse protection of suitable rating in input side shall also be provided specifically for LED luminaires. However, the normal cross section of conductor shall be not less than 0.5 Sq. mm and minimum thickness of insulation shall be 0.6 mm. The wiring shall be capable of withstanding the maximum temperature to which it will be subjected under specified service conditions without deterioration and affecting the safety of the luminaire when installed and connected to the supply. All fixing /locking screws, washers, nuts, brackets, studs etc, shall be zinc plated and passivated.
- d. All lighting fixtures shall be provided with an external, brass/GI earthing terminal suitable for connecting 14 SWG, GI earthing wire. All metal or metal enclosed parts of the housing and accessories shall be bonded and connected to the earthing terminal as so to ensure satisfactory earthing continuity through out the fixture
- e. The lighting fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection
- f. The reflectors shall be manufactured from CRCA sheet steel or Aluminium as specified. The aluminium reflectors shall be made of high purity aluminium sheet, polished

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- electrochemically brightened and anodized or proven alternate arrangement of anodizing
- g. Starters shall have bi-metal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without use of any tool. Starter shall have brass contacts and radio interference suppressing capacitor.
- h. LED luminaires body shall such designed that heat sink/heat dissipating housing shall be mounted outside the overall luminaires fixture housing, and shall be suitably clearing the driver circuit. Further for outdoor type LED luminaires, the exposed heat sink shall be suitably designed to avoid dust/foreign particles accumulation on the same.
- i. LED luminaires housing/body shall be pressure die cast aluminum or extruded Aluminium or CRCA as specified along with finished powder coating. Care shall be taken in the design that there is no water stagnation anywhere.

LED Luminaires: CODES

AND STANDARDS

All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of techno- commercial bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.

16101:2012	General Lighting. LEDs and LED modules Terms and definitions
16102(Part 1):2012	Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements.
16102(Part 2):2012	Self Ballasted LED Lamps for General lighting Services. Part-2 Performance Requirements.
16103(Part I):2012	LED modules for General lighting Safety Requirements.
15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c. Supplied Electronic control gear for LED modules
16104:2012	d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.
16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.
16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products
16107:2012	Luminarie Performance
16108:2012	Photobiological safety of Lamps and Lamp Systems
IS 513	Cold rolled low carbon steel sheets and strips

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IS 12063	Classification of degree of protection provided by enclosures.
IS 14700 2)	Electro magnetic compatibility (EMC) - Limits (Part/Sec. for Harmonic emission - THD < 15% (equipment, input current < 16 Amps. per phase.
IS 9000 (Part 6)	Environment testing: Test Z – AD: composite temperature/humidity cyclic test.
IS 15885 13)	Lamp control gear: particular requirements for (Part 2/Sec. DC or AC supplied electronic control gear
IS 16004 - 1 and 2)	for LED modules.
IS 4905	Method for random sampling
IEC 60598	Ingress protection, luminaire performance and safety
IEC 61000-3-2	Total Harmonic Distortion
IEC 61000-4-5	Surge Protection
IES-LM 80 along with Lumen Depreciation and Rated life of LED chip TM 21/ IS6105	

IES-LM 79 / IS 16106 Luminaire optics and color parameter and electrical parameter

LED LIGHTING SYSTEM

LED Luminaires shall be used for the lighting of all the indoor & outdoor areas. However for DC lighting & hazardous areas conventional type luminaires shall be used. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type.

The individual lamp wattage for LED shall be upto 3 watt for outdoor type luminaires. However for indoor type luminaires fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall not be less than 80 Lm/W. Heat sink/heat dissipation arrangement shall be provided in the luminaires. The LED used in the luminaires shall have colour rendering index (CRI) of Min 70 and 80 for outdoor and indoor luminaires respectively.

Colour designation of LED shall be “cool day light” (min 5700K) type for indoor type LED luminaires. Further for outdoor type luminaires, the colour designation shall be 5000K, except for well glass type LED luminaires, where the colour designation shall be 4000K. The LED luminaires shall have minimum life of 25,000 burning hours with 80% of lumen maintenance at the end of the life.

The beam angle for LED chip for indoor type luminaires shall be 120 degrees. However for highbay & flood light type outdoor luminaires the LED chip with suitable beam angle shall be used to deliver better lumen-output. The maximum junction temperature of bare LED without heat sink shall be limited to 85 deg C, further the lumen maintenance at this temperature shall be min 90%. The THD of tube light based LED Luminaires shall be less than 20%. For other type of luminaries, it shall be minimum 10%.

Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink/ heat dissipation arrangement, with proper thermal management shall be designed for the luminaires.

Driver Circuit: LED modules and drivers shall be compatible to each other. The LED module

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driver's ratings and makes shall be as recommended by corresponding LED manufacturer.

LED Drivers may have following control & protections:-

- Suitable precision current control of LED.
- Open Circuit Protection
- Short Circuit Protection
- Over Temperature Protection
- Overload Protection
- Surge Protection

Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have IP55 degree of protection (for outdoor panels) and IP-4X for indoor panels (inside buildings).

Wires of different phase shall normally run in separate conduit.

Power supply shall be fed from 415 / 240 V normal AC supply through suitable number of conveniently located lighting distribution boards (LDB) and at least one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc.

Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for welding purposes at one location.

Incandescent lamps may be used only with DC Lighting.

Electrification of all building shall be carried out as per IS 732-1989, IS 4648-- 1968 and other relevant standards.

Indoor Lighting fixtures shall generally be controlled from switch boxes of each area not directly from lighting panel. Each switch shall control a maximum of three fixtures.

All luminaries and their accessories and components shall be of type readily replaceable by available Indian makes.

Following test reports to be submitted for LED chip/LED luminaires:

- a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.
- b) LM 80/IS: 16105 report.
- c) LM 79/IS: 16106 report

JUNCTION BOXES, CONDUITS, FITTING & ACCESSORIES

Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type.

Junction boxes for street lighting poles and lighting mast if applicable, shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized.

The degree of protection shall be IP55.

All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox & plate.

Conduits, Pipes and Accessories:

Heavy duty PVC conduits conforming to IS: 9537 Part-III along with various accessories shall be used for indoor wiring in the buildings. These conduits shall be concealed in the wall/floor/roof. However, in PEB's, conduits can be fixed on surface.

Pull out boxes shall be provided at suitable interval in a conduit run. Boxes shall be suitable for mounting on Walls, Columns, etc. Pull-out boxes shall have cover with screw. Pull out boxes used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 4X degree of protection.

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LIGHTING WIRES

Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R,Y,B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper.

LIGHTING POLES

The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. Height of the poles should be chosen so as not to affect working of Solar panels in vicinity (if any). The poles shall be hot-dip galvanized as per relevant IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875 considering prevailing soil/ site condition considering all accessories mounting on pole. The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB. Lighting shall be provided along boundary/periphery and at roads connecting Boundary Gate to strategic locations like CMCS/Switchyard (Avg 10 Lux). Hot dipped Galvanized hexagonal/Octagonal lighting pole with inbuilt JB shall also be acceptable.

EARTHING

Lighting panels, etc. shall be earthed by two separate and distinct connections with earthing system. Switch boxes, junction boxes, lighting fixtures, fans, single phase receptacles etc. shall be earthed by means of separate earth continuity conductor. The earth continuity conductor 14 SWG GI wire shall be run along with each conduit run. Cable armours shall be connected to earthing system at both the ends.

AVERAGE ILLUMINATION LEVEL

Control Room	300	LED Luminaries
Store Room	200	LED Luminaries
Switchgear Room	150	LED Luminaries
Inverter Room	150	LED Luminaries
Street lighting-Roads Cl 7.0 above	10	LED Luminaries
Yard/ Substation/MCS etc	20(general) 50(on strategic equipment)	LED Luminaries

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6.14 AUXILIARY POWER SUPPLY SYSTEM

GENERAL

Auxiliary power supply arrangement shall be in line with tender SLD. ACDB in Control room shall have two incomer (100% rated) fed from two different sources. Following consideration shall be taken while arriving kVA capacity of auxiliary transformer,

1. 20 % future load margin.

All non-critical auxiliary loads shall be fed directly from ACDB. However, emergency, and important load shall be fed from suitable sized Uninterrupted Power Supply (UPS) or Battery system. Input AC supply for Uninterrupted Power Supply (UPS) and Battery Charger shall be fed from ACDB. Bidder shall consider the following one of the supply options for feeding different equipment loads:

Sl No	Equipment Name	Option-1 ACDB	Option-2 UPS AC	Option-3 Battery DC supply
1.	SCADA including remote RTU/IO panel		✓	✓
2.	SCADA HMI		✓	✓
3.	Data logger		✓	✓
4.	Fire Detection /Alarm Panel		✓	✓
5.	Emergency Lighting		✓	✓
6.	CCTV (if applicable)		✓	✓
7.	HMI of SCADA		✓	✓
8.	Inverter's Auxiliary supply (if applicable)		✓	✓
9.	Energy Meter/MFM		✓	✓
10.	Sub and Local Pooling Switchgear control & protection		✓	✓
11.	Main Pooling Switchgear (CMCS) control & protection			✓
12.	Switchgear spring charging motor		✓	✓
13.	switchgear space heater	✓		
14.	Illumination, Fan supply etc	✓		
15.	Module washing system	✓		
16.	Other non-critical auxiliary loads	✓		
17.	Switchyard control and protection			✓
18.	Switchyard PLCC			✓

1. UPS system shall comprise of 2 x 100% UPS with 30 minutes backup for each. Each UPS shall consist of 1x100% charger and inverter, 1 x 100% Battery bank for providing required backup as above. Bypass Line static switch, manual bypass switch, 1 x 100% UPSDB, and other necessary Protective devices and accessories. In place of UPS, bidder can provide DC supply system (1 x 100% Battery with Charger system for inverter stations/sub-pooling systems and 2x 100% system for main control room) with backup as indicated as above, if the auxiliary power supply requirement of the loads is in DC.
2. Each Battery with charger system shall consist of 1 x 100% charger and 1 x 100% Battery bank for required back up and 1 x 100% DCDB, and other necessary protective devices and accessories. DC supply system voltage shall be 12V or above upto 220V DC.
3. The rated AC output capacity shall be taken for UPS battery size calculation. However, the

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- minimum UPS rating shall be 2KVA and the battery sizing shall be calculated on a minimum load of 1 KW (DC) for required backup. All UPS having rating 5KVA or more shall have three phase input.
4. The Bidder can provide alternate arrangement with suitable redundancies such as power pack with required backup for switchgears/RMUs located at local pooling/inverter station.
 5. BESS Control Room shall be powered from 2X100% DC supply system. Each DC supply system shall consist of 1x100% charger, 1 x 100% station Battery bank rated 110V/220VDC (+10%,-20%) for providing minimum 30 minutes backup and DC switchgear. In case UPS fed from above DC supply system, in that case separate DC system for UPS is not required.
 6. Requirements of DC supply system for switchyard is mentioned in switchyard chapter. Bidder can offer common DC system for both switchyard and Main Control room, but their individual requirements must be met.
 7. For Main Control room, each UPSDB shall have two incomers fed from two separate UPS and one bus coupler. Similarly, each DCDB/DC switchgear shall have two incomers fed from two separate Battery-Charger and one bus-coupler.
 8. DC system shall be design in such way that it is possible isolate the battery and charger for boost charging of batteries, while corresponding DC switchgear section shall be capable of being in service and continue to supply the DC load by closing of bus coupler.
 9. Bidder shall submit configuration diagram, power supply distribution scheme, single line diagram and data sheets, all calculations such as Rectifier Modules/UPS Charger/Inverter rating calculations, battery sizing calculation etc. for UPS, Battery Charger & Battery system during detailed engineering stage for employer's review and approval.
 10. Size and rating of UPS, Battery Charger and Battery shall be finalized during details engineering stage. Following shall be considered for sizing calculation;
 11. UPS load power factor shall be taken as 0.8 lagging.
 12. UPS efficiency shall be taken as per actual.
 13. UPS and charger design margin shall be taken 10% at 50 deg C.
 14. IEEE-485 standard shall be followed for sizing calculation of Lead Acid Batteries and IEEE-1115 standard shall be followed for sizing calculation of Nickel-Cadmium batteries.
 15. For Battery sizing calculation, lowest electrolyte temperature shall be taken as 5 deg C more than the minimum ambient temperature or 15 deg cel whichever is lower, with Temperature correction factors as per relevant standards.
 16. Batteries aging factor shall be taken as 1.25 and design margin factor shall be taken as 1.10.

UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM

1. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The overall efficiency of UPS shall be at least 80% on full load.
2. The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.
3. For UPS capacity 5 kVA or more, in addition to indications/display on UPS panel, important alarms along with important analog signal shall also be provided for use in SCADA. For UPS capacity less than 5 kVA bidder shall provide status, common alarm, and trip DI (soft or hard) signal to SCADA
4. The UPS chargers shall be self-regulating, solid-state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates. The charger should be capable to fully charge the required batteries as well as supply the full rated load

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through inverter. The charger shall be able to re-charge the fully discharge battery within 8 hours. The charger shall be design for input supply variation of $\pm 10\%$ and frequency variation of $\pm 5\%$. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. The detailed specification for the battery charger for UPS rating of 5kVA and above has been mentioned in the battery charger section below in this specification.

5. The UPS inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro- resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts single phase, 50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, etc. The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum.
6. The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from faulty inverter to standby AC source.
7. Manual bypass switch shall be employed for isolating the UPS during maintenance.
8. Contractor has the option of supplying either Nickel Cadmium type batteries or Lead Acid Plante type batteries. The detailed specification for the batteries has been mentioned in the battery and charger section below in this specification.
9. Equipment enclosures shall match and line up in assemblies of freestanding floor mounted cabinets designed for indoor service.
10. Individual enclosure shall be ventilated switchboard type fabricated from not less than 1.6-mm thick sheet steel. Enclosures shall be furnished with concealed hinges. Front and rear doors shall be designed to permit easy access to all components for maintenance or replacement. The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three point latches.
11. Adequate ventilating louvers and enclosure top panels shall be included. All vent openings shall be covered with corrosion resistant fine screen coverings.
12. The cabinets shall be IP-42 protection class for indoor application and IP55 or better for outdoor application.
13. The temperature rise inside all the cabinets/enclosures shall not exceed 10 deg.C above ambient temperature.
14. The Contractor shall also carry out the site tests on UPS as required to be conducted as a standard practice of the UPS manufacture or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer.
15. One set of tools shall be provided for maintenance and testing purposes.

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BATTERY CHARGER

1. The chargers shall be self-regulating, solid-state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimize harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load. Furthermore, the charger should be able to re-charge the fully discharged battery within 8 hours. The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. The charger shall be design for input supply voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$.
2. Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. whether trickle or Boost charging.
3. All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. Means shall be provided to avoid current/ voltage surges of harmful magnitude/nature which may arise during changeover from Auto to Manual mode or vice-versa under normal operating condition.
4. Soft start feature shall be provided to build up the voltage to the set value slowly. 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 neither 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.
5. When on automatic control mode during Trickle charging, the Charger output voltage shall remain within $\pm 1\%$ of the set value for AC input voltage variation of
6. $\pm 10\%$, frequency variation of $\pm 3\%$, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from zero to full load. Uniform and step-less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire Trickle charging output range specified & shall be capable of matching the float voltage correction recommendations (w.r.t. temperature) as suggested by the respective battery manufacturer. Step-less adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Trickle charging mode.
7. During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service). It shall be possible to adjust the Boost charging current 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 it is operating on boost mode, as the battery charges up. For limiting the output voltage of the 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.
8. Energizing the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilize, to within

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- the specified limits as mentioned elsewhere, shall be less than fifteen seconds.
9. 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 specified as mentioned elsewhere in less than 2 seconds after the above-mentioned change.
 10. 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, even when they are not connected to a battery.
 11. The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the bidder in the DC distribution board for remote annunciation.
 12. Digital Outputs shall be configured for connection to the SCADA for real-time charger status updating. Outputs like charger output current, output voltage, float/boost mode, etc may be configured to provide the update to SCADA.
 13. The Battery Chargers as well as their automatic regulators shall be of static type. The Chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C.
 14. For Lead Acid plante battery:-Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC lead-acid Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 2.25 Volts per cell. All chargers shall also be capable of Boost charging the associated D.C. Battery at 2.3 to 2.7 Volts per cell at the desired rate.
 15. For Nickel-Cadmium battery: -Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC Nickel-Cadmium Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 1.4 to 1.42 Volts per cell. All chargers shall be capable of Boost Charging the associated D.C. Battery at 1.54 to 1.7 Volts per cell at the desired rate.
 16. All Battery Chargers shall have an AC contactor on the input side. It shall be of air break type and suitable for continuous duty. A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.
 17. The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger.
 18. Digital or analog indicating instruments shall indicate DC current, DC voltage & AC voltage.
 19. The Chargers shall be indoor, floor mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Charger shall be fabricated using cold rolled sheet steel shall not be less than 1.6 mm and shall have folded type of construction. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable undrilled gland plates of at least 3.0. mm sheet steel and lugs for all cables shall be supplied by the Contractor. The Charger shall be tropicalized and vermin proof. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed.
 20. Treatment as per IS: 6005. Two coats of lead oxide primer followed by powder painting with final shade of RAL9002 for complete panel except end covers & RAL 5012 for end covers.

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21. All acceptance and routine tests as per the manufacture recommendations and relevant standards shall be carried out.
22. The cabinets shall be IP-42 protection class for indoor application and IP55 or better for outdoor application.
23. The Contractor shall also carry out the site tests on battery charger systems required to be conducted as a standard practice of the UPS manufacture or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer.

BATTERY : NICKEL-CADMIUM BATTERY

Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.

1.42V /cell and total cells will be decided during Detail Engineering

CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein, shall be the latest editions including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes:

IEC 60623/ IS 10918	Specification for vented type Nickel Cadmium Batteries.
IS 106	Quality tolerances for water for storage batteries
IEC 60993	Electrolyte for vented Nickel-Cadmium cells
Indian electricity rules	
Indian electricity acts	

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 standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.

DC Batteries shall be stationary Nickel Cadmium Pocket plate type conforming to IS:10918. The batteries shall be high/medium discharge performance type suitable for the backup time as specified. For the purpose of design an ambient temperature of 50 degree centigrade and relative humidity of 85% shall be considered.

DC batteries shall be suitable for standby duty. The batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 1.54 to 1.7 volts per cell maximum and float charged at about 1.42 V/cell.

Construction Features:- Containers

Containers shall be made of polypropylene plastic material. Containers shall be robust, heat resistance, leak proof, nonabsorbent, alkali resistant, non-bulging type and free from flaws,

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such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of translucent containers.

Vent Plugs

Vent plugs shall be provided in each cells. They shall be antisplash type, having more than one exit hole shall allow the gases to escape freely but shall prevent alkali from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition, the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte samples.

Plates

The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS:10918. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative terminal posts shall be clearly marked.

Sediment Space

Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.

Electrolyte

The electrolyte shall be prepared from battery grade potassium hydroxide conforming to IEC 60993. The cells can be shipped either in charged condition or in dry condition. Necessary electrolyte for make-up shall be supplied separately.

Connectors and Fasteners

Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier / inter- bank connections. Bolts, nuts and washers shall be Stainless Steel / Nickel coated steel to prevent corrosion. The thickness of Nickel coating of connectors should be not less than 0.02 mm. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds.

Battery racks

Mild steel racks for all the batteries shall be provided. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries racks and supports for cable termination shall be coated with three (3) coats of anti-alkali paint of approved shade. Name plates, resistant to alkali, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor.

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The Contractor shall submit for Owner's approval the reports of all the type tests carried out as per latest IS-1146(for all applicable tests for containers) / IS- 10918 (for NI-CD batteries).The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier. Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.

BATTERY : LEAD –ACID PLANTE BATTERY

BATTERY PARAMETER

a)	Battery Voltage	To be decide during Detail Engineering
b)	No. of Cells	To be decide during Detail Engineering
c)	Battery type	Stationary Lead Acid Plante
d)	Nominal discharge voltage per cell	2.0V
e)	Float Voltage	2.25V/Cell

CODES AND STANDARDS

IEC 60896	Stationary Lead-Acid Batteries
IS : 266	Specification for sulphuric acid
IS : 1069	Specification for water for storage batteries
IS : 1146	Specification for rubber & plastic containers for lead acid storage batteries.
IS : 1652	Specification for stationary cells and batteries, lead acid type (with plante positive plates).
IS : 3116	Specification for sealing compound for lead acid batteries.
IS : 8320	General requirements and methods of tests for lead acid storage batteries.
IS : 6071	Specification for synthetic separators for lead acid batteries.
	Indian Electricity Rules
	Indian Electricity Acts

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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 standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.

DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS:1652. The batteries shall be high/medium discharge performance type suitable for the backup time as specified. For the purpose of design an ambient temperature of 50 degree centigrade and relative humidity of 85% shall be considered.

DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.7 volts per cell maximum and float charged at about 2.25 V/cell.

Construction Features: -

Containers

Containers shall be made of transparent glass, hard rubber, suitable robust, heat resistance, leak proof, non absorbent, acid resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The stem portion of the float should be long enough to prevent falling of the float inside the container even if there is no electrolyte in the container. The marking for the electrolyte level should be for the upper and lower limits. The material of level indicator shall be acid proof and oxidation proof. Container shall be closed/sealed lid type. Lid and sealing compound shall be non-cracking type. The container made of hard rubber and plastics shall be type tested as per IS: 1146. All type tests shall be carried out for sealing compound as per IS: 3116.

The pole sealing arrangement should be such that no acid particle get entrapped due to acid creep as a result of capillary action and it should be possible to remove and refix the sealing to carry out the maintenance.

Vent Plugs

Vent plugs shall be provided in each cells. They shall be antisplash type, having more than one exit hole shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed

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for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte sample.

Plates

The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS : 1652 as applicable.

The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative post shall be clearly marked.

Sediment Space

Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.

Cell Insulator

Each cell shall be separately supported on PVC/porcelain/hard rubber insulators fixed on the racks with adequate clearance between adjacent cells. Minimum distance between adjacent cells shall be more than the bulge allowed for two cells in accordance with IS: 1146.

Electrolyte

The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS: 266 and distilled water conforming to IS: 1069. The cells shall be shipped dry uncharged. The electrolyte shall be supplied separately.

Connectors and Fasteners

Lead or Lead coated copper connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. The thickness of lead-coating of connectors should not be less than 0.025 mm. The lead coating thickness shall be measured in accordance with APPENDIX F of IS:6848 (latest edition). All the terminals and cells inter- connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded copper conductors and PVC insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor.

Battery racks

Wooden racks for all the batteries shall be provided. These racks shall be made of good quality first class seasoned teak wood in line with CPWD specification. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators. Batteries shall preferably be located in



the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries rack and wooden support for cable termination shall be coated with three (3) coats of anti-acid paint of approved shade. Numbering tags, resistant to acid, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor. Wherever racks are transported in dismantled condition, suitable match markings shall be provided to facilitate easy assembly.

Test

The Contractor shall submit for Owner's approval the reports of all the type tests carried out as per latest IS-1146 (for rubber & plastic containers for lead-acid storage batteries)/IS 1652 (for lead-acid plate batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier. Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.

AUXILIARY EQUIPMENT

Manual discharge resistance bank suitable for each type of battery bank of UPS/Battery Charger has to be provided by contractor.

Following shall be provided (as per applicability) for maintenance purpose

a	Hydrometers	2 Nos.
b	Set of hydrometer syringes suitable for the vent holes in different cells	2 Nos.
c	Thermometer for measuring electrolyte temperature	2 Nos.
d	Specific gravity correction chart	2 Nos.
e	Wall mounting type holder made of teak wood for hydrometer & thermometer	2 Nos.
f	Cell testing voltmeter (3-0-3 V)	2 Nos.
g	Alkali mixing jar	2 Nos.
h	Rubber aprons	5 Nos.
i	Pair of rubber gloves	
j	Set of spanners	5 Nos.
k	No smoking notice for each battery room	2 Nos.

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I	Goggles (industrial)	2 Nos.
m	Instruction card	2 Nos.
n	Temperature indicator	1 No. per room
o	Cell lifting facility	1 Set per room

Following shall be taken as minimum load value for sizing calculation of UPS/Battery Charger/Battery system. However, Bidder needs to provide the details auxiliary power rating of each individual equipment. & any other load apart from below required for completion of the system is also in the scope of the bidder

Sl No	Description	Rated Power in Watt	Remarks
1	HT Switchgear VCB Panel		
(i)	Closing Coil	Actual as per datasheet	First minute load
(ii)	Tripping Coil	Actual as per datasheet	Last minute load
(iii)	Spring Charging Motor	Actual as per datasheet	First minute load
(iv)	Numerical Relay	20	Continuous load
(v)	Auxiliary Relays	20 (total)	Continuous load
(vi)	LED Indication Lamps	10 (total)	Continuous load
(vii)	Misc. load	20 (total)	Continuous load
2	Inverter (if applicable)	300	Continuous load
3	SCADA panel at CMCS	2000	Continuous load
4	SCADA HMI including LED Display and Printer	500	Continuous load
5	SCADA RTU panel at PEB	400	Continuous load
6	Transformer N2 Injection unit at PEB (if applicable)	100	Continuous load
7	Fire Alarm Panel at CMCS	300	Continuous load
8	Fire Alarm Panel at PEB	200	Continuous load
9	WMS	100	Continuous load
10	Emergency Load (light + Fan) at CMCS	300	Continuous load
11	Emergency Load at PEB	100	Continuous load

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Following shall be considered for main pooling/final pooling HT switchgear as a minimum.

(i) Per switchboard only one panel spring charging motor load shall be considered.

(ii) All outgoing and tie feeder panel trip coil load (subject to Minimum 3 Nos) shall be considered.

(iii) All outgoing feeders+ Aux transformer feeders+ 50% of incomer panel closing coil load shall be considered.

Following shall be considered for inverter station HT switchgear/RMU.

i) Per switchboard only one panel spring charging motor load shall be considered.

(ii) All panel trip coil and close coil load shall be considered.

SITE TESTS

The contractor shall carry out the following site tests as applicable on UPS, Battery Charger and Battery system. However, any other site test is required to be conducted as a standard practice of the OEM or deemed necessary by the employer and mutually agreed between the contractor and the employer, the same shall also be carried out.

Light Load Test

This test is carried out to verify that the UPS/Battery Charger is correctly connected and all functions operate properly. The load applied is limited to some percent of rated value. The following points should be checked:

Output voltage, frequency and the correct operation of meters;

Operation of all control switches and other means to put units into operation.

Functioning of protective and warning devices.

A. C. Input Failure Test

The test is performed in UPS/Battery Charger with a fully charged battery and is carried out by tripping input supply feeder or may be simulated by switching off all rectifiers and bypass feeder as at the same time. Output voltage variations are to be checked for specified limits with an oscilloscope/Recorder.

A. C Input Return Test

AC input return test is performed in UPS/Battery Charger by closing AC input supply feeder, or is simulated by energizing rectifiers. Proper operation of rectifier starting and voltage and frequency variations are to be observed. This test is normally performed with a fully or partially charged battery.

Auto changeover Test

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This test shall be carried out in UPS ACDB fed from two separate UPS system. Auto changeover of one UPS source to standby UPS to be check by tripping the active UPS manually or by simulation condition. This test shall be check as per approved auto changeover logic.

Transfer Test (for UPS)

This test is applicable for UPS with bypass, particularly in the case of an electronic bypass switch. Transients shall be measured during load transfer to bypass caused by a simulated fault and load retransfer after clearing of the fault.

Full load test

Load tests are performed by connecting the actual load to the UPS/Charger output. Load tests are necessary for testing output voltage and frequency, rated stored energy, recharge time, ventilation, and temperature.

Rated Stored Energy Time (Battery test)

This test is a load test to prove the actual possible time of battery operation. If rated load is not available in the case of large UPS/Battery charger, it is possible to apply a partial load to check the actual battery discharge characteristics and compare these with characteristics specified by the battery manufacturer. Discharge time with rated load shall then be calculated. The test shall be performed with a fully charged battery and also may be done under other battery conditions to be specified, if so agreed. Active power output of the UPS/Battery Charger and the battery voltage shall be recorded during the test. Since new batteries often do not provide full capacity during a starting up period, the discharge test may be repeated after a reasonable recharge time if the original test has failed.

Rated Restored Energy Time

Restored energy depends on the charging capacity of the rectifiers and the battery characteristics. If a certain recharging rate is specified, it shall be provided by repeating the discharge test after the specified charging period.

Battery Ripple Current

If battery ripple currents are specified, then the ripple current which depends on UPS operation shall be checked under normal operating conditions. Rough measuring methods are sufficient.



6.15 LIGHTNING PROTECTION SYSTEM

GENERAL REQUIRMENTS

This specification is intended to outline the requirement of external lightning protection (ELP/Lightning protection) for DC block side and AC Power block side of BESS Project. It is not the intent of the specification to specify all details of design and construction since the bidder has full responsibility for engineering and implementation of external lightning protection system meeting the intent of the specification and functional requirement. Any additional equipment, material, services which are not specifically mentioned herein but are required for successful installation, testing and commissioning of earthing system for safe and satisfactory operation of the plant shall be included under scope of the bidder.

Lightning protection requirement for outdoor metering yard/Switchyard has been mentioned elsewhere in the specification and hence shall be excluded from scope of this chapter unless Lightning protection requirement of metering yard/Switchyard is specifically mentioned in this chapter.

LIGHTNING PROTECTION DESIGN REQUIRMENT

The object of a lightning protection system is to protect buildings/structure and equipment from direct lightning strikes, potential fire as well as the effects of injected lightning currents (non-incentive flash). It consists of termination systems for direct lightning, down conductors and an earth-termination system.

Care must be taken for while designing the lightning protection that surges are prevented in the electrical system to reduce failure of electrical and electronic equipment.

CODES AND STANDARD

The equipment/product furnished for earthing system shall meet the requirements of all the applicable relevant National/International codes and standards or their latest amendment Codes and Standards. Product certification has to be CE/UL/BIS/TUV or equivalent. The relevant codes and standard for earthing system are tabulated below.

IS/IEC 62305	PROTECTION AGAINST LIGHTNING
IEEE: 80	IEEE guide for safety in AC substation grounding
IEEE: 837	Standard for qualifying permanent connections used in substation grounding

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IS: 2629	Recommended practice for hot dip galvanizing of iron & steel
IS: 2633	Method for testing uniformity of coating on zinc coated articles
IS: 513	Cold rolled low carbon steel sheets and strips
IS: 6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS 2062	HOT ROLLED MEDIUM AND HIGH TENSILE STRUCTURAL STEEL – SPECIFICATION
IS: 458	Precast Concrete Pipes (With and Without Reinforcement)
UL-467	Grounding and Bonding Equipment
IEC 62561-7	Requirements for earthing enhancing compounds
NFC 17 -102	Early streamer emission lightning protection systems
CEA regulations for electrical safety-2010 Indian Electricity Rules/ Indian Electricity Act.	

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (codes and standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the above standards/ codes as applicable.

The lightning protection system includes lightning terminal, Down conductor, test link, earth electrode, installation of lightning terminal, down conductor and earth electrode in suitable pit size, construction of earth pit with cover for the installation, connection of earth electrode with lightning terminal.

Detail specification of earthing system has been mentioned elsewhere in the specification.

DOWN CONDUCTORS

Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.

Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.

All joints in the down conductors shall be welded type.

Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.

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Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.

All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.

Lightning conductors shall not pass through or run inside GI Conduits. Testing link shall be made of galvanized steel of size 25x 6mm.

Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths oxide layer or foreign material.

LIGHTNING PROTECTION SYSTEM FOR BESS DC SIDE

IS/IEC 62305: PROTECTION AGAINST LIGHTNING

NF C 17-102 : LIGHTNING PROTECTION WITH EARLY STREAMER AIR TERMINATION ROD

Complete DC block with associated structure shall be protected from Direct Lightning Stroke. Lightning Protection for DC Block shall be achieved with any or both of the following two systems as per specification provided in the following section.

Single Rod Air Terminal (Faraday Rods) Early Streamer Emission (ESE) Air Terminal
Early Streamer Emission (ESE) Air Terminal

Suitable earthing and equipotential bonding shall be ensured for the lightning protection Air Terminal as per applicable standard/Equipment manufacturer guidelines.

Current carrying parts and accessories such as clamps, fasteners, down conductor, Test links and earth termination etc. shall be preferably procured from OEM of Air Terminals if it is supplied by them as part of lightning protection system.

LIGHTNING PROTECTION SYSTEM FOR BUILDING AND ENCLOSURE

Contractor shall provide lightning protection for Inverter room/shed/shelter/enclosure, main control room, Switchgear Room/shed/shelter and similar housing per IS/IEC 62305.

ESE Air Terminal shall not be used for lightning protection of Metering yard/Switchyard.

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6.16 METERING SYSTEM

GENERAL

Energy meter (0.2s accuracy class) suitable for ABT requirement with metering panel as required shall be conforming to STU/CTU/PGCIL requirement.

For measurement of Auxiliary power consumption, MFM in ACDB incomer shall be provided by the bidder.

Meter shall be suitable for interfacing for synchronizing the built-in clock of the meter by GPS time synchronization equipment. Bidder shall synchronize the meter using GPS time synchronization equipment. All the hardware required for synchronization shall be in scope of bidder.

The ABT meters supplied under this contract shall also meet the requirement of respective RLDC/State power Utilities.

This metering system shall have following features:

- I. Meters shall be microprocessor-based MWH meters having an accuracy class of 0.2S or better. MVARH meters shall have accuracy class of 0.5 or better.
- II. These meters shall have provision for downloading of data through an optical port and /or through RS 232/485 port.
- III. Even under absence of VT input, energy meter display shall be available and it shall be possible to download data from the energy meters.

Technical Requirements of Energy Meters for ABT Requirement

Contractor shall supply energy meters along with metering station, MRI as per the technical specification given below:

Shall be microprocessor-based conforming to IEC 62052-11, IEC 62053-22, IS 14697

Shall carry out measurement of active energy (both import and export) and reactive energy (both import and export) by 3-phase, 4 wire principle suitable for balanced/ unbalanced 3 phase load.

Shall have an accuracy of energy measurement of at least Class 0.2S for active energy and at least Class 0.5 for reactive energy.

The active and reactive energy shall be directly computed in CT & VT primary ratings.

The reactive energy shall be recorded for each metering interval in four different registers as MVARh (lag) when active export, MVARh (Lag) when active import, MVARh (lead) when active export, MVARh (Lead) when active import.

Two separate registers shall be provided to record MVARH when system voltage is >103% and when system voltage is < 97%.

Shall compute the net MWh and MVARh during each successive 15-minute block metering interval along with a plus/minus sign, instantaneous MWh, instantaneous MVARh, average frequency of each 15 minutes, net active energy at midnight, , net reactive energy for voltage low and high conditions at each midnight.

Each energy meter shall have a display unit. It shall display the net MWh and MVARh with a plus/minus sign and average frequency during the previous metering interval; peak MWh demand since the last demand reset; accumulated total (instantaneous) MWh and MVARh with

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a plus/minus sign, date and time; and instantaneous current and voltage on each phases.

All the registers shall be stored in a non-volatile memory. Meter registers for each metering interval, as well as accumulated totals, shall be downloadable. All the net active/reactive energy values displayed or stored shall be with a plus /minus sign for export/import.

At least the following data shall be stored before being over-written for the following parameters.

	Parameters	Details	Min No of days
1.	Net MWH	15 min block	40days in meter
2.	Aver Freq	15 min block	40days in meter
3.	Net MVARH for V > 103%	15min block	40days in meter
4.	Net MVARH for V < 97%	15min block	40days in meter
5.	Cumulative Net MWH at every midnight		10 days in meter/ 40 days in PC
6.	Cumulative Net MVARH for V> 103% at every midnight		10 days in Meter/ 40 days in PC
7.	Cumulative Net MVARH for V < 97% At every midnight		10 days in Meter/ 40 days in PC
8.	Date and time blocks of VT failure on any phase.		

Shall have a built in clock and calendar with an accuracy of less than 15 seconds per month drift without assistance of external time synchronizing pulse.

Date/time shall be displayed on demand. The clock shall be synchronized by GPS time synchronization equipment being supplied by the contractor.

The voltage monitoring of shall be inbuilt feature provided to signal failures to the Substation Automation System, The meter shall be suitable to operate with power drawn from the VT supplies. The burden of the meters shall be less than 2 VA.

The power supply to the meter shall be healthy even with a single-phase VT supply. An automatic backup, in the event of non-availability of voltage in all the phases, shall be provided by a built in long life battery and shall not need replacement for at least 10 years with a continuous VT interruption of at least 2 years. Even under absence of VT input, energy meter display shall be available and it shall be possible to download data from the energy meter. Incase data downloading is not possible in absence of VT supply, meter with provision of 220V DC auxiliary power shall be provided. Date and time of VT interruption and restoration shall be automatically stored in a non-volatile memory.

Shall have an optical port on the front of the meter for data collection from either a hand held meter reading instrument (MRI) having a display for energy readings or from a notebook computer with suitable software . The contractor shall supply the MRI and/or notebook complete with all optical interface unit required.

The meter shall have means to test MWh and MVARh accuracy and calibration at site in-situ

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and test terminal blocks shall be provided for the same.

Each meter shall have a unique identification code provided by the Owner and shall be permanently marked on the front of the meter and stored in the non- volatile memory of the meter.

Type Test requirement for Energy Meter

All Type Test Reports shall be provided as per IEC 62052-11, IEC 62053-22, IS 14697.

Suitable PQ meters (0.2 accuracy class) shall be provided at plant output for measurement of required electrical parameters such as active power, reactive power, power factor, voltage, current, frequency, power quality parameters, etc. PQ meter shall have TCP/IP port for SCADA and PPC communication. Selected PQ meters shall be able to measure grid frequency with minimum two digit after decimal point. CT and PT/CVT core used for PQ meters shall have accuracy class of 0.2S and 0.2 respectively.

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6.17 FIRE FIGHTING AND ALARM SYSTEM

GENERAL

The BESS plant shall be equipped with suitable Fire Alarm systems meeting the CEIG requirement for Battery yard/Container, Switchgear room, Equipment room, Store room/ shed & Control room etc as required in the scope or offered by the contractor..

Bidder shall comply with recommendation of Tariff Advisory Committee. The installation shall meet all applicable statutory requirements, safety regulations in terms of fire protection.

The firefighting system for the proposed power plant for fire protection shall consist of:

- a) Sand buckets
- b) Portable fire extinguishers
- c) Microprocessor based fire alarm panel.

Portable Fire Extinguishers and Sand Buckets

Bidder to provide following numbers of type tested portable fire extinguishers as per relevant code in the rooms mentioned below.

	DCP Type (ABC type) (10 Kg. Capacity)	CO ₂ Type 9 kg capacity	Foam Type Hand 9 kg	Hand Portable pressurized water CO ₂ 9 Litre	Sand Buckets
Control Room	2	2		2	2
All Electrical Equipment/Switchgear Room	1	1			
EMS Room		2			
Each Oil Transformer Yard	1	1	1		2
Security Room		1		2	
Storage Shed	1	1	1	1	2
Battery yard (Per 100 SQM)	1	1	1		2

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Fire protection/ alarm system for the Batteries shall be proven & certified and shall be duly endorsed by the battery OEM.

Microprocessor based fire alarm panel

Bidder to provide intelligent microprocessor based main fire alarm panel of modular construction complete with central processing unit, input and output modules, power supply module, supervision control and isolator modules with 10% spare provisions in each loop. Fire detection alarm system shall include) but not limited to the following items

1. Fire Alarm control Panel
2. Multi Sensor smoke detector
3. Heat Detectors
4. Hooter cum strobe
5. Manual call Point
6. Hooter
7. Fault isolation modules
8. Control Modules
9. Cables from Sensors to Fire panels.
10. Digital output from the fire detection system shall be integrated with SCADA
11. Network Control Module
12. Interfacing of Fire Alarm System with SCADA for display and storage of status and alarm in SCADA

Multi sensor type smoke detectors and heat detectors shall be provided for below false ceiling areas of control room and ACDB and/or inverter rooms. One (01) sensor shall be provided for each 20 sqm of area. All the cable trench inside the control room and inverter room shall be provided with Multi Sensor smoke detector.

Fault Isolation module shall be provided in every room and for every 15 sensors at location proposed by Bidder to be approved by employer during detail engineering.

Fire Alarm Control Panel Indication

- i. Alarm conditions shall be immediately displayed on the control panel and in SCADA. Alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged the LED shall remain lit. A subsequent alarm received from another zone after acknowledgement shall illuminate the alarm LED and the panel display shall show the new alarm information.
- ii. During an alarm condition, an alarm tone shall sound within the control panel until the alarm is acknowledged.
- iii. If the audible alarm signals are silenced for any reason, they shall automatically resound if another zone is activated.

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All alarm signals shall be automatically “locked in” at the control panel until the operated device is returned to its normal condition and the control panel is manually reset

There shall be weather proof Hooter cum strobe outside and strobe inside each Inverter room and control room for indication fire alarm for respective zone/area at suitable location that is visible from all direction. All the hardware, relay and accessories required for completeness of fire alarm system is in Bidder scope. Fire alarm system shall have its own battery and charger and it shall be provided power from UPS DB. Each Inverter room and control room shall be also be provided with manual call point, Alarm acknowledge and reset facility for alarm for respective zone only.

In the case of outdoor inverter control room and SCADA panel also offered in outdoor Bidder has to provide a confirmation letter by the inverter manufacturer regarding fire protection in the inverter. In case the bidder fails to do so the bidder has to ensure fire protection for the Inverter and other inverter area equipment accordingly.

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1

Bidder shall submit document to employer for approval that will include fire alarm system configuration, layout, BoM, Datasheet and necessary test report.

2

Bidder shall consider 30 % design and aging margin for selection of nos. of sensors in each loop and length of each loop. Bidder shall submit the certificate from OEM indicating maximum nos. of sensors in single loop and maximum length of single loop allowed with offered panel and type of cable to be used. Each Fire Alarm Control panel shall have provision for minimum 10 (Ten) % rounded to next higher integer but not less than 2 (two) nos. spare loops for future use of employer.

3

Bidder shall submit Site Acceptance Test (SAT) for approval by employer. The complete fire alarm system shall be checked at site for verification of faithful performance and completeness of the system. Bidder shall carry out necessary modification and supply hardware/accessories if required free of cost at site.

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7.PROJECT COMMISSIONING, TRAIL RUN AND OTHER GENERAL REQUIREMENTS

PART CAPACITY COMMISSIONING:

The BESS shall be commissioned as per commissioning criteria and procedures specified under IEGC 2023.

Minimum capacity for acceptance of first and subsequent part(s) commissioning shall be 50 MW. ~~The total number of instalments in which a Project can be commissioned will be not more than 3.~~

Availability of data communication from EMS till RLDC is to be ensured by Bidder before commissioning.

The commissioning clearances under scope shall be obtained from statutory authorities.

Scheduled Commissioning date will not get altered due to part commissioning.

Suitable part-commissioned linked payment shall be applicable as per the terms of payment mentioned elsewhere in the tender documents.

TRIAL RUN

During the trial operation, BESS plant shall perform trouble-free operation for at least cumulative 24 hours during which functionality of all plant components shall be demonstrated and the system shall be in Charging/Discharging Mode. During Trial run, Bidder should successfully demonstrate all the control function of Power Plant Controller (PPC)/EMS of whole solar Plant.

Bidder shall submit the detailed procedure for conducting trial run during detail engineering for approval. Testing shall be conducted for all BESS design parameters as per IEC 62933-2-1 including ramp rate, response time etc. All functional testing shall be done for different application as defined in EMS as per functional requirement mentioned in specification with in BESS design parameters.

During trial run, Various parameters like Round trip Efficiency and Capacity (MWh) values shall be calculated and shall be checked with declared values by Bidder for validity/acceptance.

After successful completion of trial run and acceptance by BHEL/NTPC , BESS Plant shall be deemed to be successfully erected & fully commissioned.

Part Capacity/Final Commissioning and Trial run shall be carried out in compliance with the all-applicable statutory regulations (Latest) like

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Indian Electricity Grid Code-2023, SLDC/RLDC, MNRE, CEA, STU/CTU requirements.

2.0 *TAKING OVER*

Upon successful completion of all the facilities pertaining to the scope of work contractor shall approach the owner in writing for “final take over” of the plant under its scope. On receipt of such request, owner shall issue to the contractor a taking over certificate as a proof of the final acceptance of the system. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

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8. OPERATION AND MAINTENANCE

The successful bidder shall carryout Operation and maintenance of complete BESS part under its scope from date of commissioning of full project capacity. Additionally, bidder to refer commercial portion of bidding document for details regarding O&M of part capacity commissioned. During O&M period, BHEL/NTPC personnel shall have unrestricted entry to the BESS plant and Control Room any time. BHEL/NTPC may suitably depute its personals to associate with O&M activities. Contractor shall assist them in developing expertise through their day to day O&M activities. All records of maintenance must be maintained by the contractor which can be accessed by BHEL/NTPC on demand. These records are to be handed over to BHEL/NTPC after the O&M period of contract.

The bidder shall be responsible for supply of all spare parts, repairs / replacement of any defective equipment at his own cost as required from time to time during the O&M period.

The contractor shall be responsible for the Operation and Maintenance of the entire BESS plant under its scope during the O&M period. The brief scope of works is listed below. The details shall be further elaborated by the bidder in the O&M manual to be submitted to BHEL/NTPC for approval.

- Ensuring successful operation of BESS Plant for optimum
- Charging/discharging operation/duty/Availability.
- Ensuring Breakdown maintenance, Preventive maintenance overhauls, Arranging visit of O&M experts (when required) to maximize the availability of the BESS plant.
- Daily work of the operators involves logging important parameters of the BESS system.
- The operator shall record monthly performance parameters as defined in the specification and reports shall be prepared on performance of BESS plant.
- Submission of periodical reports to the owner on the operating conditions of the BESS
- Ensuring Safety and protection of the plant by deputing sufficient security personals
- Monitoring, controlling, troubleshooting, maintaining of records, registers.
- Supply of all type of maintenance spares, consumables and fixing / application of the same. In order to meet the emergent requirements, contractor, with the permission of Employer can utilize the mandatory spares being supplied under the contract. However, the used spares shall be replenished by the contractor within reasonable time.
- Cleaning of the plant including Battery yard on regular basis and as and when required.
- Cleaning of drains, cable trenches, box culverts etc in BESS area.
- Herbicide spray and grass cutting on a periodic basis
- The contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules.
- The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his employees or his Co-contractor's employees
- The Contractor shall immediately report the accidents, if any, to the Engineer In charge & to all the concerned authorities as per prevailing laws of the state.
- The Contractor shall comply with the provision of all relevant Acts of Central or State Governments including payment of Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, Workmen's Compensation Act 1923, Industrial Dispute Act 1947, Maturity Benefit Act 1961, Employees State Insurance Act 1948, Contract Labor (Regulations & Abolishment) Act 1970 or any modification thereof or any other law relating whereto and rules made there under from time to time.
- In order to ensure longevity, safety of the core equipment and optimum performance of the system the contractor should use only genuine spares of high quality standards.

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- Deployment of Plant in Charge, adequate number of technical support staff and other supporting personnel during the O&M period
- Bidder is required to maintain adequate O&M spare during the O&M contract period of the BESS system with the view to maximize availability and operation of the plant.
- Safety Engineer and Supervisor need to be also present during O&M.
- Wages shall be as per State/center govt regulations/circulars.
- At the time handing over of the plant by the contractor to NGEL , the contractor shall handover equipment and spares in healthy condition.
 - Bidder has to take Comprehensive Annual Maintenance Contract (AMC) from Original Equipment Manufacturer (OEM) **or OEM authorized service provider** for the following components:
 - PCS System
 - EMS and SCADA
 - Battery and BMS System
 - The AMC document has to be submitted before completion of trial run
 - Replacement of equipment/spare parts/ updating of software's being phased out or not being supported by OEM's is also included in bidder's scope.
 - Contractor shall be responsible to carry out all test and work as required by statutory regulation in effect as on date of Techno- commercial bid opening during O&M period.

5.0 Handing over of the Plant

- (a) At the end of the contract period, the contractor shall hand over the plant and equipment back to the owner in completely safe and healthy condition and without any pending defect.
- (b) The items supplied by BHEL/NTPC on returnable basis, such as spares parts (from mandatory spares or through procurement)), consumables, tools

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and plants, documents etc. shall be returned back to BHEL/NTPC . Else suitable recoveries shall be made from the Contractor's bills.

- 6.0** After O&M period, BHEL/NTPC may at its discretion decide to extend the existing O&M contract on mutually acceptable terms & conditions or undertake the O&M of the BESS Plant on its own.

A disposal plan shall be included as part of the operations and maintenance documentation. The disposal plan shall demonstrate the ability to recycle or safe dispose all parts of the BESS. The plant/ system/ sub-system disposal (if required during O&M Period) has to be carried out by the bidder as per the procedure approved by the Employer during O&M period. Bidder shall comply the E-waste (management) rules-2016 Ministry of Environment, Forest and Climate Change for disposal of BESS equipment.

- 7.0 Methodology for payment during O&M of Part Commissioned Capacity and Methodology for Levy of Liquidated Damages for Shortfall in Generation during O&M of Part Commissioned Capacity**

- 7.1 The successful bidder shall carry out Operation and Maintenance of Part Commissioned BESS Plant from the date of commissioning of part capacity upto the period when the full BESS plant has been commissioned.
- 7.2 Bidder shall be eligible for Pro rata payment for carrying out O&M of part commissioned Capacity for the period in excess of the stipulated ten years of O&M of Complete BESS Plant as per original scope. This shall enable start and finish of O&M of the Complete BESS Plant at the same time.
- 7.3 Further, the levy of LD for shortfall in performance during this part O&M period (if any) shall also be calculated on pro-rata basis of part commissioned Capacity as per the declared parameters in bid documents.
- 7.4 All other provisions pertaining to Payment for O&M of part commissioned capacity, LD levy (if any) during this part commissioned and Capping of LD for shortfall during O&M of Part commissioned capacity shall be as per the provisions mentioned elsewhere in the technical specification.

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9.PERFORMANCE GUARANTEE (PG) TEST

The final acceptance test as to prove the Performance Guarantee shall be conducted at site by the contractor in presence of the Employer. The PG test shall be conducted based on PG test procedure to be submitted by the contractor and approved by BHEL/NTPC . This test shall be binding on all the parties of the Contract to determine compliance of the equipment with the functional guarantee. Any special equipment, instrumentation tools and tackles and manpower, required for the successful completion of the Performance Guarantee Test shall be provided by the Contractor free of cost. The accuracy class of the instrumentation shall be as per the documents. ~~In case bidder quote for more than one project, PG Test shall be conducted for each project separately as per the procedure outlined here.~~

The procedure for PG demonstration test shall be as follows:

Consecutive one month/30 days period for conducting performance guarantee test shall be chosen on the discretion of BHEL/NTPC . PG test may be concluded as early as possible after trial run.

The procedure for PG demonstration test shall be as follows:

Consecutive one month/30 days period for conducting performance guarantee test shall be chosen on the discretion of BHEL/NTPC . PG test may be concluded as early as possible after trial run.

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10.SAFETY MANAGEMENT

Bidder shall submit the Safety Plan and the Safety Coordination Procedure as per the requirement of relevant Attachments of the bidding documents.

During the execution of the contract, the bidder and it's sub-vendor(if any) shall follow safety procedures for the safety of the personnel and the equipment during erection, testing, commissioning, operation and the maintenance during the contract period as per the regulatory requirements and the as per the original equipment manufacturer's recommendations.

All the expenses, charges towards compliance of the safety norms by the bidder as per the Safety Plan, Safety Policy, and the Safety Coordination Procedures are deemed to be included in the bid price. No additional claims shall be entertained towards meeting the safety requirements. Minimum price to be quoted for 'Safety Aspects/ compliance to Safety Rules' shall be as per relevant requirement of bidding document.

Safety sign board to be provided near outdoor transformer yard, HT switchgear and all such risk zone areas

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11.CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

General Requirements

The intent of the specification is to define the functional & design requirements for the CCTV System meant for gathering video information from the various areas of the power plant with display and recording facilities with night vision and motion sensors as per requirement.

The Contractor shall be responsible for selection, design, engineering, manufacture, testing at manufacturer's works/site, installation of all the equipment supplied as covered in this specification and commissioning of the system meeting the intent & functional requirements of the specification. All the power supply (UPS), cables, cable trays, power packs, erection hardware (viz. junction boxes, brackets glands, nut-bolts, conduits etc.) and mounting are also included in Contractor's scope.

The Contractor's scope shall also include successful demonstration of functional requirements specified herein complete in all respects.

The Contractor shall guarantee satisfactory performance of the equipment under stipulated variations of voltage and frequency.

The design and manufacture shall be such that equipment / components of same type and rating are interchangeable.

The number of camera units, servers, network switches, wireless equipment etc. and their locations shall be finalized during detailed engineer for effective functional requirements.

Any other equipment, module, software required for the safe and satisfactory operation, control, protection, monitoring, testing and maintenance of the system shall also be included by the Bidder within the lump sum quoted price.

The equipment furnished under this section shall meet the requirements of all the applicable international codes and standards or their latest amendment Codes and Standards. Camera certification has to be CE/FCC/UL or equivalent.

Comprehensive warranty for 10 years to be provided for complete CCTV offerings.

POWER SUPPLY ARRANGEMENT

The CCTV System along with all its components i.e., network switches, storage devices, servers, LAN switches, cameras etc. shall be powered from UPS system. The contractor shall also provide local power distribution boxes as required for sub-distribution of UPS supply

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For cameras to be located in remote areas where the UPS power supply can not be extended due to voltage drop etc., then such cameras can be grouped and fed from mini-UPS. Individual mini-UPS shall be provided for the cameras which cannot be grouped. Mini UPS are to be provided by the contractor within his quoted lumpsum price. The contractor shall also provide local power distribution boxes as required for sub-distribution of supply from these mini-UPS to cameras. The location of mini-UPS & power distribution scheme shall be finalized during detail engineering.

If the offered equipment is operating at voltage level other than what is available as auxiliary supply, the Contractor shall provide all required hardware, to make the offered system compatible with specified power supply arrangement.

DESIGN, TECHNICAL REQUIREMENTS AND CYBER SECURITY

The CCTV system shall be able to provide surveillance of different locations in the plant, entry gate and all across periphery. The exact locations shall be decided during detailed engineering.

The CCTV system shall be designed as a standalone IP based network architecture. The system shall use video signals from different cameras at different locations, process the video signals for viewing on monitors at different locations and simultaneously record all the video streams using H.264 or better compression technique. Joystick and mouse-keyboard controllers shall be used for Pan, Tilt, Zoom and other functions of desired cameras.

The monitoring of these cameras shall be done at main Control Room or as finalized in detailed engineering. The required no. of hardware/software licenses to meet the requirements shall be supplied by the contractor.

Camera and database servers shall offer both video stream management, video stream storage management. These servers shall also manage and store configuration information/database for the whole system. Recording frame rate & resolution in respect of individual camera shall be programmable. It shall be possible to view and record at different resolutions and frame rates and this shall be individually programmable on every camera.

It shall be possible to take back-up of system configuration and database on portable media device and restoring the same if required.

System shall ensure that once recorded, video cannot be altered.

Camera server shall be provided with a minimum of 28 TB of storage space to store recordings of all cameras. All recordings shall have camera ID, Location, Date and time of recording.

It shall be possible to view, record, search and replay simultaneously without affecting the performance of the system.

The system supplied shall be complete in all respects for reliable performance. The Contractor shall submit the detailed block schematic, video, signal & power wiring diagram, describing the connections between the network switch/camera server Systems and various cameras, monitors, keyboard, and joystick.

The camera & Video Management Software shall conform to ONVIF profile S, G,T And M or latest available applicable ONVIF profile at the time of detail engineering.

The camera OEM Should have valid H.265 HEVC Certificate and should be listed on

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following official website of HEVC.

The network cameras supplied must be manufactured in accordance with the ISO 9001&14000 standards.

Centralized certificate management: Camera should provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates.

Hardware encryption to secure digital certificates.

The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.

The use of digitally signed firmware to validate the firmware's integrity before accepting to install it.

The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL4.

The proposed camera should have NIST SP500-267/USGv6 Approval. The proposed camera should have Brute force delay protection.

Digitally signing each video frame for validating the video's authenticity and origin.

The OEM of CCTV Camera should have ISO 27001:2013 or latest, for Information Security Management System.

The camera OEM shall provide centralized certificate lifecycle management, with both pre-installed CA certificates and the ability to upload additional CA certificates. It should be able to a) Issue CA- Signed certificates when no other CA is available, b) Easily deploy certificates to Axis devices c) Easily deploy HTTPS or 802.1X configurations on devices d) Monitor certificate expiration dates e) Easily renew certificates prior to expiration.

The Camera to be provided by the bidder all the components / parts / assembly / software used in the offered hardware and software, should not be complying to GB28181, GB/T 28181-2011; GB/T28181-2011; GBT 28181-2011; GBT28181-2011 standards. There should be no option to activate or deactivate these standards in the camera web page/Settings.

DETAILED DESCRIPTION OF THE SYSTEM COMPONENTS:

Application Software for Video Monitoring, Recording & Management.

- a) The application software shall be used to display, store, control & manage the entire surveillance system.
- b) It shall be possible to control all cameras i.e., PTZ, auto/manual focus, selection of presets, video tour selection etc. The software shall support flexible 1/2/4 windows split screen display mode or scroll mode on the display monitors for live video.
- c) The system shall support video analytics in respect of the following server/edge based.
 1. Video motion detection,
 2. Auto tracking

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3. Object classification (Human & Vehicle)
4. Cross line counting
5. Line crossing
6. Loitering

The feature can be an integral part of camera or a part of camera server. The features shall be user configurable for each camera. It shall be possible to activate recordings automatically based on events generated by video analytics. These events shall also be logged and suitably alarmed on the monitors.

Cameras:

All the cameras shall be color, suitable for day and night surveillance and network compatible. There will be two types of cameras viz. PTZ & Fixed. PTZ cameras shall be high speed integrated dome type.

The camera shall be directly connected to network and use of external encoder for connecting to network is not acceptable. The cameras shall be rugged, high performance color cameras. These cameras shall provide high resolution and high sensitivity suitable for operation in a power plant, both in natural and artificial lighted areas.

Detailed technical specification is given below.

a) PTZ Dome Cameras

High Definition (HD) PTZ cameras

Detailed technical specification is given below.

PTZ Dome Cameras

High Definition (HD) PTZ cameras

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Image Device	1/2.8-1/3" Progressive scan CMOS
Lens	4.45-4.7 /- 130-137 mm focal length
Optical Zoom	30x or better
Digital Zoom	12x or better
Number of Pixels/Effective resolution	1920X1080 (Full HD)/2 MP at 25/30 IPS
Video compression	H.264, H.265 Main Profile/High profile
Sensitivity	color mode 0.6 lux , B/W mode 0.04lux @30IRE, F1.6
Horizontal Angle of view	55.4 deg(wide)- 3.5 deg (Tele) minimum
Focus	Auto with Manual Override
Iris Range	F1.6-F2.9
Iris Control	Auto with Manual Override
Back Light Compensation	Required
White Balance	Automatic with mode selection options
Electronic Shutter	1/50 to 1/10000 Auto
S/N Ratio	>50dB
Audio	Full Duplex or 2-way
Automatic Gain Compensation	Up to 18 dB
Power Supply	The camera power supply should be of the same make as that of camera and suitable for the model no. offered. If the Power supply from the Camera OEM is not available,
Gain Control	Auto/Off
Day/Night selection	Auto On-Off
IR cut-filter	Yes
Protocols	IPV4/IPV6, RTP, UDP, TCP, IP, HTTP, HTTPS, FTP, DHCP, IGMP V2/V3, ICMP, ARP, SMTP, SNTP, SNMP, MQTT or equivalent.
Security	Password protection, Digest authentication, centralized certificate management, camera can boot only with authorized firmware and signed firmware to validate the firmware's integrity before installing.
Auto Resume after Power Failure	Yes
Multiple Streams	H.264 /H.264 & H.264/Motion JPEG, H.265 with HEVC Certificate.
Operating resolution	4 streams at 25 FPS in H.265/H.264
Analytics	Motion detection, Line crossing, Cross line counting, Loitering, Object detection (Human and Vehicles & Tamper alarm via shock detection and Camera should support installation of 3 party edge based analytics.
PoE supply IEEE 802.3af compliant or better	Yes

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Rate Control	VBR/CBR
Other Features	
	On screen Menu display, and , WDR 120 dB, ONVIF Profile G,S,T and M compliant.
WDR	Automatic Picture Enhancement to give a balanced picture where there is too much/too little light
	Minimum 2 Alarm I/Ps & 1 alarm output
PTZ Specifications	
Pan	360 Deg Continuous
Tilt	180 deg
Manual Tilt Speed	0.1 deg/sec to 280 deg/sec
Manual Pan Speed	0.1 deg/sec to 250 deg/sec
Preset Positions	Minimum 256
Preset Pan Speed	280 deg/sec min
Preset Tilt Speed	250 deg/sec min
Maximum Operating conditions	-10 °C to 55 °C
OEM Warranty	5 Years

Fixed Cameras

High Definition (HD) Fixed Camera

Image Device	1/2.8-1/3" Progressive scan CMOS
Number of Pixels	1920X1080 (Full HD)/2 MP at 25/30 FPS
Sensitivity (at f1.2,6dB)	0.21 Lux color & 0.05 Lux B/W(at 30IRE)
Lens	Varifocal Lens f=8-50/11-29 mm, Board/CSMount
Lens Mount	Board/CS-Mount
Focus	Auto with Manual Override
Multiple Streams	4 streams at 2MP, 25 FPS in H.264/H.265
IR Range	External/Built-in 70 Meters.
cybersecurity platform	Secure element minimum EAL 4+ rating
Iris Range	1.7
Audio	Full Duplex or 2-way
IR cut-filter	Yes
Protocols	IPV4/IPV6, RTP, UDP, TCP, IP, HTTP, HTTPS, FTP, DHCP, IGMP V2/V3, ICMP, ARP, SMTP, SNTP, SNMP.MQTT or equivalent
Security	Password protection, Digest authentication, centralized certificate management, camera can boot only with authorized firmware and signed firmware to validate the firmware's integrity before installing.

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Iris Control	Auto with Manual Override
Analytics	Motion detection, , Line crossing, Cross line counting, Loitering, Object detection (Human and Vehicles & Tamper alarm and Camera should support installation of 3 party edge based analytics.
PoE supply IEEE 802.3af compliant	Yes
SD/SDHC/SDXC in Camera (For Local alarm recording & scheduled local recording)	Yes, minimum 256 GB capability
Rate Control	VBR/CBR
Back Light Compensation	Required
White Balance	Automatic with mode selection options
Electronic Shutter	1/50 to 1/10000 Auto
S/N Ratio	>50dB
Automatic Gain Compensation	Up to 18 dB
Power Supply	The camera power supply should be of the same make as that of camera and suitable for the model no. offered. If the Power supply from the Camera OEM is not available, power supply shall be endorsed by the OEM.
Gain Control	Auto/Off
Day/Night selection	Auto On-Off
Other Features	
	WDR 120 dB, ONVIF Profile G,S,T and M compliant.
WDR	Automatic Picture Enhancement to give a balanced picture where there is too much/too little light
	Minimum One Alarm I/P Minimum One Alarm O/P
Maximum Operating conditions	-10 °C to 55 °C
OEM Warranty	5 Years

Camera Housing & Mount

- All the cameras and accessories are to be housed in Weather Proof IP 65 environmental housing made of aluminum and Sun shroud. The housing, with heater and blower installed, shall provide protection for camera/lens assemblies in the ambient temperature range of - 0 deg. C to 50 deg.
- For Non Dome type cameras, the housing shall also have a thermostatically controlled heater kit. Continuous duty blower kit (with suitable filters) for purge air arrangement / Window wipers shall be available within the housing for cameras as indicated against each application.
- The camera mount, camera housing and camera power supply should be of the same make as that of camera and suitable for the model no. offered as specified by the manufacturer.

4.04 Keyboard & Joystick-

The keyboard shall have full function used for system control and programming for selection of various Network switches, camera/database servers, camera functions

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- including pan, tilt and zoom lens controls and shall be ergonomically designed. Joystick shall be provided for achieving all control functions.
- 4.05 Workstation
- Operators work station & network switch station shall be in Control Room or as finalized during the detailed engineering.
- 4.06 WIRELESS CONNECTION EQUIPMENT (FOR CAMERA SPECIFIED ON WIRELESS CONNECTIVITY):
- If contractor offer any camera with wireless connectivity, Access points for these cameras shall be mounted on lighting mast/pole. Wireless equipment and type of wireless connectivity shall be decided during detailed Engineering. Wireless communication for the above should be subscribing to the latest Cyber security standards including encryption. The wireless modem should support dynamic encryption techniques.
- 4.07 NETWORK SWITCH:
- All the network switches shall be of high quality and shall be sized to meet the functional requirements as specified. The common switch to which all networks are connected shall be Layer-III switch/router. All the interconnecting cables between network switches shall be fiber optic only. All fiber optic cables shall be terminated directly to network switches through optical fiber port without using media converters. Bidder to ensure that minimum 100% cores are kept as spares in all type of optical fiber cables.
- CABLES:**
- Cables shall be of FRLS PVC sheathed cables for use in CCTV and shall conform to latest edition of Indian/International standards. Fiber optic cables are to be provided (as applicable). The remaining cables can be as per CCTV supplier's standard. For details of Fiber Optic cables, refer subsection INST CABLE. All the cables and the hardware required for powering the system are also in the scope of Contractor. All cables required for interfacing alarm contact inputs (to be provided by employer) to CCTV system are also in scope of contractor. For estimation of cable quantities, erection hardware, hardware for wireless communication etc., the Bidder shall refer to General Layout Plant, Equipment Location Plans drawings & other relevant drawings to be finalized during detailed engineering. All the cables are to be provided by the Contractor on as required basis.
- CABLES: Location of CCTV: Bidder to note:** Location of the CCTV cameras shall be reviewed during detailed engineering. The relevant drawings pertaining to location and the location of the console shall be finalized during the detailed engineering

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12.QUALITY ASSURANCE CHAPTER

COMPONENTS

- 1) LT Switchgear & LT Busduct
- 2) Cabling, Earthing, Lightning Protection
- 3) Control Cables
- 4) LT Power Cables
- 5) MV (3.3kV/ 6.6 kV/ 11kV/ 33kV) Cables
- 6) HT Switchgear
- 7) SCADA and Accessories
- 8) DC System
 - a) Battery
 - b) Battery Charger
 - c) DC Health Monitoring System
- 9) Station Lighting
- 10)Transformer 11)Switchyard
- 12)Energy Meter

Components wise QA Chapter has been furnished in **Annexure - I**. Indicative list of Vendors Approved for Electrical Components & Civil works are enclosed at **Annexure - II** of this section.

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Annexure - I

1) LT SWITCHGEAR & BUS DUCT

LT SWITCHGEAR

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERISTICS →	ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY ↓	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
	Sheet Steel (IS :513)	Y	Y		Y	Y		Y							
	Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
	Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
	Support Insulator	Y	Y	Y	Y			Y							
	Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
	Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y				Y
	Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y			Y				
	Protection & Aux. Relays (IS : 3231) (IEC 60255 / IEC 61850)	Y	Y				Y	Y			Y				Y
	Control & Selector Switches (IS : 13947)	Y	Y				Y	Y			Y				
	CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
	MCCB (IS : 13947)	Y	Y					Y			Y				
	Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y				Y
	Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y				
	Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y				
	Control Terminal	Y	Y				Y	Y							

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Blocks

LT SWITCHGEAR														
(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)														
ATTRIBUTES / CHARACTERISTICS														
ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y							
Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
MCB (IS : 8828)	Y	Y				Y	Y			Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y		Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

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Blocks																	
LT SWITCHGEAR																	
(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)																	
ATTRIBUTES / CHARACTERISTICS		ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY		Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y					Y	Y									
Control Transformer (IS : 12021)	Y	Y					Y	Y					Y				Y
Push Buttons (IS : 4794)	Y	Y					Y	Y					Y				
Transducer (IEC : 60688)	Y	Y					Y	Y					Y				Y
MCB (IS : 8828)	Y	Y					Y	Y					Y				
Breaker Handling Trolley	Y	Y					Y					Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y			Y	Y		Y									
LT SWITCHGEAR (IS : 8623)	Y	Y					Y	Y	Y	Y	Y		Y	Y		Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
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ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes													
Characteristics													
ITEM/ COMPONENT / SUB SYSTEM ASSEMBLY/ TESTING	RPM®	No Load Current®	IR&HVT®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®		Stall Torque/Current(A)	Hand Wheel operation/Auto de-clutch function(A)	Function of Aux. like Potentiometer, space heater, position indicator®	EPT output®	Grease leakage®
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(I S_9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.													
® - Routine Test (A) - Acceptance Test Y - Test applicable													

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LT BUSDUCT

ATTRIBUTES ,
CHARACTERISTICS



ITEM, COMPONENTS,
SUB SYSTEM
ASSEMBLY



	Dimension & Surface Finish	Make, Type, Rating & TC	Electrical Properties	Mechanical Properties	Chemical Properties	Item to conform to relevant IS	WPS Approval, Welder Qualification	Weld Quality Check (DP test & x-ray Test)	Paint Shade, Thickness, Adhesion & Finish	Tightness by Torque measurement	Electrical Clearances	Galvanizing Test as per IS 2629/ 2633/ 4759	IR – HV – IR Test	Phase Sequence Check	Degree of Protection routine test as per NTPC spec.
Aluminum Sheets / Plates / Strips / Flexibles / tubes (IS : 5082 / 737)	Y	Y		Y	Y	Y	Y	Y							
CRCA Flats / ISMC (IS 2062)	Y	Y		Y	Y	Y									
Neoprene / Synthetic Rubber Gaskets (IS 11149 / 3400)	Y	Y		Y	Y										
Rubber Bellows (IS : 3400)	Y	Y		Y	Y										
Support Insulator (BS : 2782, IEC : 660, IS : 10912)	Y	Y	Y	Y											
Galvanized Structure & GI Earthing Flat (IS : 2629 / 2633 / 4749)	Y	Y				Y					Y				
Space Heater & Thermostat		Y	Y									Y			
LT Busduct (IS : 8623 PART 2)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

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Control cables

ROUTINE TESTS		Following routine tests shall be carried out on each drum of finished cables for all sizes.
1)		Conductor Resistance test
2)		High voltage test
ACCEPTANCE TESTS		Following Acceptance tests shall be carried out on each size of cables, in the offered lot.
A) For Conductor (as per sampling plan mentioned in IS: 1554)		
	1)	Annealing test (Copper)
	2)	Resistance test
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 1554)		
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
C) For PVC insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554)		
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")
D) Ageing test:		
If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer will carry out ageing test & the test report will be reviewed by owner (quantum of		

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TECHNICAL SPECIFICATIONS

ageing test sample shall be one sample /batch)

E) Following tests will be carried out on completed cables as per IS on each size:

	1)	Insulation resistance test (Volume resistivity method)
	2)	High voltage test

F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes):

	1)	Thermal stability test on PVC insulation and outer sheath
	2)	Oxygen index test on outer sheath
	3)	Smoke density rating test on outer sheath
	4)	Acid gas generation test on outer sheath

G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable will be carried out as per following sampling plan:

		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured, unarmoured) will be bunched together, as per calculations in line with the IEC. All sizes of armoured & unarmoured cables shall be covered.
--	--	---

H) Following tests shall be carried on one length of each size (armoured & unarmoured) of offered lot:

	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / outer sheath extrusion's batch number marking
	2)	Measurement of Eccentricity & Ovality

GENERAL NOTE:

(a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by owner and Main Contractor at the time of final inspection. Owner and Main Contractor will also witness routine tests on cables on 10% sample basis.

(b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by Owner at the time of final inspection. Owner will witness routine tests on cables for the first order on 10% sample basis and Main Contractor will witness routine tests on cables for the first order on 100% basis.

1. For Smoke Density rating test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
2. For Acid Gas Generation test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
3. For Oxygen Index test: if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
4. In case the test results without conditioning do not meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.

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4) LT POWER CABLES

Attributes / Characteristics	Make, Type & T.C as er relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two wires	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath &	Thermal stability	Anti termite coating on wooden drums	Constructional requirements feature as per NTPC specification	Routine & Acceptance Tests as per relevant standard & NTPC specification	ERLS Tests
Item / Components / Sub System Assembly																
Aluminum (IS-8130)	Y	Y	Y	Y		Y										
XLPE Compound (IS-7098)	Y		Y			Y	Y				Y					
PVC insulation Compound (IS: 5831)	Y		Y			Y					Y	Y				
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1)	Y		Y								Y	Y				Y
Extrusion & curing /Manufacturing of Core (PVC / XLPE)		Y			Y		Y					Y				
Core Laying								Y								
Armour wire/strip	Y	Y	Y													
Inner sheath	Y	Y														
Armouring		Y							Y							
Outer Sheathing		Y								Y						
Power Cable (Finished) (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)								Y	Y	Y	Y	Y		Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y											Y	Y		

Notes:

- This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
- Make of all major Bought out items will be subject to NTPC approval.

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification Group : BESS system

DOC. NO: SPV-BESS - 01-2025-00

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If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer will carry out ageing test & the test report will be reviewed by owner (quantum of ageing test sample shall be one sample /batch)

E) Following tests will be carried out on completed cables as per IS on each size of each type (PVC / XLPE insulated)

1)	Insulation resistance test (Volume resistivity method)
2)	High voltage test

F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)

1)	Thermal stability test on PVC insulation and outer sheath
2)	Oxygen index test on outer sheath
3)	Smoke density rating test on outer sheath
4)	Acid gas generation test on outer sheath

G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cables as per following sampling plan:

	This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall be covered. For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per BHEL/NTPC approved datasheet.
--	---

H) Following tests shall be carried on one length of each size of each type (PVC / XLPE insulated) of offered lot:

1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch)number marking on sheath
2)	Measurement of Eccentricity & Ovality

GENERAL NOTE:

(a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by owner and Main Contractor at the time of final inspection. Owner and Main Contractor will also witness routine tests on cables on 10% sample basis.

(b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by Owner at the time of final inspection. Owner will witness routine tests on cables for the first order on 10% sample basis and Main Contractor will witness routine tests on cables for the first order on 100% basis.

1. For Smoke Density rating test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
2. For Acid Gas Generation test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
3. For Oxygen Index test: if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
4. In case the test results without conditioning do not meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.

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5) MV (3.3 KV / 6.6. KV / 11 KV / 33 KV) CABLES

Attributes/ Characteristics	Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness. gap between two wires	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after going on outer sheath &	Thermal stability on outer sheath	Metallic (Cu) Screening If applicable)	Anti termite coating on wooden drums	Constructional requirements feature as per NTPC specification	Routine & Acceptance Test as per relevant standard & NTPC specification	FRLS Test
	Aluminum (IS-8130)	Y	Y	Y	Y		Y											
	Semiconducting Compound	Y		Y			Y											
	XLPE Compound (IS-7098 Part-II)	Y		Y			Y					Y						
	FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58) ,IEC-60754 Part-1)	Y		Y								Y	Y					Y
	Triple Extrusion & curing /Manufacturing of Core		Y			Y		Y										
	Copper Tape	Y	Y	Y			Y											
	Polyster tape	Y	Y															
	Core Laying								Y									
	Armour wire/strip	Y	Y	Y														
	Copper tapping	Y	Y											Y				
	Inner sheath	Y	Y															
	Armouring		Y							Y								
	Outer Sheathing		Y								Y	Y	Y			Y	Y	Y
	Power Cable (Finished)								Y	Y	Y	Y	Y			Y	Y	Y
	Wooden drum(IS-10418) /Steel Drum		Y												Y	Y		

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to NTPC approval.

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TECHNICAL SPECIFICATIONS

ROUTINE TESTS

Following routine tests shall be carried out on each drum of finished cables for all types & sizes.

- | | |
|----|---|
| 1) | Conductor Resistance test |
| 2) | High voltage test |
| 3) | Partial discharge test (for Screened cables only) |

ACCEPTANCE TESTS

Following Acceptance tests shall be carried out on each size of each type (voltage rating) of cables, in the offered lot.

A) For Conductor (as per sampling plan mentioned in IS: 7098 Part II)

- | | |
|----|---------------------------|
| 1) | Annealing test (Copper) |
| 2) | Tensile Test (Aluminum) |
| 3) | Wrapping Test (Aluminum) |
| 4) | Resistance test |

B) For copper tape / Wires (as per sampling plan mentioned in IS: 7098 Part II)

- | | |
|----|---------------------------|
| 1) | Measurement of Dimensions |
| 2) | Conductivity check |

B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 7098 Part II)

- | | |
|-----|--|
| 1. | Measurement of Dimensions |
| 2. | Tensile Tests |
| 3. | Elongation Test |
| 4. | Torsion Test For Round wires only |
| 5. | Wrapping Test |
| 6. | Resistance Test |
| 7. | Mass of Zinc coating test For G S wires / Formed wires only |
| 8. | Uniformity of Zinc coating For G S wires / Formed wires only |
| 9. | Adhesion test For G S wires / Formed wires only |
| 10. | Freedom from surface defects |

C) For XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 7098 Part II)

- | | |
|----|--|
| 1) | Test for thickness |
| 2) | Tensile strength & Elongation before ageing (for tests after ageing see "D") |
| 3) | Hot set test (For XLPE insulation) |

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TECHNICAL SPECIFICATIONS

D) Ageing test:

If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer will carry out ageing test & the test report will be reviewed by owner (quantum of ageing test sample shall be one sample /batch)

(a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by owner and Main Contractor at the time of final inspection. Owner and Main Contractor will also witness routine tests on cables on 10% sample basis.

(b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by Owner at the time of final inspection. Owner will witness routine tests on cables for the first order on 10% sample basis and Main Contractor will witness routine tests on cables for the first order on 100% basis.

1. For Smoke Density rating test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.

2. For Acid Gas Generation test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.

3. For Oxygen Index test: if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.

4. In case the test results without conditioning do not meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.

E) Following tests will be carried out on completed cables as per IS on each size of each type

- | | |
|----|--|
| 1) | Insulation resistance test (Volume resistivity method) |
| 2) | High voltage test |
| 3) | Partial discharge test (for Screened cables only) |

F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)

- | | |
|----|---|
| 1) | Thermal stability test on outer sheath |
| 2) | Oxygen index test on outer sheath |
| 3) | Smoke density rating test on outer sheath |
| 4) | Acid gas generation test on outer sheath |
| 5) | Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable |

G) Following tests shall be carried on one length of each size of each type of offered lot:

- | | |
|----|---|
| 1) | Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, marking of drum no. / Batch number of outer sheath extrusion |
| 2) | Measurement of Eccentricity & Ovality |

GENERAL NOTE:

(a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by owner and Main Contractor at the time of final inspection. Owner and Main Contractor will also witness routine tests on cables on 10% sample basis.

(b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification **Group : BESS system**

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Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by Owner at the time of final inspection. Owner will witness routine tests on cables for the first order on 10% sample basis and Main Contractor will witness routine tests on cables for the first order on 100%basis.

1. For Smoke Density rating test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
2. For Acid Gas Generation test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
3. For Oxygen Index test: if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
4. In case the test results without conditioning do not meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.

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6) HT SWITCHGEAR

ATTRIBUTES / CHARACTERISTICS ↓ ITEMS, COMPONENTS, SUB-SYSTEM ASSEMBLY														
	Make, Type, Model, Rating & TC	Electrical Properties	Mechanical properties	Chemical Properties	Dimensions & Finish	Constructional, Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint shade, thickness, adhesion & finish	Functional Checks	HV & IR Test	Degree of Protection Routine test as per NTPC spec.	CB Operation timing check	All Routine Tests as per relevant standard
CRCA steel sheet/ Aluzinc*/ Zinalum*/ Galvalum*	Y		Y	Y	Y		Y							
Aluminum Bus bar material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar material (IS : 613)	Y	Y	Y	Y	Y		Y							
Bus bar Support Insulator	Y	Y	Y		Y		Y				Y			
HT Circuit Breaker (IEC-62271-100)	Y				Y	Y	Y			Y			Y	Y
HT Contactors (IS : 9046 / IEC 60470)	Y				Y	Y	Y			Y				Y
Protection & Auxilliary Relays	Y				Y	Y	Y			Y				Y
HT CT's & PT's (IS : 2705 / 3156)	Y				Y		Y							Y
HT Fuses (IS : 9385)	Y				Y	Y	Y							
Surge Arrester (IEC : 99 –4)	Y				Y		Y							Y
LT Contactors (IS : 13947)	Y				Y	Y	Y			Y				
Control & Selector Switches (IS : 6875)	Y				Y	Y	Y			Y				
Indicating Meters (IS : 1248)	Y				Y	Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y				Y	Y	Y			Y				
Push Buttons (IS : 4794)	Y				Y	Y	Y			Y				
Control Transformer (IS : 12021)	Y				Y	Y	Y			Y				Y
LT Fuses (IS : 13703)	Y				Y	Y	Y							
Energy Meters (IS : 722)	Y				Y	Y	Y			Y				Y
Transducers (IEC : 60688)	Y				Y	Y	Y			Y				Y
Diodes	Y	Y				Y	Y			Y				
Terminal Blocks	Y	Y				Y	Y							
Synthetic Rubber Gasket (IS : 11149 / 3400)	Y	Y			Y		Y							
Breaker Handling Trolley	Y				Y	Y			Y	Y				
HT Switchgear Panel (IEC-62271-200)	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
 2. Make of all major Bought Out Items will be subject to NTPC approval.
 3. Temperature rise test reports for diode plates with actual heat sink will be verified.
- *. CRCA Galvanized steel with metal coating composed of Al (55%), Zn (43.4%) & Si (1.6%),

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7) SCADA & ACCESSORIES

PROGRAMMABLE LOGIC CONTROLLER

TESTS	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/ Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ Mosaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element , Annunciation ®	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
1. PLC Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2. Control Desk With PLC	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		

Note: 1) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure along with relevant supporting documents.

***Applicable for PLC
Test**

Y - Test Applicable , ® - Routine Test (A) - Acceptance

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CONTROL DESK, PLC PANEL, SMOKE DETECTOR, FIRE ALARM & CONTROL SYSTEM

ITEMS	TESTS														
	Visual ®	GA, BOM, Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ mosaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element ,	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
1. Control Desk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
2. Annunciation/ Control/ PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
3.Smoke Detectors (UL-268, EN-54 PT-7), Heat Detectors (UL-521/EN 54 PT-5) Annunciation/ Control Panel (UL -864, EN-54, PT-2)															Y
Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure along with relevant supporting documents. • *Applicable for PLC • Y - Test Applicable. ® - Routine Test (A) - Acceptance Test															

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INSTRUMENTATION CABLE																
ITEMS	TESTS															
		Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded																
Conductor(IS-8130)		Y			Y			Y								
Insulation(VDE-207)					Y	Y	Y	Y						Y		Y
Pairing/Twisting					Y	Y		Y								
Shielding					Y			Y			Y					
Drain wire		Y			Y			Y		Y	Y					
Inner Sheath					Y	Y	Y	Y					Y	Y		
Outer Sheath					Y	Y	Y	Y					Y	Y		
Over all cable		Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)					Y			Y								
Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.																
Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.																
Note : ® - Routine Test A - Acceptance Test Y - Test Applicable																
Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)																
• * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)																
• ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk (As applicable)																
+ Sample size will be One No. of each size/type per lot.																
++ Sample size will be One No. sample for complete lot offered irrespective of size/type.																

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POWER SUPPLY FOR C&I SYSTEMS (UPS/BATTERY/BATTERY CHARGER/ACDB/DCDB)																		
ITEMS	TESTS	Visual/dimension/rating/ Paint Adhesion/ Thickness (R)	General arrangement/BOM/make of components /Mimic ®	Efficiency ,regulation(R)	Input voltage variation (A)	Out put voltage and frequency adj.range(A)	Premilinary light load test(R)	Load transfer retransfer test (R) *	AC input failure and return test (R)	Parrallel operation and current divison(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)
	UPS/CONVERTER (IEC-146 PT.4)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	VOLTAGE STABILISER	Y	Y	Y	Y	Y					Y		Y				Y	
	LEAD ACID BATTERY(TUBLAR)-IS-1651																	Y
	LEAD ACID BATTERY (PLANTE)-IS-1652																	Y
	NICKEL CADMIUM BATTERY(IS-10918/IEC-623)																	Y
	SMF BATTERY																	Y
	ACDB/DCDB	Y	Y														Y	Y
	BATTERY CHARGER	Y	Y	Y	Y	Y				Y					Y	Y	Y	Y
R-Routine Test		A- Acceptance Test					Y – Test applicable											
* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded .																		
Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.																		

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8) DC SYSTEM

LEAD ACID BATTERY

ATTRIBUTES / CHARACTERISTICS →								
ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY ↓	Dimensions & Finish	Conformance to relevant part drg. & Manufacturer' s standards	Chemical composition	Lead Coating Thickness (min. 25 microns, IS: 6848 App.F) & Adhesion Check	Conformance to CPWD Spec. for Teak Wood	Paint Process checks, Paint Shade, Thickness, Adhesion & Finish	Constructional requirements as per NTPC Spec.	Routine & acceptance tests as per relevant standard
Container & Lids (IS : 1146)	Y	Y						
Vent Plugs	Y	Y						
Sealing Compound (IS : 3116)		Y	Y					
Positive & Negative Plates		Y	Y					
Separators (IS : 6071)	Y	Y						
Electrolyte (Water / Sulphuric Acid) (IS : 1069 / 266)		Y	Y					
Inter-cell Connectors & Fasteners	Y	Y		Y				
Battery Stand	Y	Y			Y	Y		
Cell Insulators	Y	Y						
Stack Assembly	Y	Y						
Lead Acid Battery (IS : 1652)	Y						Y	Y

Note: This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

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Ni- Cd BATTERY								
ATTRIBUTES / CHARACTERISTICS →								
ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY ↓	Dimensions & Finish	Impact Strength	Conformance to relevant part drg. & Manufacturer' s standards	Resistance to Alkali	Chemical composition	Nickel Plating thickness	Paint Shade, Thickness, Adhesion & Finish	Routine & acceptance tests as per relevant standard
Container & Lids	Y	Y	Y	Y				
Vent Plugs	Y		Y	Y				
Perforated Steel Strips	Y		Y	Y		Y		
Active Material for Positive & Negative Plates			Y		Y			
Separators	Y		Y	Y				
Electrolyte			Y		Y			
Inter-cell Connectors & Fasteners	Y		Y	Y		Y		
Battery Stand	Y			Y			Y	
Cell Insulators	Y		Y	Y				
Stack Assembly	Y		Y					
Ni-Cd Battery (IS : 10918)	Y							Y
Notes:								
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.								
2. Makes of all major Bought Out Items will be subject to NTPC approval.								

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BATTERY CHARGER

Attributes / Characteristics →	Items / Components / Sub- assembly ↓														
		Make, Model, Type, Rating & Finish	Verification of Routine test reports as per relevant IS	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard & NTPC spec	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per NTPC approved drgs & specification	Temperature Rise Test	Ripple Content Test, Load Limiter & AVR Operation Test	Dynamic Response Test	Operational & Functional Checks	HV & IR Test	Burn-In Test at 50°C for 48 hrs in energised condition	Alternating current measurement test	Degree of Protection Test as per NTPC Spec.
Rectifier Transformer and Reactors IS : 4540, 2026)	Y	Y		Y			Y				Y				
Electronic Components including Potentiometer (Vernier Type)	Y			Y		Y									
Electronic Cards	Y			Y								Y			
PCB & racks for electronic cards	Y					Y									
Control & Selector Switches (IS : 6875)	Y			Y						Y					
Indicating Meters (IS : 1248)	Y			Y						Y					
Indicating Lamps (IS: 13947)	Y			Y						Y					
Air Break Switches / Fuses (IS : 13947 / 13703)	Y			Y						Y					
Control Terminal Blocks (IS : 13947)	Y			Y											
Control Transformer (IS : 12021)	Y			Y						Y					
Push Buttons (IS : 4794)	Y			Y						Y					
MCB (IS : 8828)	Y			Y						Y					
PVC insulated Copper control wires (IS : 694)	Y			Y											
Sheet Steel (IS : 513)	Y		Y	Y											
Synthetic Rubber Gaskets	Y			Y											
Annunciator	Y									Y		Y			
Battery Charger	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Notes:															
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.															
2. Makes of all major Bought Out Items will be subject to NTPC approval.															

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BATTERY CHARGER
(of capacity up to 24 V / 48 V, 150 A DC)

Attributes / Characteristics
→

Items / Components /
Sub- assembly
↓

Make, Model, Type, Rating	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per approved drawings	Ripple Content Test, Load limiter operation & AVR Operation Test	Operational & Functional Check of faux. Devices like annunciator, switches, indicator etc.	HV & IR Test	Burn-In Test	Dynamic response test	AC input current measurement test	Temperature rise test
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Battery Charger	Y	Y	Y	Y	Y	Y	Y	Y	Y
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Note

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

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DC HEALTH MONITORING SYSTEM

Attributes / Characteristics →		Make, Model, Type, Rating & Finish	Verification of Routine test reports as per relevant IS	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard & NTPC spec	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per NTPC approved drawings & specification	Operational & Functional Checks	HV & IRT Test	Burn-In Test at 50°C for 48 hrs in 27 energized condition	Degree of Protection Test as per NTPC Spec.
	Items / Components / Sub-assembly ↓										
	Enclosure	Y		Y	Y	Y					Y
	Synthetic Rubber Gaskets	Y			Y						
	Control & Selector Switches , Indicating Meters, Indicating Lamps	Y			Y			Y			
	Control Terminal Blocks , Push Buttons, MCB	Y			Y			Y			
	MCB	Y			Y			Y			
	PVC insulated Copper control / signal cables	Y	Y		Y						
	Transducers / detectors	Y	Y		Y			Y			
	PCB & racks for electronic cards	Y									
	Electronic Cards	Y						Y		Y	
	Microprocessor Based Controller	Y						Y		Y	
	SCADA	Y						Y			
	Software	Y						Y			
	DC Health Monitoring System	Y			Y	Y	Y	Y	Y	Y	Y
Notes: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2. Makes of all major Bought Out Items will be subject to BHEL/NTPC approval.											

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9) STATION LIGHTING

Item Components Sub System Assembly	Attributes Characteristic	Make, Type , Rating/ TC	Dimension	Pre-Treatment of sheat	Paint Shade Thickness Adhesion & Finish	Galvanization Tests	IP Test	Bought Out Items/ Bill of Material	HV & IR	Functional Check as per spec.	Constructional Feature as per NTP spec	Routine Test as per relevant std and spec	Acceptance Test as per relevant std and spec	Item to conform to relevant standard
Luminaries (IS-10322 Part-5 Sec.1 (non –LED type)		Y					Y		Y			Y	Y	Y
Electronic Ballast		Y										Y	Y	Y
Lighting Wire (IS-694)		Y										Y		
Fans (IS-374)		Y										Y		
Pole (IS-2713)		Y			Y						Y	Y	Y	
Lamps (IS-9800, IS-9974)		Y										Y	Y	
Lighting Mast (with raise & lower lantern type)		Y	Y			Y					Y	Y	Y	
Wall Mounted Lighting Panel (IS-513, IS-5)		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Switch Box/ Junction Box/Receptacles/ Local Push Button Station / Lighting Panel (IS-513, 2629, 2633, 4759, 6745)		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Cable Gland (BS-6121)		Y	Y									Y		
Cable Lug (IS-8309)		Y	Y									Y		
Flexible Conduit		Y										Y		

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Lighting Transformer (IS-111/1)	Y										Y	Y		
Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6/45)	Y	Y										Y		Y

LED Luminaire Quality Requirements

- 1) LED modules to conform to IS: 16103 part 2. Manufacturer to issue a certificate of compliance for the same.
- 2) Control gear to conform to IS 15885 part 2 section 13. Manufacturer to issue a certificate of compliance for the same.
- 3) LED luminaire to conform to IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 4) LED luminaire marking to be as per IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 5) Acceptance tests as per IS 16107 part 2 section 1 to be carried out on LED luminaire except long duration tests i.e. a) Chromaticity coordinates & correlated color temperature (CCT); b) Color rendering index (CRI). Manufacturer will submit a COC for above tests i.e. CCT & CRI
- 6) LED driver make, model, type & rating may be as per recommendations of LED module manufacturer.

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

Make of all major Bought Out Items will be subject to BHEL/NTPC approval

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10) TRANSFORMER

Oil Filled Transformer

Attributes / Characteristics	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	Functional check	WPS & PQR	Routine Test as per relevant standard / NTPC Specification
Items/Components Sub Systems													
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y					Y	
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y				Y			
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y			Y
Gasket	Y	Y			Y	Y		Y		Y			Y
Transformer Oil (IEC296)			Y										Y
OLTC / Off-Circuit Tap Changer	Y									Y			Y
Core Coil Assembly & Pre-tanking	Y								Y	Y			
Marshalling Box	Y									Y	Y		Y
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves	Y									Y	Y		
Welding (ASME Sect-IX)	Y						Y					Y	
Complete Transformer (IS:2026/ IEC-60076)	Y												Y

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2) All major Bought Out Items will be subject to NTPC approval.

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LT INDOOR TRANSFORMER (DRY TYPE TRANSFORMER)

Attributes / Characteristics Items/ Components Sub Systems									
	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	NDT / DP / MPI	Voltage Ratio, Vector Group & Polarity	Make / Type / Rating / Model /TC / General Physical Inspection	Routine Test as per relevant standard / NTPC Specification
Enclosure door, H.V. & L.V. Cable Box / Flange Throat	Y	Y						Y	
Copper Conductor	Y	Y	Y		Y				
Insulating Material	Y			Y	Y				
CRGO Lamination & Built Core	Y							Y	
Porcelain Bushing /Insulator (IS:2544 / 5621)	Y	Y	Y					Y	Y
Gasket (IS 2712)	Y	Y						Y	Y
Off-Circuit Tap Changer	Y							Y	Y
Core Coil Assembly	Y						Y		
Marshalling Box	Y								Y
WTI, Thermistor, Terminal Connector	Y							Y	
Complete Transformer (IS:11171 / IEC 60076)	Y								Y

Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.
2) All major Bought out Items will be subject to NTPC approval.

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AUXILIARY / LT TRANSFORMER

Attributes / Characteristics												
	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	Functional check	WPS & PQR
Items /Components Sub Systems	Routine Test as per relevant standard / NTPC Specification											
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y					Y
Conservator / Radiator / Cooler / Pipes	Y	Y					Y					
Copper Conductor (IS:191)	Y	Y	Y		Y							
Insulating Material	Y	Y	Y	Y	Y	Y						
CRGO Lamination & Built Core	Y	Y	Y		Y	Y				Y		
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y
Gasket	Y	Y			Y	Y		Y		Y		Y
Transformer Oil (IEC296)			Y									Y
OLTC / Off-Circuit Tap Changer	Y									Y		Y
Core Coil Assembly & Pre-tanking	Y								Y	Y		
Marshalling Box	Y									Y	Y	Y
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves	Y									Y	Y	
Welding (ASME Sect-IX)	Y						Y					Y
Complete Transformer (IS:2026/ IEC-60076)	Y											Y

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
 2) All major Bought Out Items will be subject to NTPC approval.

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10) SWITCHYARD

Attributes / Characteristics Items/ Components Sub Systems	Make, model, Type & Rating, Test Certificate	Routine & Acceptance Test as per IS / IEC	Functional requirements as per BHEL/NTPC Specification
Energy meter	Y	Y	Y
Circuit Breaker (IEC:62271-100)	Y	Y	Y
Isolator (IEC:62271-102)	Y	Y	Y
Current Transformer (IEC:60044/BS:3938/IS2705/ IEC: 61869)	Y	Y	Y
Potential Transformer (IEC:186A / 358/IS3156/IEC60044/ IEC: 61869)	Y	Y	Y
Bus Post Insulator (IEC:168 / 815 / IS:2544)	Y	Y	Y
Disc, Pin & String Insulator (IEC:383 / IS:731)	Y	Y	Y
Surge Arrestor (IEC:99-4/IS:3070)	Y	Y	Y
Spacers, Clamps & Connector (IS:10162 / 5561/ 617)	Y	Y	Y
Galvanized Steel Structures (IS:2062/2629/4759/6745)	Y	Y	Y
Vibration Damper (IS:9708)	Y	Y	Y
Sag Compensating Spring DIN:2089/2096 IS:3195 / 7906	Y	Y	Y
SF6 Gas filling & evacuating plant	Y	Y	Y
SF6 Gas Leak Detector	Y	Y	Y
Leakage Current Analyser	Y	Y	Y
Protection Relays	Y	Y	Y
Relay Test Kit	Y	Y	Y
Surge Monitor	Y	Y	Y
<p>Notes : 1) This is an indicative list of test/checks. The manufacture is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalization for all items.</p> <p>2) All major Bought Out Items will be subject to BHEL/NTPC approval.</p>			

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12) ENERGY METER

Attributes / Characteristics →						
Items / Components / Sub- assembly ↓	Make, Model, Type, Rating & Finish	Conform to relevant Standard & NTPC spec	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per NTPC approved drgs & specification	Burn-In Test and Elevated Temperature Test as per specification	All routine & acceptance tests as per IS 13779
Electronic Components	Y	Y				
PCB for electronic cards	Y					
Electronic Cards	Y	Y		Y	Y	
Terminal Blocks as per IS 13779	Y	Y				
Instrument Transformer CTs & PTs (IS : 2705 & IS 3156)	Y	Y				
Sheet Steel (IS : 513)	Y	Y				
Synthetic Rubber Gaskets IS 11149	Y	Y				
Energy meter IS 13779	Y		Y	Y	Y	Y
Notes: <ol style="list-style-type: none"> This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. Makes of all major Bought Out Items will be subject to NTPC approval. 						

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13.GENERAL TECHNICAL REQUIREMENTS

1.0 INTRODUCTION

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical requirements brought out in the Technical Specifications and the Technical Data Sheets.

2.0 BRAND NAME

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.0 BASE OFFER & ALTERNATE PROPOSALS

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice may also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer along with the bid to enable the Employer to determine the acceptability of these proposals.

4.0 COMPLETENESS OF FACILITIES

Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

- a) All equipment furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

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5.0

Codes & Standards

5.1

In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

- a) Bureau of Indian Standards (BIS)
- b) Indian electricity act
- c) Indian electricity rules
- d) Indian Explosives Act
- e) Indian Factories Act and State Factories Act
- f) Indian Boiler Regulations (IBR)
- g) Regulations of the Central Pollution Control Board, India
- h) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- i) Pollution Control Regulations of Department of Environment, Government of India
- j) State Pollution Control Board.
- k) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- l) Any other statutory codes / standards / regulations, as may be applicable.

5.2

Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

- a) Japanese Industrial Standards (JIS)
- b) American National Standards Institute (ANSI)
- c) American Society of Testing and Materials (ASTM)
- d) American Society of Mechanical Engineers (ASME)
- e) American Petroleum Institute (API)
- f) Standards of the Hydraulic Institute, U.S.A.

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- g) International Organization for Standardization (ISO)
- h) Tubular Exchanger Manufacturer's Association (TEMA)
- i) American Welding Society (AWS)
- j) National Electrical Manufacturers Association (NEMA)
- k) National Fire Protection Association (NFPA)
- l) International Electro-Technical Commission (IEC)
- m) Expansion Joint Manufacturers Association (EJMA)
- n) Heat Exchange Institute (HEI)

5.3 Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, alongwith the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

5.4 As regards highly standardized equipment National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

5.5 In the event of any conflict between the codes and standards referred to in the above and the requirement of this specification, the requirement of Technical Specification shall govern.

5.6 Two (2) English language copies of all-national and international codes and/or standards which are not available with BHEL/NTPC and same is used in the design of the plant, equipment, civil and structural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.

5.7 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

6.0 EQUIPMENT FUNCTIONAL GUARANTEE

- a) The functional guarantees of the equipment under the scope of the Contract is given elsewhere in the technical specification. These guarantees shall

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- b) supplement the general functional guarantee provisions covered under General Conditions of Contract.

Liquidated damages for shortfall in meeting functional guarantee(s) during the performance guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.0

DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS

Design of Facilities

- a) All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Contractor shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various parts of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

Maintenance and Availability Considerations

Equipment/facilities offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

- b)

Bidder shall state in his offer the various maintenance intervals, spare parts and man- hour requirement during such operation. The intervals for each type of maintenance namely the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage.

- c) Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.

8.0

DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR

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a) Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

b) The Contractor shall furnish engineering data/drgs. for entire equipment covered under this specification in accordance with the schedule of information as specified in Technical Specification and Data sheets.. This documentation shall include but not be limited to the following :

INSTRUCTION MANUALS

a) The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipment covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the Employer the Instruction Manuals shall be submitted. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

- i) Procedure for initial checking after erection.
- j) Procedure for testing and acceptance norms.
- k) Procedure / Check list for pre-commissioning activities.
- l) Procedure / Check list for commissioning of the system.
- m) Safety precautions to be followed in electrical supply distribution during erection

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(b) Operation & Maintenance Manuals

- i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied to the Employer.
- ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Employer for records.
- iii. A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.
- iv. The manuals shall include the following :
 - a. List of spare parts along with their drawing and catalogues and procedure for ordering spares.
 - b. Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
 - c. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or break down.
 - d. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.
 - e. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the Employer indicating lubrication method for each type/category of bearing.

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Project Completion Report

The Contractor shall submit a Project Completion Report at the time of handing over the plant. After final acceptance of individual equipment /system by the Employer, the Contractor will update all original drawings and documents for the equipment/ system to "as built" conditions and submit.

ENGINEERING INFORMATION SUBMISSION SCHEDULE

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

- a) Information that shall be submitted for the approval of the Employer before proceeding further, and
- b) Information that would be submitted for Employer's information only. The

Engineering Information Schedule shall be updated month-wise.

The schedule should allow adequate time for proper review and incorporation of changes/modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

ENGINEERING PROGRESS AND EXCEPTION REPORT

Report giving the status of each engineering information including

- (a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission
- (b) Drawings which were not submitted as per agreed schedule.

The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

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TECHNICAL CO-ORDINATION MEETING

- The Contractor shall organize and attend at least one monthly progress Meetings with the Employer/Employer's representatives during the period of Contract at mutually agreed venues for review of progress & resolving technical clarifications, if any. The Contractor shall attend such meetings at his own cost and fully co-operate with such persons and agencies involved during the discussions.
- The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that, if required, the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
- The Contractor shall furnish monthly progress report to the Employer detailing out the progress achieved on all erection activities as compared to the schedules. This shall be supplemented by printed colour photographs and video in VCD/DVD indicating various stages of erection and the progress of the work done at Site. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.

DESIGN IMPROVEMENTS

The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

EQUIPMENT BASES

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate which support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

PROTECTIVE GUARDS

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Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

LUBRICANTS, SERVO FLUIDS AND CHEMICALS

The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder.

As far as possible lubricants marketed by reputed companies shall be used. The variety of lubricants shall be kept to a minimum possible.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.

Lubrication

Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

Material of Construction

All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

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RATING PLATES, NAME PLATES & LABELS

Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non- corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.

Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear sides.

Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.

Nameplates shall be as per best practices of the industry

All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system

TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.

Welding

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If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be performed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.

COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES

All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

PROTECTION AND PRESERVATIVE SHOP COATING

Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.

Preservative Shop Coating

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish- painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

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All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Employer.

All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

Painting for Civil structures shall be done as per relevant part of technical specification

QUALITY ASSURANCE PROGRAMME

The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001.A quality assurance programme of the contractor shall generally cover the following:

- (a) His organisation structure for the management and implementation of the proposed quality assurance programme
- (b) Quality System Manual
- (c) Design Control System
- (d) Documentation and Data Control System
- (e) Qualification data for bidder's key personnel.
- (f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- (g) System for shop manufacturing and site erection controls including process, fabrication and assembly.
- (h) Control of non-conforming items and system for corrective actions and resolution of deviations.
- (i) Inspection and test procedure both for manufacture and field activities.
- (j) Control of calibration and testing of measuring testing equipment.
- (k) System for Quality Audits.
- (l) System for identification and appraisal of inspection status.

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- (m) System for authorising release of manufactured product to the Employer.
- (n) System for handling, storage and delivery.
- (o) System for maintenance of records, and
- (p) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

GENERAL REQUIREMENTS - QUALITY ASSURANCE

- a) All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS- 01-QAI-P- 01/F3. If bidder wishes to appoint a TPIA for inspection on his behalf, same shall be intimated during finalisation of Quality plans. Such agency and their representative's credential would be reviewed and approved by BHEL/NTPC as per applicable procedures.
- b) Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub- contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
- c) Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.

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- d) The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative along with Contractor's QA representative or an BHEL/NTPC approved TPIA on behalf of Contractor and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
- e) No material shall be dispatched from the manufacturer's works before the same is accepted, subsequent to predispatch final inspection in presence of Contractor's QA representative or an BHEL/NTPC approved TPIA on behalf of Contractor, including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for dispatch by issuance of Material Despatch Clearance Certificate (MDCC).
- f) All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- g) The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-CQA-W- 11/F1. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
- h) All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

All welding/brazing procedures shall be submitted to the Employer or its authorized representative for approval prior to carrying out the welding/brazing.

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- a) All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- b) Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- c) For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- d) Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- e) No welding shall be carried out on cast iron components for repair.
- f) All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- g) All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non- destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

- a) The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01- QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his

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own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

- b) For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract. **
- c) Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- d) The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- e) Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in

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ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

- f) For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- g) Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

Environmental Stress Screening

- a) Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be necessarily furnished for any sub vendors proposed for vendor assessment and approval for this contract. For other approved sub vendors of above mentioned systems, contractor shall furnish the test procedure for eliminating infant mortile components in case, if it is asked for by the employer before these items are offered for inspection / dispatched to site.

Software Reliability / Quality Certification

- a) Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β -version and offered software is also free from all known bugs as on date of approval of systems documents by BHEL/NTPC as a part of quality documentation review and approval process during detail engineering.

An indicative list of sub-vendors which has been accepted by NTPC in the past for Corporate Awarded similar packages based on the respective Technical Specifications are enclosed in the tender specification for reference purpose only. The purpose of this list is to provide general guidance to the prospective Bidders / Main Contractors for this package only. Further, this list is indicative in nature and may undergo revision for future packages based on the performance feedback received from NTPC sites / other agencies about the supplier / sub vendors / supplied material. However, it is not the intention to limit the sub- vendor to only such names appearing in the above list and Main contractor is free to propose additional sub-vendors in his bid offer which will be subject to NTPC sub-vendor assessment system upon receipt of requisite details in a time

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bound mutually agreed schedule. . Moreover listed suppliers may or may not be able to supply the material as per current Tech Specifications for the present package. Bidder is required to enquire before finalizing the suppliers / sub vendors for the present contract to meet provisions of the current Tech Specs.

Standard Manufacturing Quality Plan (SQP)/Indicative Manufacturing Quality Plan(IQP)/ Standard Field Quality Plan (SFQP)/ Indicative Field Quality Plan(IFQP) are enclosed for the major items, which can be used as a reference purpose for item under consideration.

The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors and shall be submitted to the Employer for approval within a time bound schedule drawn during detailed engineering process. Such sub-vendor proposed in his bid offer shall be deemed to be identified in DR category and upon final acceptance by BHEL/NTPC in writing, contractor can place order on such accepted sub-vendor only.

Monthly progress reports on sub-contractor detail submission / approval shall be furnished as per Engineering Co-ordination Procedure. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract. Sub-vendor whose details are not submitted within the agreed cut- off date, shall be deemed to be withdrawn by the contractor.

d) QA DOCUMENTATION PACKAGE

The Contractor shall be required to submit the QA Documentation in two copies and two CD ROMs, as identified in respective quality plan with hard tick mark.

- b) Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

- a) Typical contents of QA Documentation is as below:-
b) Quality Plan
c) Material mill test reports on components as specified by the specification and approved Quality Plans.

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- d) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
 - e) Heat Treatment Certificate/Record (Time- temperature Chart)
 - f) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
 - g) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
 - h) Certificate of Conformance (COC) wherever applicable.
 - i) MDCC
- Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.
- Before dispatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.
- (a) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
 - (b) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
 - (c) If a decision is made dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

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INSPECTION, TESTING AND INSPECTION CERTIFICATES

- The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days

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PRE-COMMISSIONING AND COMMISSIONING FACILITIES

The Contractor upon completion of installation of equipment's (BHEL scope) and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities. All pre- commissioning/commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in specification elsewhere in the technical specifications shall be performed by the contractor.

The pre-commissioning and commissioning activities of the equipment/systems furnished and installed by the contractor shall be the responsibility of the Contractor. The Contractor shall provide, in addition, temporary instrumentation and other measuring devices, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at site during such operations.

All erection & commissioning checks shall be as per manufacturer's manual on mutually agreed terms

- (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre- commissioning tests, commissioning and start-up at Site. The list of pre- commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included elsewhere in the Technical Specifications.
- (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.
- (c) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- (d) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over for commissioning (start-up), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SCL (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] to be furnished by the manufacturer/supplier.
- (e) The Contractor shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the

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equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

- (a) Working platforms should be fenced and shall have means of access.
- (b) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

PACKAGING AND TRANSPORTATION

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at

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Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Employer's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

Instrumentation and Control

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units

All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

ELECTRICAL NOISE CONTROL

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

ELECTRONIC MODULE/COMPONENT DETAILS

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The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

S. N.	Description Of Documents	No of (Sets)	NO. OF CD-ROMs Prints /Floppy
1.	Drawings for Initial Submission (Either "FOR or "FOR INFORMATION re-submissions after review by (including Data sheets/ Calculations, all Equipment/instrument schedule, BOM etc)	8	1 Soft Copy APPROVAL" (through 2 sets of Category) and Floppy or 1 no of BHEL/NTPC CD-Rom or through E-Mail)
2.	Final Approved Drawings (Cat-I & Cat – IV (As referred in SI no: 1 above)	3	4 CD- Roms Approved)
3.	Documents / Drawings "AS BUILT "	3	4 CD- Roms
4.	Type test reports (Intial)	8	1 Soft Copy (through 2 sets of Floppy or 1 no of CD-Rom or through E-Mail)
5	Type test reports (Final)	1	2 CD-Roms
6.	Piping / Equipment Analysis (Transient) etc, reports (Draft) Including the input/	8	1 Soft Copy Model study (through 2 sets of output data etc. Floppy or 1 no of CD-Rom or through E-Mail)
7.	Piping / Equipment Analysis (Transient) etc, reports (Final Approved) Including the input/ output data etc.	2	4 CD-Roms Model study

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S. N.	Description Of Documents	No of (Sets)	NO. OF CD-ROMs Prints /Floppy
8	Erection manual "Draft "	4 sets	1 CD ROMS
8	Erection manual "Final "	4 sets	1 CD ROMS
9	Operation & Maintenance manual "DRAFT"	4 sets	2 CD ROMS
10	Operation & Maintenance manual "FINAL"	4 sets	4 CD ROMS
11	Commissioning Procedure (If applicable)	4 sets	1 CD ROMS (DRAFT)
12.	Commissioning Procedure (If applicable)	4 sets	1 CD ROMS (FINAL)
13	Performance and Guarantee test Procedure	8	1 Soft Copy (Draft) (through 2 sets of Floppy or 1 no of CD-Rom or through E-Mail)
14.	Performance and Guarantee test Procedure or 1 no of	8	1 Soft Copy (2 (Final) Floppy CD-Rom or through E-Mail)
16	Progress Reports	8	3 FLOPPIES
16	Project completion report	3 Sets	3CD ROMS
17	QA programme including Organisation for implementation and QA system manual (with revision-servicing)	1	1 CD-ROM
18	Vendor details in respect of proposed vendors contractor's evaluation report.	1	1 CD -ROM including

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S. N.	Description Of Documents	No of (Sets)	NO. OF CD-ROMs Prints /Floppy
19	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, POR etc.		
	i) For review/comment -	3	1 set of soft copy
	(ii) For final approval 1 set floppies	4	1 CD ROM
20	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals		
	Draft	4 sets	
	Final	4 sets	2 CD ROMS
21	Monthly Vendor Approval /QP approval status	2 sets	1 FLOPPY
22	QA Documentation Package for field equipment / systems at site	2 Sets	2 CD ROMS activities on
23	QA Documentation Package for field equipment / systems at site	2 Sets	2 CD ROMS activities on

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14.TENDER DRAWINGS

SL. NO.	DRAWING NO.	TITLE
1.	5817-004-POE-A-001	Basic Single Line Diagram- Indicative
2.	5817-004-POE-A-002	Vicinity Map- Tentative Available Land Area
3.	5817-004-POE-A-003	Indicative Cable Route Of Existing Solar And Tapping/Rerouting Methodology
4.	5817-004-POC-A-001	Typical Details Of Approach Roads (BHEL scope)
5.	5817-004-POC-A-002	Details Of Chain Link Fencing (BHEL scope)

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15.DATA TO BE PROVIDED BY BIDDER

BESS Service Life:

Project design Life: 20 Years Battery Life : 20 Years

O&M Period 10 Years

O&M Year (n th) (After Successful Commissioning)	Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh	Declared BESS AC/AC Round Trip Efficiency (%) at Metering Point (Including auxiliary Consumption)
01	400	
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Note:-

- Above declared efficiency shall be the annual average round trip AC/AC Efficiency (%) of BESS system at Metering Point considering the energy loss (including auxiliary power requirement) of BESS. Annual average round trip AC/AC efficiency shall not be less than 80% for 1st year. Degradation in efficiency in subsequent years shall be allowed. However, RTE including auxiliary consumption shall not be less than 75 % in any year (upto 20 years).
- Bidder to fill the Daily Dischargeable Energy Capacity and efficiency data upto 20 years of designed service life of the BESS system. As per tender specification the service life of BESS shall be 20 years and O&M period shall

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be 10 years.

(k) Dispatchable capacity at any time during the project design life shall not be less than 65% of dispatchable capacity at beginning of project life.

Both Charging and discharging energy shall be measured in BESS incomer feeders at BESS Pooling Switchgears. Other meters shall serve as standby/backup. Kindly refer revised tender SLD for better clarity.

(Signature).....
(Printed Name).....
(Designation).....
(Common Seal)

Further, we confirm to carry out comprehensive Operation & Maintenance (O&M) of the BESS plant for a period of BESS Service Life (i.e. **10 Years**) including replacement and Disposal for the BESS Service Life as specified in the Technical Specifications

(Declaration on Local Content)

*1.0 We confirm that we are not a 'Class-I local supplier'.

**Bidder to Strike off, whichever is not applicable.*

1.1 We confirm that we are a Class-I local supplier for Item(s) mentioned at Annexure in Technical Specifications, as applicable. We further confirm that in case such item(s) are bought-out for us, we shall source the same from Class-I local supplier only.

1.2 We undertake that a certificate from the statutory auditor or cost auditor (in the case the bidder is a company) or from a practicing cost accountant or practicing chartered accountant (in respect of bidders other than companies) certifying the percentage of local content shall be submitted by us prior to submission of our last bill for payment.

2.0 Further, we hereby confirm that we are presently not debarred / banned by any other procuring entity for violation of 'Public Procurement (Preference to Make In India), Order 2017' (PPP-MII Order) dated 15.06.2017 and its subsequent revisions/ amendments issued by Department of Industrial Policy and Promotion (DIPP).

3.0 We agree to furnish any information as a proof of the above to your satisfaction as and when required.

(Signature).....
(Printed Name).....
(Designation).....

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Declaration regarding Import Content

We confirm the details of Import Content included in our bid in respect of Ex-works (India) price quoted

These details are furnished for the purpose of issuance of Relevant Certificate by the employer

Sl. No.	Description of item to be supplied	Quantity	Value*
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			

* Please state the currency and fill in the amount in figures and words.

Note:

- Continuation sheets of like size and format may be used as per Bidders requirements and shall be annexed to this Attachment.
- These details are furnished for the purpose of issuance of the Required Certificate. We further confirm that we shall be solely responsible for availing benefits (If Available).
- Bidder may apprise themselves of provisions of bidding documents regarding "Preference to Make in India and Eligibility for Participation/granting of Purchase Preference to Class-I local suppliers" before submission of bid.

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LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH TECHNICAL BID

1. Total BESS layout till 33KV with equipment's and its ratings.(AutoCAD file).
2. Bidder Design Total Auxiliary power consumption
3. Bidder suggestion on Multi winding Transformer rating and features , HT panel rating and features.
4. Distance between PCS and Transformer and HT panel.
5. Battery containers Dimensions, weight and Minimal Inputs for BHEL Civil Design.
6. PCS Dimensions, weight and Minimal Inputs for BHEL Civil Design.
7. Earthing recommendations for Battery, PCS system.
8. LT AC cable Details, total runs from PCS to transformer
9. HT AC cable Details, total runs from transformer to HT panel
10. Aux Transformer KVA requirement details
11. All the Datasheets may be provided by Bidder.
12. Bidder need to provide the offer in the attached format.
13. Bidder need to provide no deviation certificate wrt PBG and LD calculations.
14. RTE Calculation with and without auxiliary power till 33kv end as per specification with all battery parameters.

16.DELIVERY SCHEDULE

The following shall be the schedule for completion of work for this package

Design, engineering, manufacture, Factory testing, transport and delivery at Site till 33KV (testing, commissioning trial run,PG test)of overall system for 100MW/400MWh BESS Power Plant **10 Months from the date of LOA/PO.**

Design and Drawings shall be submitted for approval within one month of LOA/PO notification.
Manufacturing as per Document and Factory Inspection call , Transportation to Site within Six months of Drawing Approval.

O&M of the Plant including the power evacuation system till 3kV end
10 Years from the date completion of trail test.

Extended Battery and associated systems Warranty for 10 years from the date of completion of O&M. (so that declared RTE will be achieved till 20 years)

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PERFORMANCE PARAMETERS AND LIQUIDATED DAMAGES FOR DURING PG TEST AND O&M PERIOD

PERFORMANCE PARAMETER OF BESS FOR COMPLETE LIFE: -

1.0

i. Round Trip AC-AC Efficiency: -

The contractor shall also ensure the yearly round trip efficiency as declared during Bid. BESS system will meet its auxiliary consumption also through stored energy. The auxiliary consumption shall be included in RTE calculation. Daily/Monthly/Yearly Efficiency of BESS plant shall be calculated by contractor and suitably automatically logged in configured performance monitoring system of BESS EMS system. Incoming and outgoing energy at metering/delivery point shall be measured with ABT/TEM class meters. The Auxiliary consumption of complete BESS plant shall also be measured separately (as applicable) with ABT/TEM class meter installed at intermediate voltage level/33kV Auxiliary load feeders. The efficiency shall be measured as follows:

$$\eta_{meas\ Y} (\%) = (G_{out}/G_{in}) \times 100\%$$

Where G_{in} and G_{out} are the total cumulative incoming and outgoing energy measured during one complete charge-discharge cycle.)

Monthly Roundtrip Efficiency $\eta_{meas_M}(\%)$

$$= \frac{\text{Sum total of Actual Discharging MU in a month}}{\text{Sum Total of Actual Charging MU in a month}} \times 100$$

Where,

Charging and discharging energy schedules shall take into account the declared Discharge capacity and round trip efficiency for the particular year.

And Yearly Round Trip Efficiency $\eta_{meas_Y}(\%)$ = Mean of $\eta_{meas_M}(\%)$ measured over period of 12 months in one year.

The declared RTE shall be as per consideration one daily single cycle operation. However, if the BESS is not operated as per this schedule, suitable corrections shall be provided in calculating RTE to account for continuous auxiliary consumption, self-discharge losses etc.

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ii. MW and MWh Capacity Demonstration of BESS: -

Bidder shall also demonstrate, on monthly basis, 100% of the minimum throughput Capacity of the BESS Plant as quoted by bidder , at the metering/delivery point to the grid. Monthly/Yearly MW/MWH capacity of BESS should be suitably automatically logged in the configured performance monitoring system/EMS of BESS Plant.

Note : As bidder is allowed to quote BESS Dischargeable capacity for every year based on actual degradation, replacement of batteries is not envisaged. However, if the actual measured parameters at site are not as per quoted parameters, required replacement/addition shall be done by Bidder considering 20 year design life at no additional financial implication to BHEL/NTPC.

iii. BESS ANNUAL AVAILABILITY: -

The bidder shall maintain a minimum of **95% availability** on an annual basis over the complete O&M period of the project. Availability of the Project shall mean the ability to execute a function i.e. charging or discharging, when called upon to do so as per the schedule, subject to the minimum system ratings as per specifications and parameters quoted by Bidder in attachment 9. The Bidder shall make the BESS available for 1 operational cycle per day, i.e. 1 complete charge-discharge cycles per day. The EMS of BESS Plant should have facility to calculate availability of the BESS capacity. The Annual availability shall commence from the date of commissioning and shall be calculated as below:

Annual System Availability (SA) = Mean of the System availabilities of all time-blocks during the year in which the power has scheduled for charging/ discharging the BESS.
where,

BESS system Availability in a time block

$$= \frac{\text{Actual Injection or drawl } MUi(A)}{\text{Scheduled Injection or drawl } MUi(B)}$$

Where,

i refers to the ith time-block in the year where Scheduled Injection/Drawl $MUi \neq 0$.

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2.0

Actual Injection/Drawl MUI is the Energy Scheduled for Charging/Discharging in the ith time block, in MUs.

Scheduled Injection/Drawl MUI is the Energy Scheduled for Charging/Discharging in the ith time block, in MUs.

A and B shall be as per the measurement at the Main ABT Meter at the Point of Interconnection/metering point.

The Scheduled capacity shall be subject to the System Power Rating of 100MW.

LIQUIDATED DAMAGES:

As per the provision of the bid document, Operation & Maintenance of the BESS system for the period of 10 years from the date of completion of the trial run lies in scope of bidder. During the O&M period, the bidder shall be responsible for the following activities but not limited to the following:

- a) Maintaining availability of the BESS plant
- b) Carry out preventive maintenance as per OEM practices
- c) Carry out breakdown maintenance.

During the O&M period following parameters shall be tested every year:

- a. Outage duration (calculated)
- b. Fall in Mega Watt (MW) and Mega Watt Hour (MWh) Capacity
- c. The efficiency of BESS system.

During O&M periods, BHEL/NTPC may ask the Bidder (at any point of time) to carry out capacity tests and other functional tests (as applicable) in case BESS is not able to perform/functions as per technical specification requirements. Bidder shall be responsible for taking all corrective action, including installing an additional battery bank, etc. (if required), in order to make the BESS system fully functional as per technical specification requirements.

a) LD applicable due to shortfall of Yearly Round Trip Efficiency: -

In case measured efficiency of ESS $\eta_{\text{meas Y}}$ (%) is less than declared efficiency $\eta_{\text{decl Y}}$ (%) in a particular year, bidder shall be liable to pay LD for loss in dispatchable energy on account of fall in efficiency which shall be calculated as follows,

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$$LD_{\eta Loss}(INR) =$$

$$1.5 * (Evaluated INR Per MU) * \frac{MWhCn}{1000} * 365 * BESS Availability * \left(\frac{1}{\eta_{meas_Y}} - \frac{1}{\eta_{decl_Y}} \right) * 100$$

b) LD applicable due to shortfall of BESS Annual Availability: -

Liquidated damages on account of shortfall in meeting the performance criteria will be computed as follows:

$$LD_{avail} = 1.5 * (Evaluated INR per MU) * (MWhCn/1000) * 365 * (GSA - SA)/100$$

where,

GSA is Minimum allowed ESS Annual Functional Availability (95%).

SA is Actual Annual System Availability, as calculated as per above.

The above equation applicable only if SA is less than 95%.

MWhCn is the daily discharge capacity for nth year quoted by bidder.

O&M period of part commissioned capacity: Liquidated damages for shortfall in dispatchable capacity during O&M period of part commissioned project capacity shall also be applicable on pro rata basis of part commissioned Capacity.

Maximum Liquidated Damages for the shortfall in dispatchable energy during each year of O&M period shall be limited to value corresponding to 10 % of the annual dispatchable energy as per parameters quoted by the bidder at 1.5 times of evaluated tariff as indicated above.

In case of shortfall in dispatchable energy during O&M, recovery of LD shall be first deducted from payment towards O&M contract value Upto limiting level of 25% of the Annual Contract Value. The adjustment of LD amount shall be done in the 4th Quarter.

In case the LD recovery amount exceeds above limiting value, the balance amount shall be recovered through Bank Guarantees (CPBG/EPBG/BPBG), as applicable , submitted by successful bidder. The value of amount encashed from above BG shall have to be replenished by Bidder within three months.

- i. LD applicable due to shortfall of Yearly Round Trip Efficiency
- ii. LD applicable due to shortfall of BESS Annual Availability

Maximum Liquidated Damages for the shortfall in dispatchable energy during each year of O&M period shall be limited to value corresponding to 10 % of the annual dispatchable energy as per parameters quoted by the bidder at 1.5 times of evaluated tariff as indicated above.

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Performance Bank Guarantee (PBG)

S no	Activity	Amount	Time
1	Contract Performance BG	10% of Total contract value except O&M contract (i.e. of 10% of Supply and Service Contract) with an initial validity upto ninety (90) days beyond the end of scheduled Defect Liability Period	
1	Submission of EPBG	10 % of O&M contract value to be submitted	Before commissioning
2	Modification of EPBG	EPBG amount to be increased to 8% of total Contract value	Completion of PG test and Submission of Modified EPBG.

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification Group : BESS system

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3	Modification of EPBG	Release of each 10 % of modified EPBG Value at SI No. 2.	From 2 nd year to 10 th year, at the end of each year of successful operation.
4	Submission of BPBG And Final Release of EPBG	Bidder shall submit BPBG amounting to 10 % of original EPBG value at SI no. 2 from Battery OEM for performance of battery as per quoted parameters for remaining life of battery. If BG from Battery OEM is not submitted, remaining 10% EPBG shall be treated as BPBG. Validity of the same would be needed to be increased.	Before the End of 10 th year of successful operation. The final installment of EPBG would be released only after Submission of BPBG
5	Modification of EPBG	Release of each 20 % of BPBG Value at SI No. 4	From 10 th year to 20 th year. At the end of each two year, after successful performance of battery.

The EPBG shall be valid up to (90) days after the end of BESS Service Life period of 10 Years. Whereas, BPBG shall be valid up to (90) days after the end of Designed Life of 20-years. The above security amount shall be payable to the Employer without any condition whatsoever.

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An illustrative method of evaluation is explained below: Illustrative Method of Evaluation

Illustrative Method of Evaluation

	Any Bidder ---(Equivalent INR)---
1. Quoted Bid Price (after considering arithmetical corrections)	
(i) Ex-works price including type test charges for equipment and mandatory spares (Schedule-1)	A1
(ii) Price for transportation and mandatory spares (Schedule-2)	A2
(iii) Price for Erection Support and commissioning (Schedule-4)	A3
(iv) Total Price (TP)	$TP = A1 + A2 + A3$
2. Taxes & Duties (not included in 1 above)	
(i) GST on Schedule 1, 2 & 4	GST
3. Complete Initial capital cost up to commissioning (A)	$A = TP + GST$
4. Efficiency/Performance/ Adjustments as mentioned below)	C
5. Specific Additional Criteria as mentioned below)	B
5a. Comprehensive Warranty (Schedule-8)	D
6. Evaluated Bid Price (EP)	$EP = A + B + C + D$
7. "BESS Levelized energy for entire service life (20-years) in MU" as mentioned below)	L
8. Evaluated Price in INR per Million Unit (INR/MU) (i.e. "Levelized Cost on the basis of INR per Million Unit (MU)")	EP/L

Efficiency/Performance/ Adjustments

1. For the purpose of evaluating the cost of Energy loss due to BESS efficiency (C), the following shall be considered.

a. The energy tariff shall be considered **INR 2.90/kWh**.

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b. BESS year-wise energy loss shall be calculated as,

Energy Loss in n^{th} year,

$$Energy_{Loss}^n = MWhC^n \times 1000 \times 365 \times BESS_{Availability} \times \left(\frac{100}{\mu_{decl}^n} - 1 \right) kWh$$

Where,

$MWhC^n$ is the rated BESS discharge energy (MWh) capacity at metering point corresponding to the n^{th} year of O&M, as declared by the Bidder

μ_{decl}^n (%) is the BESS AC/AC round trip efficiency (%) at metering point including auxiliary consumption corresponding to n^{th} year of O&M, as declared by the Bidder.

Total NPV of year-wise recurring cost on account of energy loss due to BESS round trip AC-AC efficiency (C) shall be evaluated as under:

$$C = \sum_{n=1}^n \{ (Energy_{Loss}^n \text{ in } n^{\text{th}} \text{ Year} \times 2.90) \times NF^n \}$$

- ' n ' = 20 i.e BESS design life (in years)
- ' NF^n ' is the NPV Factor corresponding to the n^{th} Year considering discount rate of 7.5%

n^{th} Year	NPV Factor (NF^n)
1	0.93023
2	0.86533
3	0.80496
4	0.74880
5	0.69656
6	0.64796
7	0.60275
8	0.56070
9	0.52158
10	0.48519
11	0.45134
12	0.41985
13	0.39056
14	0.36331
15	0.33797
16	0.31439

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SOLAR BUSINESS DIVISION
BENGALURU – 560012, INDIA
Purchase Specification **Group : BESS system**

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17	0.29245
18	0.27205
19	0.25307
20	0.23541

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Specific Additional Criteria

Net Present Value (NPV) of year wise Comprehensive O&M cost (for 10 years) **(B)**.

The NPV shall be calculated as per the year wise Comprehensive O&M cost including Taxes & Duties and corresponding GST as quoted in **Schedule-7**. For the purpose of evaluating the above NPV, following shall be considered.

$$B = \sum_{n=1}^n O_n \times NF_n$$

Where

O_n = Comprehensive O&M cost of nth Year (including taxes, duties and GST) N = BESS Service Life (in years) as quoted by bidder

NF_n is the NPV Factor corresponding to nth Year of O&M is given below.

n^{th} Year	NPV Factor (NF^n)
1	0.93023
2	0.86533
3	0.80496
4	0.74880
5	0.69656
6	0.64796
7	0.60275
8	0.56070
9	0.52158
10	0.48519

For the purpose of evaluation, the “BESS Levelized Energy for entire design life” (L) shall be calculated as:

$$\text{BESS levelized energy for entire service life} = \sum_{n=1}^n BESS_{ADE}^n \times NF^n$$

Where,

- $BESS_{ADE}^n$ is the BESS annual discharge energy (in MU) in n^{th} year and same shall be calculated as,

$$BESS_{ADE}^n = MWhC^n \times 365 \times BESS_{Availability} / 1000$$

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Where,

- MWh^n is the rated BESS discharge energy (MWh) capacity at metering point corresponding to the n^{th} year of O&M, as declared by the Bidder in the Attachment- 9 of Techno-Commercial Bid.
- BESS annual availability ($BESS_{Availability}$) shall be taken 95%.
- ' n ' = 20 i.e. BESS Design life (in years)

' NPV^n ' is the NPV Factor corresponding to the n^{th} Year (Considering discount rate of 7.5%) is given below:

n^{th} Year	NPV Factor (NPV^n)
1	0.93023
2	0.86533
3	0.80496
4	0.74880
5	0.69656
6	0.64796
7	0.60275
8	0.56070
9	0.52158
10	0.48519
11	0.45134
12	0.41985
13	0.39056
14	0.36331
15	0.33797
16	0.31439
17	0.29245
18	0.27205
19	0.25307
20	0.23541

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Information to Bidder :

Requirement of Single IBR unit Simulation model & Benchmarking report :

- a. Single SoC (Statement of Conformity) and Evaluation Report for Type test report as per CEA Connectivity standard mentioning all Hardware/software/Firmware version
- b. Fault current characteristics (voltage -current) of Inverter(PCS) during fault condition. The Reactive power response of the Inverter(PCS) in case of fault condition, should be faster to support Grid or as per Grid operator.
- c. Current and voltage Waveform capture facility during LVRT/HVRT at Inverter(PCS) output terminal during event and accessible to BHEL/NTPC in EMS/ SCADA /PPC. Availability of high-resolution data with pre fault/post fault time and automatic extraction of the above data into EMS/ SCADA /PPC subsequent to fault avoiding manual/OEM intervention.
- d. During LVRT and HVRT, the Inverter(PCS) shall distribute its active and reactive capacity in such a way that first priority will be reactive power support as per voltage dip. The active current and overall current shall be limited as per the transient rated current limit of inverter(PCS). Inverters should be capable to support reactive current in case of asymmetrical (1 ph/2 ph) fault condition. Active and reactive power response shall be oscillation free.
- e. Inverter(PCS) controller Setting facility from local as per CEA Regulation. The Inverter(PCS) and its PSS/e and PSCAD model should have the tuneable parameters: FRT Voltage threshold, K factor, Proportional Gain, Integral Gain and Active and reactive power recovery gain during fault recovery duration etc as recommended by grid Operator
- f. Time synchronization facility of Inverter with PPC/SCADA
- g. Single IBR Controller Setting in compliance with CEA grid connectivity regulation.
- h. Single IBR model shall be prepared or get from OEM (for PSS/E and PSCAD) and benchmark it with the lab/factory/field test measurements taken during certification process. Benchmarking report shall include model validation against all the clauses mentioned in B1 & B2 of CEA Technical Standards for Connectivity to the Grid (Amendment) Regulation, 2019. (Bidder to refer Report of the Working Group in respect of Data Submission Procedure and Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid by RE Generators July 2022 and it's amendments/clarifications for detailed requirement of Benchmarking Report of single IBR.
- i. Provision to change setting in inverter according to various operating condition at site is to be provided.

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- j. A separate benchmarking report /simulation comparison is required for SCR=5 and 3 for PSS/E and PSCAD software and furnishing the Parameters for the same. Provision to change setting in inverter according to various operating condition at site is to be provided.

Following shall be part of submission-

1. Comparison of field test measurement with simulation results numerical values & as well as graphical values for following points.
 - a. Power Quality (only in EMT).
 - b. Active power set change (RMS & EMT)
 - c. Reactive power control- V control, pf & Q control (RMS & EMT)
 - d. IBR capability demonstration (RMS & EMT)
 - e. LVRT (RMS & EMT)
 - f. HVRT (RMS & EMT)
 - g. Frequency response (RMS & EMT)
2. Final simulation model parameters like Generator model, Electrical control model, drive train model etc. shall be included in benchmarking report. (RMS & EMT)
3. Firmware version of IBR unit controller for which IBR unit got certified shall also be included in this report.
4. Field test report documents shall be referenced in the benchmarking report.
5. Ensure the setting kept in IBR while field testing & actual IBR installed at site are same, if any alteration kindly include justification for the same.
6. IBR simulation model flat run results for 100 seconds with simulation time step of 1ms shall be included for electrical parameters (P, Q, V, f) and speed to be included (RMS)
7. EMT model of IBR unit- flat run results for 100 seconds with simulation time step of 10us or greater shall be included for electrical parameters (P, Q, V, f) and speed. Further, model shall get initialised within 3 seconds & shall have snapshot capability.
8. Model compatibility: EMT models provided to shall be compatible with PSCAD version 4.6 and above and Intel Visual FORTRAN version 15 or higher and RMS model for PSS/E version 34.4 and above. Same shall be included in the report. The models which is compatible with PSCAD V5 (latest version) with GNU Fortran compiler and with intel Fortran compiler need to be provided. If the model compiled

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in one compiler is not compatible with other compiler, it is requested to provide both models


9. Include a table having IBR controller setting, RMS & EMT model parameter for different control parameters as specified. (RMS & EMT)
10. IBR unit model for PSS/E shall include .sav, .dyr, .py, .idv, .sld, .out files and PSCAD.pscx and other supporting files.
11. Conclusion part include table for which models are benchmarked & whether the model replicates the actual. Error in simulation vs. actual shall be minimum to the extent possible, however it shall not be more than 5%.


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	PROJECT: Solar Project	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				DOC NO	
	PACKAGE:					REV. NO.	
	Main supplier:	SUB SYSTEM: CIVIL WORKS				DATE	
	Contract No. :						
SL. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
1.	COLOUR COATED METAL DECK & CLADDING SHEET (COIL)	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
2.	PROFILERS FOR COLOUR COATED METAL DECK & CLADDING SHEETS	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
3.	ELECTROFORGED GRATING	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
4.	CEMENT	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
5.	REINFORCEMENT STEEL	III	-	STEEL AUTHORITY OF INDIA LTD. (SAIL)		A	
				JINDAL STEEL & POWER LTD. (JSPL)		A	
				TATA STEEL LIMITED.		A	
				RASHTRIYA ISPAT NIGAM LTD. (RINL)	VISAKHAPATNAM, ANDHRA PRADESH	A	
				JSW STEEL LTD.	RAIGAD, MAHARASHTRA BELLARY, KARNATAKA.	A	
				ESL STEEL LIMITED.	BOKARO, JHARKHAND	A	
				JSW ISPAT SPECIAL PRODUCTS LTD.	RAIGARH, CHHATTISGARH	A	
6.	STRUCTURAL STEEL FOR ICR/ SCB/ PEB/ FENCING/ GATE	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE			Main Contactor approved sub-vendor
7.	CONSTRUCTION CHEMICALS, WATER PROOFING COMPOUNDS AND GROUTS	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
8.	PAINT AND PAINTING SYSTEM	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
9.	FIREPROOF DOORS	III	-	MAIN CONTRACTOR APPROVED SOURCES WITH VALID PROTOTYPE	-	-	


	PROJECT: Solar Project	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				DOC NO	
	PACKAGE:					REV. NO.	
	Main supplier:	SUB SYSTEM: CIVIL WORKS				DATE	
	Contract No. :						
SL. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
				TEST REPORT FROM CBRI/CPRI/GOV. LAB.)			
10.	CI PIPES	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
11.	MS BLACK/GI PIPES (IS:3589, IS:1239)	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
12.	RCC PIPES	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
13.	CPVC/UPVC PIPES	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
14.	PVC WATER STOP	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
15.	POLYTHENE WATER STORAGE TANKS	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
16.	BITUMEN	III	-	ALL GOVERNMENT REFINARIES	-	-	
17.	HIGH SOLID CONTENT LIQUID APPLIED URETHANE BASED ELASTOMERIC MEMBRANE FOR WATER PROOFING	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
18.	CERAMIC / VITRIFIED TILES	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
19.	PARTICLE BOARDS, PLYWOOD, MDF	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
20.	PRE-ENGINEERED BUILDINGS	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
21.	FOUNDATION BOLT, HEX BOLT, STEP BOLT	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	
22.	NUTS AND WASHERS	III	-	MAIN CONTRACTOR APPROVED SOURCE	-	-	


	PROJECT: Solar Project	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				DOC NO	
	PACKAGE:					REV. NO.	
	Main supplier:	SUB SYSTEM: CIVIL WORKS				DATE	
	Contract No. :						
SL. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
<p>LEGENDS:</p> <p>1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY EMPLOYER)</p> <p>A – For these items proposed vendor is acceptable to Employer. To be indicated with letter “A” in the list along with the condition of approval, if any.</p> <p>DR – For these items “Details required” for Employer review. To be identified with letter “DR” in the list.</p> <p>2. QP/INSPN CATEGORY:</p> <p>CAT-I: For these items the Quality Plans are approved by Employer and the final acceptance will be on physical inspection witness by Employer.</p> <p>CAT-II: For these items the Quality Plans approved by Employer. However, no physical inspection shall be done by Employer. The final acceptance by Employer shall be on the basis review of documents as per approved quality plan.</p> <p>CAT-III: For these items the Quality control to be exercised as per Main Contractor Quality Assurance System. The final acceptance by Employer shall be on the basis of Certificate of conformance (COC) by Main Contractor.</p> <p>UNITS/ WORKS: Place of manufacturing Place of Main Supplier of multi units/works.</p> <p>NOTE 1: Approval is conditional and subject to Sub QR / Proveness clearance as specified in the contract specification. Further for any change in the Technical Specification at later stage vendor approval will be reviewed accordingly.</p> <p>NOTE 2: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by Employer-EIC/ FQA on the basis of MTC / certificate of conformance in line with Technical Specifications/FQP.</p>							


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 1
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
1.	Battery Cell	I		NTPC Approved Sources			
2.	Battery Management System (BMS)	I		NTPC Approved Sources			
3.	PCS (Power Conditioning System)	I		NTPC Approved Sources			
4.	Energy Management System (EMS)	I		NTPC Approved Sources			
5.	Container	III		Main Contractor approved source			
6.	HVAC System	III		Main Contractor approved source			
7.	Inverter Transformer	I	Q-004	Raychem	Pune	A	Up to 16.8 MVA
				Toshiba Transmission & Distribution Systems (India) Pvt. Ltd.	India	A	Up to 12.5 MVA
				Sudhir Power	Silvassa	A	
				Shilchar	Vadodara	A	
				Hammond	Canada	A	
				Ornet Transformer	Kadi, Gujarat	A	Up to 16.8 MVA
				Telawne Power Equipment's	Taloja and Rabale	A	
				Uttam (Bharat)	Jaipur	A	Up to 12.5 MVA
				Danish	Jaipur	A	Up to 16.8 MVA
8.	DC Cable Connector	III		Any make-model which is Type Tested as per EN 50521: 2008 or having marking of VDE/ CE/UL/ CSA/ "BIS with CML no." (Refer Note-1)			
9.	Floor mounted Draw out type indoor/outdoor LT	Ref Note 2D	Q-005	L&T	Mumbai / Coimbatore/ Ahmednagar	A	BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 2
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
	Switchgear Panel (MCC etc.) Refer Note-4			GE	Bangalore	A	
				C&S Electric	Noida / Hardwar	A	
				Schneider	Nasik	A	ACB from Schneider, France
				Unilec	Gurgaon	A	
				Siemens	Kalwa	A	
				Tricolite	Manesar	A	
				Pyrotech	Udaipur	A	
				Nitya Electrocontrols	Noida	A	
10	LV Air Circuit Breaker	Ref Note 2D		C&S Electric	Noida	A	*(part of Swgr MQP)
				L&T	Mumbai	A	
				GE	Bangalore	A	
				Siemens	Germany	A	
				Schneider	France	A	
11	Floor mounted Fixed type indoor/outdoor LT Switchgear Panel (ACDB/DCDB/MLDB/BMK etc.) Refer Note-4	Ref Note 2D	Q-005	Switching Circuits	Kolkata	A	BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
				Hindustan Control & equipment Ltd	Kolkata	A	With fabrication & painting at unit II & MP Electrical Narendrapur
				Maktel	Vadodara	A	Prior Type Testing
				Jakson	Greater Noida	A	
				Vidyut Control	Gaziabad	A	
				Novateur Electrical & Digital Systems Pvt. Ltd	Rohad (Jhajjar)	A	
				Pyrotech	Udaipur	A	


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 3
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
				Conquerent Control System	Manesar	A	Conditions apply, up to 1250A
				Control & Schematics	Hyderabad	A	
				Positronics	Vadodara	A	
				Anand Power Ltd.	Noida	A	
				Voltech Manufacturing Company	Thiruvanamalai (Tamilnadu)	A	
				BCH Electric Limited	Faridabad Haryana	A	ACDB/DCDB/MLDB/BMK
				Ultima Switchgear Limited	Roorkee	A	Up to 250 Amp
				Additionally, all vendors identified for Floor mounted Draw out type indoor/outdoor LT Switchgear Panel			
12	Wall mounted fixed type indoor / outdoor LT Switchgear non compartmentalized Panel (Lighting panels / AC / DC Fuse boards etc.) Refer Note-4	III		Control Devices	Kolkata	A	BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
				Jasper	Noida	A	
				Havells	Faridabad	A	
				Novateur Electrical & distribution	Murthal	A	
				Avoid Technovator	Manesar	A	
				Additionally, all vendors identified for Floor mounted Draw out type indoor LT Switchgear Panel			
				Additionally, all vendors identified for Floor mounted fixed type indoor LT Switchgear Panel			
13	Lighting & Welding	III		Southern Electric	Chennai	A	


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 4
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
	Transformer			Indcoil	Thane	A	
				Pragati	Thane	A	
				Prayog	Pune	A	
				Precise	Mumbai	A	
				Logicstat	Delhi	A	
				Gujarat Plug in	Vadodara	A	
				AE	Thane	A	
				Power Pack Enterprises	Mumbai	A	
				Amex Impex	Ahmedabad	A	
14	LT CT/PT/CBCT/ Control Transformer	III		Kappa	Bangalore	A	
				Southern Electric	Chennai	A	
				Precise	Mumbai	A	
				G&M (CBCT Only)	Baroda	A	
				Silkaans	Mumbai	A	
				Ind Coil	Mumbai	A	
				Pragati	Thane	A	
				Prayog	Pune	A	
				AE	Mumbai	A	
				Logicstat	Delhi	A	For control transformer only
				C&S Electric	Noida	A	For CT only
				Newtek	Aurangabad	A	For CT/PT/Control transformer
15	1.1KV LT Power Cable	Refer Note-2A	Q-006	Universal Cable Ltd.	Satna	A	
				NICCO	Shamnagar, Kolkata	A	
				Torrent Cable Ltd	Nadiad	A	
				In cab	Pune	A	


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 5
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
				Hindustan Vidyut Products Ltd	Faridabad	A	
				KEI Industries	Bhiwadi	A	
				Delton Cable Ltd	Faridabad	A	A) Unarmoured cable all sizes. B) Armoured cable up to 3.5 x 240 sq. Mm with GI strip armour and 1CX70 sq mm with Al strip armour
				Paramount Cable	Khushkhhera	A	
				Polycab Wires Pvt. Ltd	Daman	A	
				Gemscabs Industries	Bhiwadi	A	
				Cords Cables	Bhiwadi	A	
				Havells India Ltd.	Alwar	A	
				Sri ram Cables	Bhiwadi	A	
				Ravin Cables	Pune	A	
				Thermocables	Hyderabad	A	
				Sbee Cables	Bangalore	A	
				Suyog Cables	Vadodara	A	
				Gupta Power Cables	Khurda	A	
				Finolex	Pune	A	
				Scot Innovation wires and cables	Baddi	A	
				Anhui Hualing	China	A	
				LS Cable	Korea	A	
				Radiant Cables	Hyderabad	A	
				Tirupati Plastomatics	Jaipur	A	


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 6
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
				Apar Industries	Khatalwada, Umbergaon	A	Up to 3.3 KV cable grade
				Special Cables	Rudrapur	A	1CX400 Sqmm, 1.9kV/3.3kV DC Cable
				ABB Kabel	Germany	A	
				Advance cable	Bengaluru	A	
				Step Industries	Shahjahanpur	A	
				Taihan Electric Wire	Korea	A	
				Tbea Shandong	China	A	
				CMI	Baddi	A	
				Dynamic Cables	Jaipur	A	LT XLPE Cable with AL Conductor
				Indo Alusys	Bhiwadi	A	
16	1.1 KV Control Cable	Refer Note-2B	Q-007	Universal Cable Ltd.	Satna	A	
				NICCO	Kolkata	A	
				Torrent Cable Ltd	Nadiad	A	
				Incab	Pune	A	
				Polycab Wires Pvt. Ltd	Daman	A	
				Hindustan Vidyut Products Ltd	Faridabad	A	
				KEI Industries	Bhiwadi	A	
				Delton Cable Ltd	Faridabad	A	
				Paramount Cable	Khushkhera	A	
				Gemscabs Industries	Bhiwadi	A	
				Cords Cables	Bhiwadi	A	
				SPM Cables	Hyderabad	A	

		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 7
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
				Elkay Telelink	Faridabad	A	
				Havells India Ltd.	Alwar	A	
				R.R. Kabel	Silvasa	A	
				Ravin Cables	Pune	A	
				Gupta Power cable	Khurda	A	
				Thermocables	Hyderabad	A	
				Finolex	Pune	A	
				Sbee Cables	Bangalore	A	
				Suyog Cables	Vadodara	A	
				Scot Innovation wires and Cables	Baddi	A	
				Anhui Hauling	China	A	
				LS Cable	Korea	A	
				Radiant Cables	Hyderabad	A	
				Tirupati Plastomatics	Jaipur	A	
				Apar Industries	Umbergaon	A	
				Special Cables	Rudrapur	A	
				Advance cable	Bengaluru	A	
				Step Industries	Shahjahanpur	A	
				Taihan Electric Wire	Korea	A	
				Tbea Shandong	China	A	
				CMI	Baddi	A	
				Goyoline Fibres(I) Ltd	Daman	A	
				Indo Alusys	Bhiwadi	A	
17	HT Cable Up to 11KV		Q-008	Universal Cable Ltd.	Satna	A	
				NICCO	Kolkata	A	


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 8
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
		Refer Note-2C		Torrent Cable Ltd	Nadaid	A	
				Incab	Pune	A	
				Polycab Wires Pvt. Ltd	Daman	A	
				KEI Industries	Bhiwadi	A	
				Havells India Ltd.	Alwar	A	
				Sri ram Cables	Bhiwadi	A	
				Krishna Electrical Industries	Gwalior	A	
				Apar Industries	Valsad	A	
				Finolex	Pune	A	
				KEC International	Vadodara	A	
				Tirupati Plastomatics	Jaipur	A	
				Gupta Power	Kashipur	A	
				Paramount	Khuskhera	A	
				Gemscab	Bhiwadi	A	
				Sterlite	Haridwar	A	
				CMI		A	For 1Cx240
18	HT Cable up to 33kV	Refer Note-2C	Q-009	Universal Cable Ltd.	Satna	A	
				Torrent Cable Ltd	Nadiad	A	
				Polycab Wires Pvt. Ltd	Daman	A	
				KEI Industries	Bhiwadi	A	
				Havells India Ltd.	Alwar	A	
				Apar Industries	Valsad	A	
				Finolex	Pune	A	
				KEC International	Vadodara	A	


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 9
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
				Gupta Power	Kashipur	A	
				Paramount	Khushkhera	A	
				Gemscab	Bhiwadi	A	
				Sterlite	Haridwar	A	
				Gupta Power	Kashipur	A	
19	DC Cable	I	Q-011	Siechem	Pondicherry	A	Upto 35 sq.mm.
				Apar	Khatalwada	A	
				Polycab		A	
				KEC		A	
				Leoni	Siechem	A	6 mm2
				LAPP	Korea	A	Up to 12 mm2
20	Earthing & Lightning Protection Material like Earthing electrode, Copper bonded rod, Copper Flat, GI Strip/GI Wire etc.	III		Main contractor Approved source			
21	HT Cable Termination Kit & Straight Through Jointing Kit (Heat shrinkable type)	III		3M Electro & Communication	Pune	A	Upto 33kV
				Raychem	Halol	A	Upto 33kV
				Hari Consolidated	Delhi	A	Upto 33kV
				BEHR BIRCHER CELLPACK BBC INDIA PRIVATE LIMITED	INDIA	A	56MW KAWAS and 300MW CPSU
22		III		Crompton	Mumbai		Main contractor approved
				Bajaj Electricals	Mumbai		


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 10	
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS	
	Lighting fixtures with accessories including lamp (Filament type & LED type)			Philips	Noida		source is acceptable.	
				Wipro	Mumbai			
				Surya Roshni	Noida			
				Goldwyn	Noida			
23	MCB Boxes/Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III		i. Main Contractor approved sources including galvanization ii. BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no, Refer Note-4				
24	Industrial /welding receptacles & boxes	III		Schneider	Nasik	A		
				BCH	Faridabad	A		
				Ajmera	Mumbai	A		
				Sakthi & Crown	Chennai	A		
				Any other make having CE / UL / CSA mark or BIS approval with valid CML number.				
25	PVC conduit/hume pipe/lighting wire/GI pipes/HDPE pipe/Structural Steel/ GI steel rigid conduit/ epoxy conduit/DWC Pipe	III		Main Contractor approved sources with BIS licensee with valid CML number / ISI marked with valid CML number				
26	MV Switchgear Panel (Refer Note-4)	I	Q-012	BHEL	Bhopal	A	Upto 33kV	
				Megawin	Salem	A	Upto 33kV	
				L&T	Ahmednagar	A	Upto 33kV	


		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 11
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
				Siemens	Mumbai	A	Upto 33kV
				Jyoti	Vadodara	A	Upto 33kV
				ABB	Nasik	A	Upto 33kV
				Schneider	Kolkata	A	Upto 11KV -Salt lake works -VG series Interrupter made at Salt Lake Works
				Trisquare	Haryana	A	Upto 33kV
				Technocraft	Bhiwandi, Thane	A	Upto 33kV
				Sterling Generators Pvt. Ltd.	Silvasa	A	Upto 33kV
				Popular Switchgears Pvt. Limited	Nashik	A	Upto 33kV 1250 Amp
				Tricolite	Manesar	A	Upto 33kV
				Siemens	Mumbai	A	Upto 33kV
27	MV Vacuum Type Circuit Breaker	I & (part of Swgr MQP)		BHEL	Bhopal	A	Upto 33kV
				L&T	Ahmednagar	A	Upto 33kV
				ABB	Nasik	A	Upto 33kV
				ABB	Italy	A	Upto 33kV
				Megawin	Salem	A	Upto 33kV
				Jyoti	Vadodara	A	Upto 33kV
				Schneider	Kolkata	A	Upto 11kV
28	IEC 61850 compliant Numerical Protection Relays			SEL	Pullman, USA	A	NTPC approved make shall be acceptable
				ALSTOM T&D	Stafford, UK	A	


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		I (Part of Swgr MQP)		ALSTOM T&D	Chennai	A		
				ABB	Finland	A		
				ABB	Baroda	A		
				GE Multilin	Zamudio, Vizcaya, Spain/ Markham, Ontario, Canada	A		
				Schneider	Stone, UK	A		
				Siemens	Germany	A		
				Siemens	Goa	A		
29	Single Rod Air Terminal Lightning Arrestor	III		Main Contractor approved sources: subject to manufacturer / supplier having valid Type Test Report as per IS 2309: 2005 or equivalent Standard				
30	ESE Lightning Arrestor	III		Main Contractor approved sources: subject to manufacturer / supplier having valid Type Test Report as per latest version of NFC 17-102 & country of origin documents				
31	Lighting Poles	III		Main Contractor approved sources				
32	RSJ Poles and Accessories	III		Main Contractor approved sources				
33	Cable Lug	III		Dowell	Mumbai	A		
				Billets Elektro Werke Ltd. (3 D)	Umbergaon	A		
				Chetna	Nasik	A		
				Additional Vendors with Make-Model having mark of VDE/ UL /CSA / BIS with CML no. Refer Note-1 or Main contractor approved source.				


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34	Cable Gland	III		Any Make-Model having mark of VDE/ UL /CSA / BIS with CML no. Refer Note-1 or Main contractor approved source			
35	GI Cable Tray, fitting, accessories including bends.	III		Inar Profiles Ltd	Enkapalli (Vishakhapatnam)	A	
				Vatco	Mumbai	A	Galvanization at Sigma Mumbai
				Indiana cable trays	Mumbai	A	Galvanization at Karamtara galvanizer- Mumbai
				Industrial Perforation	Kolkata	A	Galvanized and offered for inspection at Industrial Perforation Pvt Ltd, Ganganagar , Kolkata, WB
				Ratan Projects	Howrah	A	Galvanization at DMP Projects- Howrah
				India Electric Syndicate	Kolkata	A	Galvanization at BMW Industries/B.P Projects- Howrah
				Sterlite engg.	Mumbai	A	
				Premier Power Products	Howrah	A	Galvanising at Neha Galvaniser- Howrah
				Indiana Gratings	Pune	A	
				M.J. Engineering	Okhla/ Bhiwadi	A	
				T.R.G	Chennai	A	Galvanization at TM Radhakrishna Chetty & Co- Chennai
				Amtech	Pune	A	Galvanization at B.G. Shirke – Pune

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
				Kannade Anand Udyog	Mumbai	A	Fabrication at their units: Plot No. 42, Morivali, MIDC Thane & Plot No.: D-35 Anand Nagar MIDC, Addl. Ambernath , Dist.Thane Galvanization and offer the galvanized cable trays for inspection at D-34 Anand Nagar MIDC, Addl. Ambernath, Dist.Thane.
				Rukmani	Raipur	A	Ladder type cable trays only
				Passive Infra	Hasangarh (Rohtak)	A	
				Unitech Fabricators & Engineers	Howrah/ Hoogly (Kolkata)	A	
				Patny System	Hyderabad	A	
				Rabi Engg	Kolkata	A	Galvanizing from NTPC approved sources
				MKSD Industries	Taloja	A	Galvanising at Encorp Power trans PVT Ltd, Palghar
				Reliable Sponge	Kalunga	A	
				Rukmani	Hoogly	A	Galvanization at Rukmani Fab & Gal- Howrah
				Eros Metal Works	Nagpur	A	
				Maheshwari Electricals Manufacturer Pvt. Ltd	Ghaziabad	A	Galvanization at M/s Shivam Engineers & Fabricators, Ghaziabad
				Indmark Formtech	Pune	A	

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
36	Cable Tray Flexible Tray Support System	III		Vatco	Mumbai	A	Galvanising at Sigma Mumbai
				Inar profiles	Enkapalli	A	
				Industrial perforations	Kolkata	A	
				Premier power products	Howrah	A	Galvanising at Neha Galvaniser- Howrah
				Sterlite engg.	Mumbai	A	
				Indiana gratings	Pune	A	Galvanising at Poona Galvaniser- Pune
				Amtech	Pune	A	Galvanising at B.G. Shirke- Pune
				Ratan Projects	Howrah	A	Galvanization at NTPC approved sources
				MKSD Industries	Taloja	A	Galvanising at Encorp Power trans PVT Ltd, Palghar
				Maheshwari Electricals Manufacturer Pvt. Ltd	Ghaziabad	A	Galvanization at M/s Shivam Engineers & Fabricators, Ghaziabad
				Indmark Formtech	Pune	A	
				Patny Systems	Hyderabad	A	
37	Conventional gate/globe valve/ check valve (size up to 600 NB & rating pr class up to 300)/ fittings- (MS/GI/CS/SS) & (forged/ formed)/ nozzles/ strainers/filters/ pump (up to 30kw)/ HDPE pipes/fittings/ hoses.	III		Main Contractor approved sources accepted			

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38	High Velocity Water Spray System (HVWS)	III		Main Contractor approved sources accepted			
39	MS PIPE (BLACK/GI) (IS 1239:2011 / IS 3589:2001) (UPTO 1000 NB)/	III		Main Contractor approved sources; BIS marked, manufacturers with valid BIS license			
40	AB Tariff energy meter	III		SEMS	Udaipur/Solan	A	
				Elster	Mumbai	A	
				L&T	Mysore	A	
41	Transformer (Oil filled type) Refer Note-4	I	Q-019	BHEL	Bhopal	A	up to 400 kV Class
				GE(T&D)	Naini	A	up to 400 kV Class
				Toshiba	Hyderabad	A	up to 400 kV Class
				TELK	Agnamaly, Kerala	A	up to 400 kV Class
				ABB	Vadodara/Sweden	A	up to 765 kV Class
				CG Power & Industrial Solutions Ltd.	Mandideep	A	up to 400 kV Class
				Siemens	Mumbai	A	up to 400 kV Class
				EMCO	Thane	A	up to 400 kV Class
				BHEL	Jhansi	A	up to 220 kV Class
				Schneider	Vadodara	A	up to 50 MVA, 132 kV Class
				T&R	Changodar, Ahmedabad	A	up to 90 MVA, 132 kV Class, Conditions Apply
				T&R	Moraiya, Ahmedabad	A	250 MVA, 400kV
				Kanohar	Meerut	A	up to 16 MVA, 33 kV Class
				EMCO	Jalgaon	A	up to 16 MVA, 33 kV Class

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				Kirloskar	Mysore	A	up to 16 MVA, 33 kV Class
				Andrew Yule	Chennai	A	up to 10 MVA, 33 kV Class
				Tesla (Unit-2)	23A, Sector-B, Industrial Area, Govindpura, Bhopal	A	up to 5.0 MVA, 33 kV Class
				Indotech Transformers	Kancheepuram District, Chennai	A	up to 180 MVA, 220 kV Class
				Hammond Power Solutions	Hyderabad	A	up to 10 MVA, 33 kV Class
				CG Power & Industrial Solutions Ltd.	Malanpur	A	up to 7.5 MVA, 33 kV Class
				ECE	Sonepat	A	up to 4.0 MVA, 11 kV Class
				Kalpa Elektrikal	Bangalore	A	Up to 1.4MVA, 11 KV Class
				Voltamp	Savli	A	up to 3.5 MVA, 33 kV Class
				Kirloskar	Pune	A	up to 2.0 MVA, 33 kV Class
				RAYCHEM RPG	Pune	A	Up to 5 MVA, 33 kV Class
				Esennar	Medak	A	Up to 16 MVA, 66 kV Class
				Technical Associate Ltd	Sitarganj	A	220 kV Class
				SkipperSeil Limited	Bhiwadi	A	up to 50/63 MVA, 132 KV
				Meiden T&D (India) Limited	Nellore	A	up to 63 MVA, 132 kV Class
				KRYFS Power Components Ltd	Silvassa	A	Up to 2.5 MVA, 33 kV Class
				Sudhir Transformers	Bangalore	A	Up to 12.5 MVA, 33kV Class
				Sudhir Power Ltd	Silvassa	A	Up to 12.5 MVA, 33kV Class
42	FOTE	III		RITTAL	BANGALORE	A	

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				PYROTECH	UDAIPUR	A	
				MPP	BANGALORE	A	
				FABIONIX	BANGALORE	A	
				ADOBE	BANGALORE	A	
				Commnet Networks	Raheja, Navi Mumbai	A	
				Siemens	Navi Mumbai	A	
43	RS485	III		Main Contractor Approved source accepted.			
44	CAT 6 LAN CABLE	III		Main Contractor Approved source accepted			
45	Fire Extinguisher	III		BIS approved sources with valid BIS License			

Above list shows manufacturers proposed by main contractor for listed items and are acceptable to NTPC

Note: This is a Standard List applicable for all NTPC Solar Projects. However, for items involving small quantity or urgency at site, the categorization may be modified as per requirement with the concurrence of Head (RE QA).

A - For those items proposed vendor is acceptable to Customer. To be indicated with letter "A" in the list along with the condition of approval, if any.
DR-mean that manufacturer proposed by main contractor for the items will be assessed by NTPC. Main contractor is obliged to procure the item from "DR" category manufacturer only after written approval from NTPC.


Under QP / INSPN CATEGORY column:

CAT-I: For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection & witness by NTPC as per approved QAP.

CAT-II: For these items the Quality Plans approved by NTPC. However, no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on basis of verification of documents as per approved QP. Physical inspection *to be witnessed by NTPC Approved TPIA/ Main contractor*.

CAT-III: For these items Main supplier approves the Quality Plans. The final acceptance by NTPC shall be on basis of COC (Certificate of Conformance) by the Main supplier.

General Notes:

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1. Vendor acceptance is subject to Sub-QR and Technical Clearance as applicable. Sub-QR/Prove-ness criteria as per the scope/technical specification shall also be applicable for consideration as approved manufacturer/vendor
2. Vendor list & inspection category of the mandatory spares shall be as mentioned above.
3. For item not appearing in the above list, Main Contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
4. NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

Note-1- "TYPE TEST REPORT AS PER EN 50521" OR "VDE / CE / UL / CSA MARKING CERTIFICATION PREFERABLY FROM THIRD PARTY AGENCY" OR "BIS APPROVAL LETTER" SHALL BE SUBMITTED FOR NTPC's VERIFICATION /INFORMATION.


Note-2-

A. Category of inspection for LT Power Cable:

TOTAL CONTRACT QUANTITY PER SIZE	CATEGORY OF INSPECTION
For cable total quantity \leq 2.5 km	Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through corporate contracts for at least 2 years
For Cable total quantity above 2.5 km up to 10 km per size/type	Cat-II for the manufacturers having successfully supplied to any project-site through Corporate contracts for at least 2 years
For Cable total quantity above 10 km per size/type	Cat-I

B. Category of inspection for Control Cable:

TOTAL CONTRACT QUANTITY PER SIZE	CATEGORY OF INSPECTION
For cable total quantity \leq 2.5 km	Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through corporate contracts for at least 2 years


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For cable total quantity above 2.5 km per size/type	Cat-II for the manufacturers having successfully supplied to any project-site through corporate contracts for at least 2 years
C. Category of inspection for HT cables	
TOTAL CONTRACT QUANTITY PER SIZE/TYPE	CATEGORY OF INSPECTION
LESS THAN EQUAL TO 500 M	CAT-III
GREATER THAN 500 M	CAT-I
D. Category of Inspection for LT Switchgear and LV Air circuit breaker:	
For LT Switchgear connected with String inverter	CAT-I
LT Switchgear for other auxiliaries	CAT-II

Note-3- Indicative List of acceptable galvanizing sources:

1. M J Engg, Delhi 2. Indmark , Pune 3. A.V. Engg, Kolkata 4. Inar Profiles, Vishakapatnam 5. Anand Udyog, Mumbai 6. Techno Engg, Chandigarh 7. Steelite Engg, Mumbai	8. National Galvanizer, Kolkata 9. Unistar Galvanizer, Kolkata 10. B.P. Project. Kolkata 11. Bajaj Pune 12. Electrocure Industries, Mumbai 13. B.G. Shirke, Pune 14. Gurpreet Galvanizer, Hyderabad	15. Sigma, Mumbai 16. Radhakrishnan Shetty, Chennai 17. Karamtara Mumbai 18. Poona Galvanizers Pune 19. Neha Galvanizer- Kolkata 20. Unitech Fabricators & Galvanizers- Hoogly 21. Patny Systems- Mehdak	22. Indian Gratings, Pune 23. Encorp Power trans PVT Ltd, Palghar 24. Reliable Sponge, Kalunga 25- Rukmani Fab & Gal- Howrah
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Note-4: Raw material & Bought Out components for main equipment will be finalized with vendor identified by Main Contractor.

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Note-5: "VDE / CE / UL / CSA MARKING CERTIFICATION PREFERABLY FROM THIRD PARTY AGENCY" OR "BIS APPROVAL LETTER" SHALL BE SUBMITTED FOR NTPC's VERIFICATION /INFORMATION.

Note-6: Every 10th Inspection call of Cat II and Cat III items received by RIO for that week shall be surveillance inspected / tested by NTPC/ Authorized agency.

Note-7: The surprise visit of Vendors works of Cat II and Cat III items shall be done by NTPC / Authorized agency during manufacturing of items under supply to verify whether the vendor is following agreed documents, procedure/ QAP, Inspection documents, Third party inspection wherever envisaged, Main contractor inspection records, etc.


Note-8: Main contractor to ensure and facilitate the Remote Inspection at the manufacturing works as and when NTPC may not attend physically for inspection of Cat I item(s) as per approved QAP due to unavoidable circumstances. Main contractor to finalize the required procedure in advance during manufacturing stage. At least 03 no's recordable real time cameras to be used based on the item to be inspected, at least one out of 03 camera to be controlled by the other side of manufacturer works. Sufficient space and light (20 Lux) to be ensured.

Note-9: Main Contractor will consider only those additional sub-vendors for their relevant projects who have been assessed and found acceptable by them and sub-vendors who have already supplied the proposed equipment of equal to or higher rating (viz. standard items like Cables, Switchyard Equipment(s), etc.) in other projects. Main Contractor shall provide an undertaking to this affect.


Further, Main Contractor shall submit the Vendor proposal to RE QA along with their Internal assessment report & supporting credentials and shall also provide an undertaking that based on their Internal assessment, the proposed sub-vendor has been assessed and found acceptable by them and it has requisite capabilities & supply experience and is suitable for supplying the proposed item/scope of sub-contracting.

Note-10 For Auxiliary Transformers (Oil Filled & Dry Type- below 1.0 MVA, 33 KV Class):


1. Main Contractor's approved sub-vendors will also be acceptable subject to sub-vendor shall have minimum two years of supply experience for similar rating & type of transformers.
2. NTPC will review the Routine Test Inspection Report, witnessed by Main Contractor as per IS 2026/IS 1180 for Oil Filled Transformer and as per IS 11171 for Dry type Transformer

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1.	Battery (Lead Acid - Plante)/for UPS / Intelligent Battery Charger	III		Hoppecke batterien gmbh & co kg	Germany	A	
				Exide	Kolkata	A	
2.	Battery (Ni-Cd) for UPS / Intelligent Battery Charger	III		Saft india limited	Bengaluru	A	
				HBL power	Hyderabad	A	Up to 990AH (H type)
				Saft	France/Sweden	A	
				Hoppecke Batterien Gmbh & Co Kg	Germany	A	
3.	Battery Charger	II		Amararaja	Tirupati	A	
				HBL- Power System	Hyderabad	A	
				Chhabhi electrical	Jalgaon	A	
				Chloride Power	Kolkata	A	
				Statcon	Hapur	A	Up to 220, V 850 A
				Dubas	Banglore	A	Up to 220 V, 250 A
				Saft Nife Power Systems	Singapore	A	
				Masstek	Jalgaon	A	
4.	Control Desk	III		Pyrotech Workspace Solutions Pvt Ltd	Udaipur	A	BOI shall be as per LOA approved sources
				Cosmos Media Products Pvt Ltd	Greater Noida	A	1.H block should be from knurr Germany. 2.Complete integrated mosaic grid should be procured from ntpc approved sources like Pro Plan/Subklew 3.solid acrylic surface should be procured from Du Pont/NTPC approved sources 4.Extruded Al profile structure should


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							be procured from Hindalco (With Knurr design)
				Adarsha Control System Pvt Ltd	Bengaluru	A	1.Mosaic items should be from NTPC approved sources. 2. Acrylic solid surface (ASS) should be procured from Du Pont /NTPC approved sources 3. wood works are to be done by M/S C K Furn Bengaluru
5.	Fiber optic cable	III		KEC International Ltd	Mysore	A	
				Apar Industries Limited	Valsad	A	
				HFCL	Goa	A	
				Aksh Fibre	Bhiwadi	A	
				Finolex	Pune/Goa	A	
				M/S Birla Cable Limited	Rewa	A	
				Jiangsu Tongguang	China	A	
				R&M	Switzerland	A	
				Molex	UK	A	
				Corning	USA	A	
				Polycab India Ltd	Halol	A	
				U M Cable	Silvasa	A	
6.	Fire alarm panel	II		Notifier	USA	A	
				Autronica	Norway	A	
				TYCO	USA	A	Simplex Brand
				Bosch Security System	Bengaluru	A	Detector, Hooter, MCP, Modules, Panel shall be from M/s Bosch Make
				Schrack	Austria	A	
				Edwards	Mexico	A	
				Toshniwal Industrial Pvt Ltd	AJMER	A	M/s Notifier Make Fire Alarm Panel
				M/s Shield fire safety and security ltd	UK	A	


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7.	Instrument Cables (F, G & T/C Cables)	III	Jhonson Controls	USA	A	Simplex Brand
			Tempsens instruments (i) Pvt Ltd-unit-II	Udaipur	A	0.5 SQMM F&G TYPE CABLES
			Havells India	Alwar	A	Type F cable
			Paramount Communication ltd	Khushkhera	A	PVC, FRLS type
			Polycab	Daman	A	PVC, FRLS type
			Delton	Faridabad	A	PVC, FRLS type
			KEI	Bhiwadi	A	
			Elkey Telelinks	Faridabad	A	PVC, FRLS type
			CORDS	Kaharani	A	PVC, FRLS type
			CORDS	Bhiwadi	A	PVC, FRLS type
			Nicco	Kolkata	A	PVC, FRLS type
			Universal Cable	Satna	A	PVC, FRLS type
			Thermocables	Hyderabad/Mah boobnagar	A	A, B, F&G
			Gupta Power Infrastructure Ltd.	Khurdha	A	PVC, FRLS, Shielded, Multi Pair, Twisted Type A, B, F&G
			CMI	Faridabad	A	PVC, FRLS type / 0.5 SQMM F&G TYPE CABLES
			Advance Cables Pvt Ltd	Bengaluru	A	0.5 SQMM F&G TYPE CABLES
			Gemscab Industries Ltd	Bhiwadi	A	0.5 SQMM F&G TYPE CABLES
			Apar Industries Limited	Valsad	A	0.5 SQMM F&G TYPE CABLES
			Suyog Electricals Ltd	Halol	A	0.5 SQMM F&G TYPE CABLES
			Special Cables Pvt Ltd	Rudrapur	A	0.5 SQMM F&G TYPE CABLES
			T C Communication	Ghaziabad	A	PVC, FRLS type
			TEW & C	USA	A	
			Habia cables	Sweeden	A	
			Kerpen cables	Germany	A	
			Lapp cables	Germany	A	


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8.	24V Intelligent Battery charger DC/ DCDB/BHMS	III		Goyolene Fibers (India) Pvt Ltd	Silvassa	A	F&G type Cable
				KEC International	Vadodara	A	
				Thermo elecrt Bv	Netherland	A	
				Chabbi Electricals	Jalgaon	A	Rectifier module, Controller module and Battery Health monitoring system shall be of M/s VERTIV make
9.	Master Slave Clock System	II		Eltek SGS Pvt Ltd	Gurgaon	A	Unit-II for assembly and function testing only
				Masstech Controls Pvt Ltd	Jalgaon	A	Rectifier modules shall be of Setec, China
				Vertiv Energy Pvt Ltd	Mumbai	A	Rectifier module, Controller module and Battery Health monitoring system shall be of M/S VERTIV China
				Signals and Systems Pvt. Ltd. (SANDS)	Chennai	A	
10	PLC Based SCADA System (Ref Note 4)	I	SQP	Masibus	Gandhinagar	A	
				Sertel Electronics Pvt. Ltd.	Chennai	A	
				Hopf Electronik GmbH	Germany	A	
				Hathway	USA	A	
				Mein Berg	Germany	A	
				Moser Baer AG	Switzerland	A	
				Rockwell	Sahibabad	A	
				Emerson automation solution Intelligent platforms Pvt Ltd	Bengaluru	A	PLC modules from Emerson USA
				ABB	Bengaluru	A	
				Honeywell	PUNE	A	1-PLC modules should be procured from M/s Honeywell Co Ltd, Korea. All Major BOI From NTPC Approved

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							Make
				Siemens	Nashik	A	
				Phoenix Contact Electronics GmbH	Germany	A	
				Mitsubishi Electric Corporation	Japan USA	A	iQF and iQR PLC series Iconics SCADA
				Schneider Electric System India Pvt Ltd	Chennai	A	Modules From Schneider, France And All Major BOI From NTPC Approved Make
11	PLC System Integrators	I		Schneider Electric India Pvt Ltd	Bengaluru	A	Modules From Schneider, France And All Major BOI From NTPC Approved Make
				Trinity Touch Private Limited	Palwal, Haryana	A	System Integrator of Phoenix Germany Make
				Virtual Automation	Ranga Reddy	A	System integrator for schneider make
				Cotmac Electronics Pvt Ltd	Pune	A	System integrator for Seimens make
				Tech-Masters	Hyderabad	A	System integrator for Emerson Management IP make
				Powertech Switchgear (I) Pvt Ltd	Sonepat	A	System integrator for schneider make
				Unity Industrial Automation Pvt Ltd	Delhi	A	System integrator for Rockwell make
				EMCONS	Ranchi	A	System integrator for Rockwell make
				M D Industries	Vadodara	A	System integrator for M/s Emerson make system
				Velox automation	Surat	A	System integrator for Siemens make
				Vision Comptel	Kolkata	A	System integrator for Emerson make
				Adaptive engineering Private limited	Ahemdabad	A	System integrator for schneider make
				Greenwave Solutions Private Limited	Kolkata	A	System integrator for Rockwell make

		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: C&I		DOC NO. : REVISION NO. 00 PAGE : 6
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS

				Dreamz Automation	Ghaziabad	A	System integrator for Siemens make
				Creative Robotics	Ghaziabad	A	System integrator for Honeywell make
				Kruti Techno Engineer Pvt Ltd	Chhapraula (GB nagar)	A	System integrator for Siemens make
				EDS Instruments & Systems pvt Ltd	Chennai	A	System integrator for Honeywell make
				Delsys automation Technologies pvt ltd	Chennai	A	System integrator for Emerson make
				Hindustan Control and Equipment Ltd	Kolkata	A	System integrator for Emerson make
				Vollkraft Engineering And Consultant (P) Ltd	Kolkata	A	System integrator for Emerson make
				SSM Infotech Solution Pvt Ltd	Surat	A	System integrator for schneider make
				Sun Industrial Automation	Chennai	A	System integrator for schneider make
				Netware Computers	New Delhi	A	System integrator for Honeywell make
				Armax Automation Private Limited	Bengaluru	A	System integrator for ABB make
				Nandi Powertronics	Bengaluru	A	System integrator for Mitsubishi make
				Ladder Automation Solution Pvt Ltd	Gurugram	A	For M/s Honeywell make System
				Divya Engineers	Chennai	A	For M/s Siemens make system
12	UPS with ACDB	III		Fuji Electric	Kancheepuram	A	UPS systems less than 10KVA
				Vertiv Energy Pvt Ltd	Pune	A	up to 125 KVA for 1 phase & 300 KVA for 3 phase
				Vertiv Energy Pvt Ltd	Mumbai	A	Upto 160 KVA
				Hitachi Hirel Power Electronics Pvt Ltd	Sanand	A	Upto 120KVA, Single phase IGBT

		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: C&I		DOC NO. : REVISION NO. 00 PAGE : 7
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS

				Fuji Electric	Pune	A	Up to 100 KVA single phase
				KELTRON	TRIVENDRUM	A	
				Merlin & Gerin	France	A	
				Gutor	Switzerland	A	
				AEG (Saft)	Germany	A	
				Fuji Electric	Japan	A	
				Power One Micro System	Bangalore	A	20 KVA
13	SMF lead-acid battery for microprocessor Based fire alarm panel	III		Exide	Kolkata	A	
				Amara Raja	Trupati	A	
				HBL Power System	Hyderabad	A	
MC-1	Blank Panels / Cabinets	III		Main Contractor Approved Sources			
MC-2	Compression Fittings (SS)	III		Main Contractor Approved Sources			
MC-3	Computer Furniture	III		Main Contractor Approved Sources			
MC-4	Desk for OWS/EWS/Printer/Server	III		Main Contractor Approved Sources			
MC-5	FRP Junction Box	III		Main Contractor Approved Sources			
MC-6	Graphic Interface Unit	III		Main Contractor Approved Sources			
MC-7	Impulse Pipes/Tubes	III		Main Contractor Approved Sources			
MC-8	Level Indicator (Float & Board type)	III		Main Contractor Approved Sources			
MC-9	Mini UPS-Type C configuration	III		Main Contractor Approved Sources			

		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: C&I		DOC NO. : REVISION NO. 00 PAGE : 8
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS

MC-10	Printer (Inkjet / Laser)	III		Main Contractor Approved Sources			
MC-11	Terminal Block	III		Main Contractor Approved Sources			
MC-12	Instrumentation valve & Fitting	III		Main Contractor Approved Sources			
MC-13	Weather station panel (comprising of Pyranometer, anemometer & thermometer etc.)	III		Any make-model with VDE/ CE/UL/ CSA marking or BIS approved with CML no			
MC-14	Operator Workstation	III		Main Contractor Approved Sources			DELL/HP/IBM/LENEVO/COM PAQ/FUJITSU OR OEM APPROVED
MC-15	Container	III		Main Contractor Approved Sources			
MC-16	CCTV	III		Main Contractor Approved Sources			

LEGENDS:

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY

A - For those items proposed vendor is acceptable to Customer. To be indicated with letter "A" in the list along with the condition of approval, if any.

SQP-Standard Quality Plan RQP-Reference Quality Plan

2.0 QP INSPECTION CATEGORY:


CAT - I: For those items the Quality Plans are approved by Customer and final acceptance will be on physical inspection witness by Customer

CAT - II: For those items the Quality Plans are approved by the Customer. However, no physical inspection shall be done by the Customer. The final acceptance by Customer shall be on the basis of review of documents.

CAT - III: For these items Quality control to be exercised as per Main contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of Conformance (COC) by Main Contractor.

UNITS/WORKS: Place of manufacturing- Place of main supplier of multi units/works.

NOTE - 3: For the items not appearing in the pre-award list and falls in the scope of supply of the bidder, bidder and Customer will mutually be discussed in

		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: C&I		DOC NO. : REVISION NO. 00 PAGE : 9
SI. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS

future.

NOTE-4 - Major Bought-Out-Items are to be procured from LOA approved sources & the same shall be finalized during the finalization of Manufacturing Quality Plan. MQP shall be duly vetted by OEM with their project specific authorization letter.

ADDENDUM NO. 01 TO BIDDING DOCUMENTS

**NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)**

CONTRACTS SERVICES

**PACKAGE: EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC
RAMAGUNDAM.**

ETS Portal Tender Search Code: NTPC-2024-TN000013

Bidding Document No: RE-CS-5817-004-9

**The following Clarification(s) and Amendment(s) to the Bidding Documents of the subject
package are being issued:**

1	RE-CS-5817-004-9-AMDT-01:	Amendment No-01 to FORMS AND PROCEDURE (F&P)
2	RE-CS-5817-004-9-AMDT-02:	Amendment No-01 to SPECIAL CONDITIONS OF CONTRACT (SCC)
3	RE-CS-5817-004-9-CLRF-01:	Clarification No-01 to Commercial Portion of Bidding Documents

The above Clarification(s) and Amendment(s) to Bidding Documents shall be read in conjunction with and shall form integral part of Bidding Documents. The Clarification(s) and Amendment(s) will be binding on Bidders, and it will be assumed that the information contained therein have been taken into account by the Bidder in his bid.

All other terms and conditions of the Bidding Documents shall remain unchanged.

Date: 23.12.2024

**(Ghazanfer Munam)
Dy. General Manager (CS)**

DOCUMENT NO.	RE-CS-5817-004-9-AMDT-01
TITLE	AMENDMENT NO - 01 TO SECTION VII (FORMS AND PROCEDURES)
PACKAGE	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
IFB NO.	RE-CS-5817-004-9
ETS PORTAL TSC	NTPC-2024-TN000013
DATE	23.12.2024

Sl. No.	Volume/ Section/ Clause No.	Existing Clause	Amended Clause
1	Section-VII: Book 1 of 3	TABLE OF FORMS AND PROCEDURES (Pg. No-03 & 04 of 257)	TABLE OF FORMS AND PROCEDURES (Pg. No-03 & 04 of 257) Replaced with TABLE OF FORMS AND PROCEDURES(Rev-1) enclosed at Appendix-A to this Amendment.
2	Section-VII: Book 2 of 3	TABLE OF FORMS AND PROCEDURES (Pg. No-94 & 94 of 257)	TABLE OF FORMS AND PROCEDURES (Pg. No-94 & 94 of 257) Replaced with TABLE OF FORMS AND PROCEDURES(Rev-1) enclosed at Appendix-B to this Amendment.
3	Section-VII: Book 3 of 3	TABLE OF FORMS AND PROCEDURES (Pg. No-116 & 117 of 257)	TABLE OF FORMS AND PROCEDURES (Pg. No-116 & 117 of 257) Replaced with TABLE OF FORMS AND PROCEDURES(Rev-1) enclosed at Appendix-C to this Amendment.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO FORMS AND PROCEDURES (SECTION-VII: F&P) DOCUMENT NO. RE-CS-5817-004-9-AMDT-01	PAGE 1 OF 2
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DOCUMENT NO.	RE-CS-5817-004-9-AMDT-01
TITLE	AMENDMENT NO - 01 TO SECTION VII (FORMS AND PROCEDURES)
PACKAGE	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
IFB NO.	RE-CS-5817-004-9
ETS PORTAL TSC	NTPC-2024-TN000013
DATE	23.12.2024

Sl. No.	Volume/ Section/ Clause No.	Existing Clause	Amended Clause
4	Section-VII: Book 3 of 3	2A. Form of Insurance Surety Bond towards Bid Security (Pg. No-121 & 122 of 257)	2A. Form of Insurance Surety Bond towards Bid Security (Pg. No-121 & 122 of 257) Replaced with 2A. Form of Insurance Surety Bond towards Bid Security (Rev-1) enclosed at Appendix-D to this Amendment.
5	Section-VII: Book 1 of 3	Appendix-A to Attachment-3A1 (Pg. No-25 & 122 of 257)	Appendix-A to Attachment-3A1 (Pg. No-25 & 122 of 257) Replaced with Appendix-A to Attachment-3A1(Rev-1) enclosed at Appendix-E to this Amendment.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO FORMS AND PROCEDURES (SECTION-VII: F&P) DOCUMENT NO. RE-CS-5817-004-9-AMDT-01	PAGE 2 OF 2
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TABLE OF FORMS AND PROCEDURES

(REV-01)

Sl.. No.	Description
SECTION-VII (BOOK 1 OF 3)	
1A	Bid Form and Attachments (Techno Commercial Bids)
SECTION-VII (BOOK 2 OF 3)	
1B	Bid Form and Attachments (Price Bid)
SECTION-VII (BOOK 3 OF 3)	
2	Bid Security Form - Bank Guarantee
2A	Form of Insurance Surety Bond towards Bid Security
2B	Format for EFT Details for Bid Security submission
3	Forms of Notification of Award
4	Form of Contract Agreement and Appendices
5	Performance Security Forms
5A	BEES Equipment Performance Bank Guarantee (EPBG) for life of the Project Form
5B	BG forwarding letter from Bank to Employer in Bank's letterhead
5C	Form of Insurance Surety Bond towards Performance Security
5D	BEES Equipment Performance Bank Guarantee (EPBG) for life of the Project Form (Insurance Surety Bond)
6	Bank Guarantee Forms for Advance Payment
a.	Supply Ex-Works
b.	Installation Services/ Civil & Allied Works/ Additional Advance Payment – NOT APPLICABLE
7	Form of Completion Certificate
8	Form of Operational Acceptance
9	Form of Trust Receipt
10	Forms of Indemnity-cum-Undertaking Agreement
11	Form of Authorization Letter
12	Form of Bank Guarantee / Insurance Surety Bond Verification Checklist
13	Form of Validity Extension of Bank Guarantee / Insurance Surety Bond
14	Form of Indemnity-cum-Undertaking Agreement regarding Removal/ Disposal of Scrap and Surplus Material
15	Form of Bank Guarantee by Associate/Collaborator
15A	Form of Insurance Surety Bond by Associate/ Collaborator
16	Form of Notification by the Employer to the Bidder
17	Form of Joint Deed of Undertaking (Enclosed at Appendix A to Attachment 3A1)
18	Bank Guarantee Form for Quoted Generation in Excess of DC:AC ratio of 1.5. -Not Applicable
19	Joint Undertaking for AMC of Critical Equipment for Stipulated Duration beyond O&M Period -Not Applicable
20	Forms for Stage Closing Activities

- Proforma of Certificate regarding Labour Payments and
- a. Statutory Requirements to be furnished by the Contractor
 - b. Proforma of No Demand Certificate by the Contractor Undertaking for Indemnifying the Employer against any
- 21 Encumbrance on the Project Land transferred/ leased to Employer in respect of Development of Solar PV Project-**Not Applicable**
- 22 Certificate from Bank regarding BG Charges
- 23 Declaration Of Absence Of Conflict Of Interest With Conciliation Committees Of Independent Experts (CCIE)

TABLE OF FORMS AND PROCEDURES

(REV-01)

Sl.. No.	Description
SECTION-VII (BOOK 1 OF 3)	
1A	Bid Form and Attachments (Techno Commercial Bids)
SECTION-VII (BOOK 2 OF 3)	
1B	Bid Form and Attachments (Price Bid)
SECTION-VII (BOOK 3 OF 3)	
2	Bid Security Form - Bank Guarantee
2A	Form of Insurance Surety Bond towards Bid Security
2B	Format for EFT Details for Bid Security submission
3	Forms of Notification of Award
4	Form of Contract Agreement and Appendices
5	Performance Security Forms
5A	BEES Equipment Performance Bank Guarantee (EPBG) for life of the Project Form
5B	BG forwarding letter from Bank to Employer in Bank's letterhead
5C	Form of Insurance Surety Bond towards Performance Security
5D	BEES Equipment Performance Bank Guarantee (EPBG) for life of the Project Form (Insurance Surety Bond)
6	Bank Guarantee Forms for Advance Payment
a.	Supply Ex-Works
b.	Installation Services/ Civil & Allied Works/ Additional Advance Payment – NOT APPLICABLE
7	Form of Completion Certificate
8	Form of Operational Acceptance
9	Form of Trust Receipt
10	Forms of Indemnity-cum-Undertaking Agreement
11	Form of Authorization Letter
12	Form of Bank Guarantee / Insurance Surety Bond Verification Checklist
13	Form of Validity Extension of Bank Guarantee / Insurance Surety Bond
14	Form of Indemnity-cum-Undertaking Agreement regarding Removal/ Disposal of Scrap and Surplus Material
15	Form of Bank Guarantee by Associate/Collaborator
15A	Form of Insurance Surety Bond by Associate/ Collaborator
16	Form of Notification by the Employer to the Bidder
17	Form of Joint Deed of Undertaking (Enclosed at Appendix A to Attachment 3A1)
18	Bank Guarantee Form for Quoted Generation in Excess of DC:AC ratio of 1.5. -Not Applicable
19	Joint Undertaking for AMC of Critical Equipment for Stipulated Duration beyond O&M Period -Not Applicable
20	Forms for Stage Closing Activities

- Proforma of Certificate regarding Labour Payments and
- a. Statutory Requirements to be furnished by the Contractor
 - b. Proforma of No Demand Certificate by the Contractor Undertaking for Indemnifying the Employer against any
- 21 Encumbrance on the Project Land transferred/ leased to Employer in respect of Development of Solar PV Project-**Not Applicable**
- 22 Certificate from Bank regarding BG Charges
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TABLE OF FORMS AND PROCEDURES

(REV-01)

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1A	Bid Form and Attachments (Techno Commercial Bids)
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5	Performance Security Forms
5A	BEES Equipment Performance Bank Guarantee (EPBG) for life of the Project Form
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5C	Form of Insurance Surety Bond towards Performance Security
5D	BEES Equipment Performance Bank Guarantee (EPBG) for life of the Project Form (Insurance Surety Bond)
6	Bank Guarantee Forms for Advance Payment
a.	Supply Ex-Works
b.	Installation Services/ Civil & Allied Works/ Additional Advance Payment – NOT APPLICABLE
7	Form of Completion Certificate
8	Form of Operational Acceptance
9	Form of Trust Receipt
10	Forms of Indemnity-cum-Undertaking Agreement
11	Form of Authorization Letter
12	Form of Bank Guarantee / Insurance Surety Bond Verification Checklist
13	Form of Validity Extension of Bank Guarantee / Insurance Surety Bond
14	Form of Indemnity-cum-Undertaking Agreement regarding Removal/ Disposal of Scrap and Surplus Material
15	Form of Bank Guarantee by Associate/Collaborator
15A	Form of Insurance Surety Bond by Associate/ Collaborator
16	Form of Notification by the Employer to the Bidder
17	Form of Joint Deed of Undertaking (Enclosed at Appendix A to Attachment 3A1)
18	Bank Guarantee Form for Quoted Generation in Excess of DC:AC ratio of 1.5. -Not Applicable
19	Joint Undertaking for AMC of Critical Equipment for Stipulated Duration beyond O&M Period -Not Applicable
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- Proforma of Certificate regarding Labour Payments and
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 - b. Proforma of No Demand Certificate by the Contractor Undertaking for Indemnifying the Employer against any
- 21 Encumbrance on the Project Land transferred/ leased to Employer in respect of Development of Solar PV Project-**Not Applicable**
- 22 Certificate from Bank regarding BG Charges
- 23 Declaration Of Absence Of Conflict Of Interest With Conciliation Committees Of Independent Experts (CCIE)

2A. Form of Insurance Surety Bond towards Bid Security (Rev-01)

(To be stamped in accordance with Stamp Act of India)

Insurance Surety Bond No.

Date.....

To,
NTPC Limited
Contract Services, 4th Floor,
NTPC Energy Technology Research Alliance Complex,
E-3, Ecotech-II, Udyog Vihar, Greater Noida,
Gautambudh Nagar, U.P. PIN-201306

Dear Sirs,

In accordance with Invitation for Bids under your Bid Document No....., M/s.....[Bidder's Name]..... having its Registered/Head Office at.....(hereinafter called the 'Bidder') wish to participate in the said bid for [Name of Package]

As an irrevocable Insurance Surety Bond against Bid Security for an amount of(*).....valid for.....days from.....(**)..... required to be submitted by the Bidder as a condition precedent for participation in the said bid which amount is liable to be forfeited on the happening of any contingencies as mentioned under the Bidding Documents.

We, the [Name & address of the Insurer]having our Head Office at (#) guarantee and undertake to pay immediately on demand by NTPC Limited (hereinafter called the 'Employer') the amount of(*).....without any reservation, protest, demand and recourse. Any such demand made by the 'Employer' shall be conclusive and binding on us irrespective of any dispute or difference raised by the Bidder and/or any right/remedy available to the bidder in terms thereof.

This Insurance Surety Bond shall be unconditional as well as irrevocable and shall remain valid upto(@)..... If any further extension of this Insurance Surety Bond is required, the same shall be extended to such required period (not exceeding one year) on receiving instructions from M/s[Bidder's Name]..... on whose behalf this Insurance Surety Bond is issued.

In witness where of the Insurer, through its authorised officer, has set its hand and stamp on this.....day of.....20.....at.....

.....
(Signature)

.....
(Name)

.....
(Designation with Insurer Stamp)

Authorised Vide
Power of Attorney No.....
Date.....

- NOTE : 1. (*) The amount shall be as specified in the Bid Data Sheets.
(**) This shall be the date of opening of Techno-Commercial bids.
(#) Complete mailing address of the Head Office of the Insurer to be given.
(@) This date shall be forty five (45) days after the last date for which the bid is valid.
2. The Insurance Surety Bond shall be from an Insurer as per guidelines issued by Insurance Regulatory and Development Authority of India (IRDAI) as amended from time to time.
 3. The Employer shall be the Creditor, the Bidder shall be the Principal debtor and the Insurance company/Insurer shall be the Surety in respect of the Insurance Surety Bond to be issued by the Insurer.
 4. The Insurance Surety Bond should be on Non-Judicial stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the state(s) where the Insurance Surety Bond is submitted or is to be acted upon or the rate prevailing in State where the Insurance Surety Bond is executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Bidder/Insurer issuing the Insurance Surety Bond.
 5. While getting the Insurance Surety Bond issued, Bidders are required to ensure compliance to the points mentioned in Form of Bank Guarantee/Insurance Surety Bond Verification Check List enclosed in this Section of Bidding Documents. Further, Bidders are required to fill up this Form and enclose the same with the Insurance Surety Bond.

FORM OF UNDERTAKING BY BIDDER AND THE FIRM

DEED OF JOINT UNDERTAKING TO BE EXECUTED BY THE BIDDER MEETING THE REQUIREMENTS SPECIFIED AT CLAUSE NO. 1.3 AND THE LICENSE PROVIDER/ TECHNOLOGY COLLABORATOR/ JV PARTNER (BATTERY MANUFACTURER MEETING THE REQUIREMENTS AS PER CLAUSE 1.1 ON HIS OWN), ITEM 3 OF BID DATA SHEETS FOR SUCCESSFUL PERFORMANCE OF EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM IN WHICH THE LICENSE PROVIDER/ TECHNOLOGY COLLABORATOR/ JV PARTNER AND THE BIDDER ARE JOINTLY LIABLE TO THE EMPLOYER TO PERFORM ALL THE CONTRACTUAL OBLIGATIONS INCLUDING THE TECHNICAL GUARANTEES FOR COMPLETE BATTERY SYSTEM OF BESS PACKAGE

This DEED OF UNDERTAKING executed thisday of Two thousandby M/s a Company incorporated under having its Registered Office at (hereinafter called the “**License provider/ Technology Collaborator/ JV Partner**”, which expression shall include its successors, administrators, executors and permitted assigns) and M/s a company incorporated under the having its registered office at (hereinafter called the “**Bidder**”, which expression shall include its successors, administrators, executors and permitted assigns) in favour of NTPC Limited, a company incorporated under the Companies Act, 2013, having its Registered Office at NTPC Bhavan, Scope Complex, 7, Institutional Area, Lodhi Road, New Delhi - 110 003, (India) (hereinafter called “**NTPC**” or “**Employer**” which expression shall include its successors, administrators, executors and assigns).

WHEREAS, the Employer invited bids for with designed service life of 20 years and for Design, Engineering, Supply, Packing and Forwarding, Transportation, Unloading, Storage, Installation and Commissioning of grid connected Battery Energy Storage System (BESS) of discharge capacity of 100MW and 400MWh at NTPC Ramagundam on turnkey basis including warranty, insurance etc with designed service life of 20 years and comprehensive O&M for 10 years after successful commissioning.

AND WHEREAS the bid document stipulated that bidding is open to a bidder who meets the requirement at Clause No. 1.3 of Item No 3.3.1 of [Section-III \(BID DATA SHEET\)](#) and associates with a Firm which fully meets the requirement at Clause No. 1.1 of Item No 3.3.1 of [Section-III \(BID DATA SHEET\)](#), forming part of the bid documents.

WHEREAS, M/s.(Bidder) is submitting its proposal in response to the aforesaid Invitation for Bid for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO.: RE-CS-5817-004-9.

AND WHEREAS M/s. (Bidder) itself meet the requirements of Clause No. 1.3 of Item No 3.3.1 of [Section-III \(BID DATA SHEET\)](#) and desire of **License provider/ Technology Collaborator/ JV Partner** with M/s. (hereinafter referred to as 'Associate') who fully meet the qualifying requirements as specified in Clause No. 1.1 of [Item No 3.3.1 of Section-III \(BID DATA SHEET\)](#) referred to above, the Bidder and Associate are required to jointly execute and furnish along with the bid an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Employer for successful performance of the Battery System of EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM fully meeting the guaranteed parameters and characteristics of Battery System as per the Bid Documents, in the event the bid is accepted by the Employer resulting in a Contract.

Signature of authorized signatory.....

NOW THEREFORE, THIS DEED WITNESSETH AS UNDER:

1. That in consideration of the Award of the Contract by the Employer to the Bidder, we the Associate and the Bidder, do hereby declare and undertake that we shall be jointly and severally responsible and bound unto the Employer for the execution of successful performance of the Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM such that it fully meets the guaranteed parameters and characteristics of the Battery System as specified under the said Contract to the satisfaction of the Employer.
2. In case of any breach of the Contract committed by the Bidder, we the Associate do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of the Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM and undertake to carry out all the obligations and responsibilities under this Deed of Undertaking in order to discharge the Bidder's obligation and responsibilities in respect of Battery System stipulated in the contract. Further if the Employer sustains any loss or damage on account of any breach of the Contract in respect of Battery System, we the Associate and Bidder jointly and severally undertake to promptly indemnify and pay such loss/damages caused to the Employer on its written demand without any demur, reservation, contest or protest in any manner whatsoever. This is without prejudice to any rights of the Employer against the Bidder under the Contract and/or guarantees. It shall not be necessary or obligatory for the Employer to first proceed against the Bidder, nor any extension of time or any relaxation by the Employer to the Bidder shall prejudice any rights of the Employer under this Deed of Joint Undertaking to proceed against the Associate.
3. Without prejudice to the generality of the Undertaking in paragraph 1 above, the manner of achieving the objective set-forth in paragraph 1 above shall be as follows:

- a) The Associate will be fully responsible for design, manufacturing, supply, transportation, supervise erection, testing, commissioning, putting into satisfactory operation, carrying out the performance testing of Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM fully meeting the guaranteed parameters and characteristics as specified under the Contract to the satisfaction of the Employer including twelve years O&M after successful commissioning.

Further, the Associate, shall depute their technical experts from time to time to the Bidder's works/Employer's project site as required by the Employer and agreed to the Bidder/Employer to facilitate the successful performance of the Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM as stipulated in the Bid Documents.

Further, Associate shall ensure proper design, manufacture, supply, transportation, supervise erection, testing, commissioning and successful performance of the Battery System in accordance with the Contract Specifications and if necessary the Associate shall advice the Bidder suitable modification of design and implement necessary corrective measures to discharge the obligations under the contract.

- b) In the event the Associate and the Bidder fail to demonstrate successful performance of the Battery System for the EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM the Associate and the Bidder shall promptly carry out all the corrective measures at their own expense and shall promptly provide corrective design to the Employer.

Signature of authorized signatory.....

- c) Implementation of the corrected design and all other necessary repairs, replacements, rectifications or modifications to the Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM of financial liabilities, penalties and any other obligations as provided under the Contract shall be the joint and several responsibilities of the Bidder and Associate.
4. We, the Bidder and the Associate do hereby undertake and confirm that this undertaking shall be irrevocable and shall not be revoked till the expiry of the project Life period for the Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM under Contract, and further stipulate that the Undertaking herein contained shall terminate upon satisfactory completion of such period. We further, agree that this Undertaking shall be without any prejudice to the various liabilities of the Bidder, including Contract Performance Guarantee as well as other obligations of the Bidder / Contractor in terms of the Contract.
5. The Bidder and Associate/ Collaborator will be fully responsible for the quality of all the equipment manufactured at their works or at their Vendors works or construction at site, and their repair or replacement, if necessary, for incorporation in the Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM along with associated auxiliary equipment and timely delivery thereof to meet the completion schedule under the Contract.
6. In order to achieve the successful completion of the Battery System for EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BATTERY ENERGY STORAGE SYSTEM (BESS) AT NTPC RAMAGUNDAM as per schedule and the performance and guarantee tests at site from time to time, the detailed planning for design, engineering procurement, supply, supervision of erection and commissioning and O&M activities shall be drawn by the Bidder and vetted by Associate. In addition to above, the Associate shall ensure implementation of successful Project Management system adopted by them in the past, by the Bidder.
7. Apart from the Bidder's Performance Bank Guarantee, the Associate shall, furnish 'as security' a separate On Demand Performance Bank Guarantee from any reputed Commercial Bank as specified in the bid document in favour of the Employer in the form acceptable to the Employer.
- The value of such Bank Guarantee shall be equal to **two percent (2%)** of the total value of the contract as specified at BDS of bid documents, as awarded by the Employer and it shall be guaranteed towards the faithful performance/ compliance of this Deed of Undertaking in accordance with the terms and conditions specified herein. The Bank Guarantee shall be unconditional, irrevocable and valid for the entire period of the Contract, i.e. till the end of the Warranty period of the Plant under the Contract. The guarantee amount shall be promptly paid to the Employer on demand without any demur, reservation, protest or contest.
8. This DEED OF UNDERTAKING shall be construed and interpreted in accordance with the laws of India and the courts in Delhi shall have exclusive jurisdiction.
9. We, the Associate and the Bidder agree that this undertaking shall be irrevocable and shall form an integral, part of the Contract. We further agree that this undertaking shall continue to be enforceable till the successful completion of Contract and till the Employer discharges it.
10. That this Deed shall be operative from the effective date of the Contract.

Signature of authorized signatory.....

IN WITNESS WHEREOF, the Associate and the Bidder through their authorized representatives, have executed these presents and affixed common seal of their respective companies on the day, month and year first mentioned above.

Witness:

For M/s
(License provider/ Technology Collaborator/ JV Partner)

1.
(Signatures/Name/Address) (Signature of the authorised representative)

Name :

Designation :.....

Common Seal of the Company
.....

Witness :

For M/s.....
(Bidder)

2.
(Signatures/Name/Address) (Signature of the authorised representative)

Name :

Designation :.....

Common Seal of the Company
.....

Note : Power of Attorney of the Persons Signing on behalf of License provider/ Technology Collaborator/ JV Partner and Bidder is to be furnished by the Bidder and to be attached with this signed Deed of Joint Undertaking.

DOCUMENT NO.	RE-CS-5817-004-9-AMDT-02
TITLE	AMENDMENT NO - 01 TO SECTION-V (SPECIAL CONDITIONS OF CONTRACT)
PACKAGE	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
IFB NO.	RE-CS-5817-004-9
ETS PORTAL TSC	NTPC-2024-TN000013
DATE	23.12.2024

Sl. No.	Volume/ Section/ Clause No.	Existing Clause	Amended Clause
1	Section-V/CI No.-14 [GCC 19.4]	<p>Add a new GCC sub-clause 19.4 under GCC Clause 19.0 titled “Subcontracting” as following:</p> <p>19.4 The Contractor shall not be allowed to sub-contract works to any subcontractor/ sub-vendor from a country which shares a land border with India unless such subcontractor is registered with the competent Authority.</p> <p>The Competent Authority for the purpose of registration shall be as mentioned in the Annexure-II of SCC.</p> <p>However, the said requirement of registration will not apply to subcontractors from those countries (even if sharing a land border with India) to which the Government of India has extended lines of credit or in which the Government of India is engaged in development projects. The Contractor may apprise itself of the updated lists of such countries available in the website of the Ministry of External Affairs.</p> <p>Procurement of raw material, components, etc. does not constitute sub- contracting.</p>	<p>Add a new GCC sub-clause 19.4 under GCC Clause 19.0 titled “Subcontracting” as following:</p> <p>19.4 The Contractor shall not be allowed to sub-contract works to any subcontractor/ sub-vendor from a country which shares a land border with India unless such subcontractor is registered with the competent Authority [except for ‘First Contract’ i.e., Supply Contract referred at GCC Clause 3.6.1 read in conjunction with SCC Clause 5 of Bidding Documents].</p> <p>The Competent Authority for the purpose of registration shall be as mentioned in the Annexure-II of SCC.</p> <p>However, the said requirement of registration will not apply to subcontractors from those countries (even if sharing a land border with India) to which the Government of India has extended lines of credit or in which the Government of India is engaged in development projects. The Contractor may apprise itself of the updated lists of such countries available in the website of the Ministry of External Affairs.</p> <p>Procurement of raw material, components, etc. does not constitute sub- contracting.</p>

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO SPECIAL CONDITIONS OF CONTRACT (SECTION-V: SCC) DOCUMENT NO. RE-CS-5817-004-9-AMDT-02	PAGE 1 OF 1
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

Date: 23.12.2024

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
1.	ANEXURE-II TO SECTION-III (BID DATA SHEET)	Annexure-II to BDS, Page 1 of 3	Preference to Make In India and Eligibility for Participation/ granting of Purchase Preference to Class-I local suppliers- regarding	Kindly clarify if there is any mandatory "local content" requirement in this bid. If yes, kindly share the minimum percentage of "local content" requirement.	Provisions of bidding document shall prevail.
2.	SECTION-VII	20	EQUIPMENT PERFORMANCE BANK GUARANTEE	Is Equipment performance bank guarantee and Life cycle performance bank guarantee (mentioned in document RE-CS-5817-004-9 SECTION-I to V) is same? Please clarify	Bidder to refer AMDT-01 to SECTION-VII (Doc Ref No – RE-CS-5817-004-9-AMDT-01)
3.	SECTION-III	83	All Bids must be accompanied by Bid Security in a separate sealed envelope for an amount of Rs 10 Crore (Rupees Ten Crore Only) in the form as stipulated in the Bidding Document.	There seems to be a discrepancy in the Bid Security amount mentioned in the document. On page 83, the Bid Security amount is stated as 10 Crores, while on page 41, it is stated as 1 Lakh. Please clarify the correct Bid Security amount.	Provision of Bidding Documents is amply clear. However, for sake of clarity, it is reiterated to follow BDS Item No – 6 for applicable Bid Security amount.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 1 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
4.	SECTION-III	CI No – 6.0 (Local Content), Sub CI – 6.1 Pg No-103 of 416	The bidder / its Sub-vendors must be class-I local supplier for items(s) mentioned at Annexure to Technical Specification (Section-VI), as applicable, in case such items are Self Manufactured / Bought-out.	Please clarify which Annexure to Technical Specification is referred to in this clause 6.0 – Sub clause 6.1. From the referred Annexures, We understand that, for the Sub-Vendor for BESS System, the restriction/requirement of being class-I Local Supplier for Battery (the most important item of Raw Material for BESS System), is not applicable as “Battery OR Battery Cell” is not specifically mentioned in any of the Annexure to Technical Specification. PLEASE CLARIFY/CONFIRM.	Provisions of bidding document shall prevail.
5.	SECTION-IV	GCC-13.3.1 Page No. 145 of 416	The Contractor shall, within twenty-eight (28) days of the Notification of Award, provide securities for the due performance of the Contract for ten percent (10%) of the	We request NTPC to reduce Performance Security from ten percent (10%) to Three percent (3%) of the Contract Price for all the Contracts.	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 2 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
			Contract Price of all the Contracts, with an initial validity upto ninety (90) days beyond the end of scheduled Defect Liability Period of the last equipment covered under the package. However, in case of delay in completion of the defect liability period, the validity of all the contract performance securities shall be extended by the period of such delay.		

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 3 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply																																																															
6.	SECTION-VII_Book 2 of 3_Price Schedule	Price Schedule-1	<table><tr><th colspan="3">A Main Equipment</th></tr><tr><td>1</td><td>Battery Bank & Battery Management System</td><td>Lot</td></tr><tr><td>1</td><td>PCS</td><td>Lot</td></tr><tr><td>1</td><td>DC Cables</td><td>Lot</td></tr><tr><td>1</td><td>LT Cables</td><td>Lot</td></tr><tr><td>1</td><td>HT Cables</td><td>Lot</td></tr><tr><td>1</td><td>LT Switchgear</td><td>Lot</td></tr><tr><td>1</td><td>HT Switchgear/RMU</td><td>Lot</td></tr><tr><td>1</td><td>Inverter(PCS) Transformer</td><td>Lot</td></tr><tr><td>1</td><td>Auxiliary transformer</td><td>Lot</td></tr><tr><td>1</td><td>Earthing and Lightning Protection System</td><td>Lot</td></tr><tr><td>1</td><td>Illumination System</td><td>Lot</td></tr><tr><td>1</td><td>Energy Management System, SCADA, PPPC, DFC & Time Synchronization</td><td>Lot</td></tr><tr><td>1</td><td>Auxiliary Power Supply System</td><td>Lot</td></tr><tr><td>1</td><td>Fire Detection and Protection System</td><td>Lot</td></tr><tr><td>1</td><td>Measuring system</td><td>Lot</td></tr><tr><td>1</td><td>CCTV System</td><td>Lot</td></tr><tr><td>1</td><td>Main Control Room/Kiosks</td><td>Lot</td></tr><tr><td>1</td><td>Misc. Equipment (other than Specified Above)</td><td>Lot</td></tr><tr><td colspan="3">TOTAL (A) (MAIN EQUIPMENT)</td></tr><tr><td colspan="3">TOTAL (A) (Total of Schedule-1 to be filled in Item Data)</td></tr></table>	A Main Equipment			1	Battery Bank & Battery Management System	Lot	1	PCS	Lot	1	DC Cables	Lot	1	LT Cables	Lot	1	HT Cables	Lot	1	LT Switchgear	Lot	1	HT Switchgear/RMU	Lot	1	Inverter(PCS) Transformer	Lot	1	Auxiliary transformer	Lot	1	Earthing and Lightning Protection System	Lot	1	Illumination System	Lot	1	Energy Management System, SCADA, PPPC, DFC & Time Synchronization	Lot	1	Auxiliary Power Supply System	Lot	1	Fire Detection and Protection System	Lot	1	Measuring system	Lot	1	CCTV System	Lot	1	Main Control Room/Kiosks	Lot	1	Misc. Equipment (other than Specified Above)	Lot	TOTAL (A) (MAIN EQUIPMENT)			TOTAL (A) (Total of Schedule-1 to be filled in Item Data)			Could you please confirm if we are also permitted to enter only the total cumulative price in Schedule-1, instead of providing the item-wise breakdown?	<p>Bidder's understanding is correct.</p> <p>Bidders can submit the total cumulative price in Schedule-1.</p>
A Main Equipment																																																																				
1	Battery Bank & Battery Management System	Lot																																																																		
1	PCS	Lot																																																																		
1	DC Cables	Lot																																																																		
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1	Earthing and Lightning Protection System	Lot																																																																		
1	Illumination System	Lot																																																																		
1	Energy Management System, SCADA, PPPC, DFC & Time Synchronization	Lot																																																																		
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1	Misc. Equipment (other than Specified Above)	Lot																																																																		
TOTAL (A) (MAIN EQUIPMENT)																																																																				
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7.	SECTION-VI_GCC	GCC Cl No-28, Pg No- 173 of 416	<p>.....</p> <p>..... However, if the level of the specified Functional Guarantee parameters, as demonstrated even during repeat of the Guarantee Test(s), are outside the acceptable shortfall limit as</p>	<p>Bidder request to replace the clause as per the following suggestion:</p> <p>"As per technical specifications, rejection of the plant is not envisaged based on functional guarantee test</p>	<p>Provisions of bidding document shall prevail.</p> <p>Bidders to comply with the provisions of Bidding Documents.</p>																																																															

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 4 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
			<p>specified under "Functional Guarantees and Liquidated Damages", Part-A of Section-VI (Technical Specification), the Employer may at its option, either</p> <p>(a) Reject the Equipment and recover the payments already made,</p> <p>or</p> <p>(b) Terminate the Contract pursuant to GCC Sub-Clause 42.2.2 and recover the payments already made,</p> <p>or</p> <p>(c) Accept the equipment after levy of liquidated damages in accordance with the provisions specified under 'Functional Guarantees and Liquidated Damages', Part-A of Section-VI (Technical Specification) to the</p>	<p>of the plant.</p> <p>However, other provisions related to performance guarantee and LD as mentioned in the Section-VI (Technical Specifications) and subsequent amendments shall prevail."</p>	

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 5 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
			Contract Agreement		
8.	SECTION-I to V	BDS, Annexure-II, Pg No- 101 of 416	Preference to Make In India and Eligibility for Participation/ granting of Purchase Preference to Class-I local suppliers- regarding	Bidder request to kindly remove this clause as in case bidder chooses to import battery to maintain high RTE (As per Tender Specification) then the bidder will not be able to meet the 50% local content because battery is the major valued equipment in the entire project.	Provisions of bidding document shall prevail. Bidders to comply with the provisions of Bidding Documents.
9.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of Payment Pg No- 139 of 257	Schedule No. 1: Plant & equipment (Exclu mandatory Spares and type tests) 1. Initial Advance Payment: 5% of Ex-Works Price Component 2. Upon Dispatch: 60% of Ex-Works Price Component 3. Upon Receipt: 20% of Ex-	Bidder Request to change the clause as follows: Schedule No. 1: Plant & equipment (Exclu mandatory Spares and type tests) 1. Initial Advance Payment:	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 6 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
			<p>Works Price Component</p> <p>4. Upon Commissioning: 2.5% of Ex-Works Price Component</p> <p>5. Upon Completion of Facilities: 2.5% of Ex-Works Price Component</p> <p>6. Upon Successful PG Test: 10% of Ex-Works Price Component</p>	<p>15% of Ex-Works Price Component</p> <p>2. Upon Dispatch: 65% of Ex-Works Price Component</p> <p>3. Upon Receipt: 10% of Ex-Works Price Component</p> <p>4. Upon Commissioning: 2.5% of Ex-Works Price Component</p> <p>5. Upon Completion of Facilities: 2.5% of Ex-Works Price Component</p> <p>6. Upon Successful PG Test: 5% of Ex-Works Price Component</p>	
10.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of	<p>Schedule No. 3: Installation & service excluding O&M</p> <p>1. Initial Advance Payment: 5%</p>	Bidder Request to change the clause as follows:	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 7 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
		Payment Pg No- 141 of 257	(Interest Bearing) of Installation service Component (Excluding AMC)..... 2. Initial Advance Payment: 5% (Interest Bearing) of Installation service of the Contract Price 3. Upon Installation: 75% of Installation service 4. Upon Commissioning: 2.5% of Installation service 5. Upon Completion of Facilities: 2.5% of Installation service 6. Upon Successful PG Test: 10% of Installation service	Schedule No. 3: Installation & service excluding O&M 1. Initial Advance Payment: 15% (Interest Free) of Installation service Component 2. Upon Installation: 75% of Installation service 3. Upon Commissioning: 2.5% of Installation service 4. Upon Completion of Facilities: 2.5% of Installation service 5. Upon Successful PG Test: 5% of Installation service	

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 8 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
11.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of Payment Pg No- 144 of 257	<p>Schedule No. 3: Civil Works & Allied Works</p> <p>1. Initial Advance Payment: 5% (Interest Bearing) of the total civil works price component.....</p> <p>2. Initial Advance Payment: 5% (Interest Bearing) of the total civil works price component.....</p> <p>3. Upon Installation: 75% of the total civil works price component.....</p> <p>4. Upon Commissioning: 2.5% of the total civil works price component.....</p> <p>5. Upon Completion of Facilities: 2.5% of the total civil works price component.....</p> <p>6. Upon Successful PG Test: 10% of the total civil works price component.....</p>	<p>Bidder Request to change the clause as follows:</p> <p>Schedule No. 3: Civil Works & Allied Works</p> <p>1. Initial Advance Payment: 15% (Interest Free) of the total civil works price component.....</p> <p>2. Upon Installation: 75% of the total civil works price component.....</p> <p>3. Upon Commissioning: 2.5% of the total civil works price component.....</p> <p>4. Upon Completion of Facilities: 2.5% of the total civil works price component.....</p>	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 9 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
				component..... 5. Upon Successful PG Test: 5% of the total civil works price component.....	
12.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of Payment Pg No- 140 of 257	In case Installation Price (excluding Civil/Structural works price) is less than 11% of the Ex-works Price of Main Equipment, the amount by which it is lower shall be retained proportionately from the Ex-works component of Contract price while releasing payments due on receipt of equipment, and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid on pro-rata basis upon completion of installation of the respective equipment	Bidder request to kindly remove the retention of these payment considering that this is a BESS tender not similar to the Solar tender. Where the majority of the cost is for the supply of the Battery.	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 10 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
			and its certification by the Project Manager.		
13.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of Payment Pg No- 140 of 257	In case Comprehensive O&M Charges are below the minimum percentage of 1% per year of total quoted price excluding Comprehensive O&M Charges, the amount by which it is lower shall be retained from the Ex-Works component of Contract price while releasing payments due on receipt of equipment, and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid on pro-rata basis upon completion of the Comprehensive O&M Period and its certification by the project manager.	Bidder request to kindly remove the retention of these payment considering that this is a BESS tender not similar to the Solar tender. Where the majority of the cost is for the supply of the Battery.	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 11 of 33
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
14.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of Payment Pg No- 144 of 257	In case the Installation Price (excluding Civil/Structural works price) is more than 14% of the Ex-works Price of Main Equipment, the amount by which it is higher shall be retained while releasing progressive payments due on installation of equipment, and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid along with payment due on completion of Trial Operation / Completion of Facilities.	Bidder request to kindly remove the retention of these payment considering that this is a BESS tender not similar to the Solar tender. Where the majority of the cost is for the supply of the Battery.	Provisions of bidding document shall prevail.
15.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of Payment Pg No- 147 of 257	(iii) In case the Civil Works Price (including Site Fabricated Structural Works Price) is more than 3% of the Ex-works Price of Main Equipment, the amount by which it is higher	Bidder request to kindly remove the retention of these payment considering that this is a BESS tender not similar to the Solar tender. Where	Provisions of bidding document shall prevail.

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			shall be retained while releasing progressive payments due on completion of civil works (including Site Fabricated Structural works), and no interest shall be payable on the retained amount. The aforesaid retained amount shall be paid along with payment due on completion of Trial Operation / Completion of Facilities.	the majority of the cost is for the supply of the Battery.	
16.	SECTION-VII_FP	Appendix – 1, Terms and Procedure of Payment Pg No- 153 of 257	In case 'Amount linked to Safety Aspects / compliance to Safety Rules' is less than 2 % of the cumulative total of Service Portion of the Contract, i.e. Civil + Installation/ Erection + Structural Works, the amount by which it is lower shall be retained proportionately from the other components of	Bidder request to kindly remove the retention of these payment considering that this is a BESS tender not similar to the Solar tender. Where the majority of the cost is for the supply of the Battery.	Provisions of bidding document shall prevail.

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			Schedule-3 of the Contract price while releasing payments of each RA bill. No interest shall be payable on the amounts linked to Safety Aspects / Compliance to Safety Rules including aforesaid retained amount. The amounts linked to Safety Aspects / Compliance to Safety Rules including aforesaid retained amount shall be payable in part or- full based on safety compliance duly certified by Project Manager and Safety-incharge on quarterly basis.		
17.	SECTION-II	ITB 34. Performance Security Pg No-59 of 416	Within twenty-eight (28) days after receipt of the Notification of Award, the successful Bidder shall furnish performance securities for ten percent (10%) of Contract	Bidder request to modify the clause as per following: "Within twenty-eight (28) days after receipt of the Notification of Award, the	Bidders to refer SECTION-V, SCC Cl. No – 10.1.

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			Price for all the contracts and in the form provided in the section "Forms and Procedures" of the bidding documents.	successful Bidder shall furnish performance securities for ten percent (10%) of Contract Price (Excl O&M Price) for all the contracts and in the form provided in the section "Forms and Procedures" of the bidding documents."	
18.	SECTION-V	SCC Time for Commencement and Completion (GCC Clause 8), Pg No-350 of 416	Further, bidder is also required to provide comprehensive Operation & Maintenance(O&M) of the BESS system for a period of Ten (10) Years by the Bidder from the date of successful commissioning.	Bidder wants to understand the start of O&M Period in case of partial commissioning.	Provision of Part commissioning is covered in Technical Specification (SECTION-VI). However, for sake of clarity, the 10-year O&M period and other related provisions shall be accounted from date of full commissioning. For further details, bidder is to refer to "D-2 PROJECT COMMISSIONING AND OTHER

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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
					GENERAL REQUIREMENTS" under SECTION-VI.
19.	SECTION-V	SCC Completion Time Guarantee (GCC Clause 26) Pg No-365 of 416	For each day of delay in Commissioning, Stabilization & Trial Run of Plant/BESS System at NTPC Ramagundam under the contract as per the scope of work of the contractor	Bidder request to modify the clause as per follow: "For each day of delay in Commissioning for the un-commissioned value, Stabilization & Trial Run of Plant/BESS System at NTPC Ramagundam under the contract as per the scope of work of the contractor"	Provisions of bidding document shall prevail.
20.	SECTION-V	SCC Completion Time Guarantee (GCC Clause 26), Pg No-365 of 416	Sum of INR 43,82,454.00 (Indian Rupees Forty-Three Lakh Eighty-Two Thousand Four Hundred Fifty Four only).	Bidder Request to modify the rate w.r.t the un-commissioned MW capacity.	Provisions of bidding document shall prevail.
21.	SECTION-IV	GCC 6.5.1 Pg No-133 of 416	The parties to the contract shall invoke arbitration within	Q. We seek deletion of this clause which curtails the	Provisions of bidding document shall prevail.

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			Six months from the date of completion of the Facilities under the contract or the termination of the contract as the case may be and the parties shall not invoke arbitration later on after expiry of the said period of six months. In case, no claim is filed within this period of six months, it shall be presumed that there is no claim. Any claim filed after the aforesaid period of six months shall not be entertained	period of limitation for invoking arbitration. Also, parties shall be free to invoke arbitration irrespective of completion of the Facilities or termination of contract.	
22.	SECTION-IV	GCC 6.5.3 Pg No-134 of 416	Any dispute raised by a party to arbitration shall be adjudicated by a Sole Arbitrator appointed by mutual consent from among the List of empanelled Arbitrators maintained by EMPLOYER	Q. We seek that the arbitrator/ arbitrators shall be appointed by the parties mutually without reference to the panel maintained by NTPC.	Provisions of bidding document shall prevail.

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23.	SECTION-IV	GCC 37 Pg No-185 of 416	Force Majeure	Q. We seek the inclusion of right of termination in the event of prolonged force majeure event (beyond a cumulative period of 90 days). Upon such termination, the Contractor shall be entitled to payment as stated in GCC 42.1.3.	Provisions of bidding document shall prevail.
24.	SECTION-IV	GCC 43 Pg No-201 of 416	The Contractor shall not, without the express prior written consent of the Employer, assign to any third party the Contract or any part thereof, or any right, benefit, obligation or interest therein or thereunder, except that the Contractor shall be entitled to assign either absolutely or by way of charge any monies due and payable to it or that may	Q. We seek that this clause to be made mutual "The Parties shall not, without the express prior written consent of the Employer, assign to any third party or any part thereof, or any right, benefit, obligation or interest. Any such assignment shall not result in any changes to the terms of the Contract, unless otherwise agreed by the	Provisions of bidding document shall prevail.

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			become due and payable to it under the Contract.	Parties"	
25.	SECTION-IV	GCC 60.3 Pg No-210 of 416	Upon successful fulfilment of all the obligation of the Contractor pursuant to GCC Sub-Clause 60.1 and 60.1, the Employer shall require the Contractor to furnish a "No Demand Certificate" as per the format enclosed at Section-VII (Forms and Procedures) – Forms for Stage Closing Activities	We seek that provision of this "No Demand Certificate" shall not be a pre-condition for releasing the Contractor's payments. The provision of the "No-Demand Certificate" shall not prejudice any claims/disputes already a subject of the dispute resolution process under the contract.	Provisions of bidding document shall prevail.
26.	SECTION-V	SCC 25 Pg No-367 of 416	the aggregate liability of the Employer to the Contractor except for GCC sub-clause 29.3, whether under the Contract, in tort or otherwise, at any point of time during the execution/performance of the	Q. Please confirm that this liability limit of the Employer is in addition to the Employer's obligation to make payments to the Contractor as per the	Provisions of bidding document is amply clear and the same shall prevail. Bidders to comply with the provisions of Bidding Documents.

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			Contract, shall not exceed the 'total Contract Price less payments already released to the Contractor'.	Contract.	
27.	SECTION-III	BDS read with ITB-43 Pg No- 95 of 416	The Bidder shall be solely responsible for obtaining the benefits of exemption on excise duty GST or any other taxes and duties (if applicable) on the items to be supplied under the contract from the Govt. of India. In case of failure of the bidder to receive the benefits partly or fully from Govt. of India or in case of delay in receipt of such benefits, the Employer shall neither be responsible nor liable in this regard in any manner whatsoever.	Q. We seek that withdrawal of any benefits by the government shall be treated as a change in law and the Contractor shall be entitled to recover any excess costs incurred as a result from the Employer.	Provisions of bidding document shall prevail.

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28.	SECTION-III	ITB 12.6, Pg No- 42 of 416	Subject to clause 12.8 below, the Bid Security of the Bidder whose Techno-Commercial Bid has not been found acceptable, shall be returned along with letter communicating rejection of Techno-Commercial Bid. The Bid Security of the Bidders who are not short-listed for Reverse Auction shall be returned within fifteen (15) days of the completion of Reverse Auction process. The Bid Security of the bidders who are unsuccessful after opening of Price Bids and reverse auction shall be returned expeditiously.	Bidder wants to understand when will be the Bid Security of the participants shall be returned who are not L1 in this Bid.	Bid Security shall be returned/released as per the provisions of bidding documents.
29.	SECTION-IV	GCC 6.5.3 Pg No- 134 of 416	It is agreed between the parties that the Arbitration proceedings shall be conducted as per the provisions of Fast Track Procedure as provided under The Arbitration and Conciliation Act, 1996, as amended from time to time.	Q. Fastrack Arbitration may be agreed (proposed in the notice of invocation of arbitration) depending on the nature and quantum of claims. Please delete this mandatory provision.	Provisions of bidding document shall prevail.
30.	SECTION-VII_FP	2. Form of Bank Guarantee towards Bid Security Page No: 120/257	Note: 3. The BG should be on Non-Judicial stamp paper/e stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG is executed, whichever is higher. The Stamp	we have processing the BG from the state of Telangana. Request you to please provide the value of stamp paper with illustrations. This will help us to estimate the project cost properly	BG Stamp paper value shall be as per the provisions of bidding document.

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			Paper/e- Stamp paper shall be purchased in the name of Bidder/Bank issuing the guarantee.		
31.	SECTION-II	ITB 10.3 Page No: 37/416	<p>Bidders are required to fill up their Bid Price in the Electronic Form on the ETS Portal and uploaded in the ETS Portal (Financial Part).</p> <p>Separate numbered Schedules shall be used for each of the following elements and all the price schedules shall be furnished by successful bidder within two (2) hours of Auction end time without fail, if required as per the "Terms and Conditions of Reverse Auction" and "Business Rules for Reverse Auction" enclosed at Annexure-I and II. The sum total of each of the Schedule 1, 2, 3, 6 & 7 shall be equal to the Award Price as defined in "Business Rules for</p>	Please share the business rules for reverse auction	<p>Bidders are requested to refer to BDS Item No – 5.1 in this regard.</p> <p>Further, provisions of bidding document shall prevail.</p>

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			Reverse Auction”.		
32.	SECTION-II	ITB 40.6, Note: ii Page No: 66/416	However, a bidder who only procures raw material, components etc. from an entity from a country which shares a land border with India and then manufactures or converts them into other goods will not be treated as an Agent	The Bidder is NOT a bidder who shares land border with India. However, he wants to procure some equipments, i.e. battery, in fully finished form (i.e. in container form) OR PCS from a country that shares land border with India. Will that be allowed?	Provisions of bidding document shall prevail.
33.	SECTION-I to V	GCC 19.4 Page No: 360/416	Add a new GCC sub-clause 19.4 under GCC Clause 19.0 titled “Subcontracting” as following: 19.4 The Contractor shall not be allowed to sub-contract works to any subcontractor/ sub-vendor from a country which shares a	Will Procurement of batteries on container form OR procurement of PCS be considered as 'sub-contracting' and hence, applicable by land border clause?	Bidder to refer AMDT-01 to SECTION-V (Doc Ref No – RE-CS-5817-004-9-AMDT-02)

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			land border with India unless such subcontractor is registered with the competent Authority. The Competent Authority for the purpose of registration shall be as mentioned in the Annexure-II of SCC. However, the said requirement of registration will not apply to subcontractors from those countries (even if sharing a land border with India) to which the Government of India has extended lines of credit or in which the Government of India is engaged in development projects. The Contractor may apprise itself of the updated lists of such countries available in the website of the Ministry of External Affairs. Procurement of raw material, components, etc. does not constitute sub- contracting.		

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34.	Sec-II	Cl. 10.7 / P 15 of 42	10.7 Price Basis Prices quoted by the Bidder shall remain firm and fixed for the entire period of execution of the Contract.	There is price uncertainty due to various reasons which is beyond control of bidder. Therefore, bidder is requesting to have PRICE VARIATION clause on the basis of IEEMA Indices which is being followed by all over.	Provisions of bidding document shall prevail.
35.	Sec-II	Cl. 34 / P 34 of 42	34 Performance Security 34.1 Within twenty-eight (28) days after receipt of the Notification of Award, the successful Bidder shall furnish performance securities for ten percent (10%) of Contract Price for all the contracts and in the form provided in the section "Forms and Procedures" of the bidding documents. 34.2 In case Joint Deed(s) of Undertaking by the Contractor along with his associate(s)/collaborator(s) form	<p>➤ Is BG's mentioned under Cl 34.1 & 34.2 are separate BG's?</p> <p>If yes, then it will be heavy burden on bidder. Hence it is requested to have only one performance security BG of 5% of Contract price.</p>	<p>Bidder's understanding is correct.</p> <p>Further, the provisions of bidding document shall prevail.</p>

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			part of the Contract, then, unconditional Bank Guarantee(s) from such associate(s)/collaborator(s) towards faithful performance of the Joint Deed(s) of Undertaking for amount(s) specified in Bid Data Sheets shall be furnished within twenty eight (28) days after Notification of Award. These Bank Guarantees shall be furnished in the form provided in the section "Forms and Procedures" of the bidding documents and shall be valid till such period as specified in the corresponding format for Deed of Joint Undertaking.		
36.	Sec-V	CI 10.4 / P 5 of 27	10.4 For ensuring declared performance of BESS System, the Contractor shall provide Equipment Performance Bank Guarantee (EPBG) for initial 10-years of O&M and Battery Performance Bank Guarantee	EPBG period of 10 years & BPBG period of 20 years to too long. Request to keep as 5 years & 10 years respectively.	Provisions of bidding document shall prevail.

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			(BPBG) for 11 th to 20 th year of O&M.		
37.	Sec-VII	CI (VI) / P 139 of 257	APPENDIX – 1 TERMS AND PROCEDURES OF PAYMENT (VI) Ten percent (10%) of Ex-works price component of the Contract Price on successful completion of the Performance Guarantee Tests, as specified, and issuance of Operational Acceptance Certificate by the Project Manager.	Request to make a provision of release of this 10% payment of PG test against the submission of an additional Bank Guarantee of an equivalent amount by the contractor at commissioning stage only.	Provisions of bidding document shall prevail.
38.	Section II	10.3, 37/416	Separate numbered Schedules shall be used for each of the following elements and all the price schedules shall be furnished by successful bidder within two (2) hours of Auction end time without fail, if required as per the "Terms and Conditions of Reverse Auction" and "Business Rules for Reverse Auction"	As per Price Bid Form; Bidder understands that e-Reverse Auction (eRA) is not applicable in this tender. Please confirm.	Bidders to refer BDS Item No – 5.1 in this regard. Further, provisions of bidding document shall prevail.

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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
			enclosed at Annexure-I and II. & Section VII - Bid Form (Price-Bid), page 2 of 6 eRA - Not Applicable		
39.	Section II	40.1, 64/416	Further the successful bidder shall not be allowed to sub-contract supplies/services/works to any "Sub-contractor" from a country which shares a land border with India unless such Sub-contractor is registered with the competent Authority as mentioned in SCC. & Pg. 385/416 Sub-contracting in works contracts [Note: Procurement of raw material, components, etc. does	Bidder understands that since, Battery cells/modules being raw material/components of finished assembled BESS product, procurement of battery cells/modules shall be exempted from the land border procurement restrictions. Please confirm.	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 28 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC's Reply
			not constitute sub-contracting.]		
40.	Section V	GCC 8.2, 350/416	Time for Completion: The time schedule for completion of facilities for the bidder will be 15 Months from the date of NOA.	As per Guidelines for Procurement and Utilization of Battery Energy Storage System, Bidder request that 24 months shall be provided as timeline for completion. Please accept.	Provisions of bidding document shall prevail.
41.	Section V	10.6 GCC 13.7 (e), 357/416	Minimum extension of any BG/Insurance Surety Bond should be three months.	Bidder understands that EMD BG extension, if required, shall be as per the requirement based on the extended due date (if any) of bid submission and not 3 months. Please confirm.	Provisions of bidding document shall prevail.
42.	Section V	22, 365/416	Applicable rate for liquidated damages (A) Liquidated Damages for Delay in Commissioning, Stabilization & Trial Run of the plant shall be as under: If the contractor fails to achieve the Successful Commissioning, Stabilization & Trial Run of the	Bidder request NTPC for Delay LD to be one-tenth percent (0.1%) per week of the Contract Price [total of First and Second Contract] subject to a maximum of five percent (05%) of the Contract Price [total of First and Second Contract].	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 29 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
			Plant / BESS System within the 14.5 months, the Contractor shall pay to the Employer as liquidated damages and not as penalty, a sum calculated at the following rates: Sum of INR 43,82,454.00 (Indian Rupees Forty-Three Lakh Eighty-Two Thousand Four Hundred Fifty Four only). - For each day of delay in Commissioning, Stabilization & Trial Run of Plant/BESS System at NTPC Ramagundam under the contract as per the scope of work of the contractor		
43.	Section VII	2, 119/257	Form of Bank Guarantee towards Bid Security	While issuing BGs, banks insist to include "Notwithstanding Clause" in the BG text. The BG Format provided in the tender document does not have any notwithstanding clause. It is	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 30 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
				<p>requested to include Notwithstanding clause as per following details: Notwithstanding anything to the contrary contained herein</p> <ul style="list-style-type: none"> • Our Liability under this guarantee shall not exceed Rs./- (Rupees Only) • This Bank Guarantee shall remain valid up to and • We are liable to pay to the guarantee amount only and only if we receive from you a written claim or demand not later thanat Bank Name (Complete Address). All your rights as well as our liability under this guarantee shall stand extinguished unless a written claim or demand is made under this guarantee not later thanwhether or not the 	

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 31 of 33
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Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Commercial Portion of Bidding Documents (SECTION – I to V & SECTION-VII)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
				original BG is submitted to us. Alternately, NTPC to accept Bank Guarantee having above text in addition to the text provided in the tender document. Please accept.	
44.	Section VII	Appendix 1, 139/257	TERMS AND PROCEDURES OF PAYMENT Schedule No.1: Plant and Equipment (excluding Mandatory Spares and Type Tests)	Batteries being the major capital item of a BESS system and needs procurement order to be placed at the beginning of the Project. Therefore, Bidder request that the 'Terms of Payment - Schedule 1' may please be amended as: (i) Ten Percent (10%) of the total Ex-works price component as Initial Advance Payment. (ii) Fifty Five Percent (55%) of Ex-works price component of the Contract price for each identified equipment	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 32 of 33
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Document No.:	RE-CS-5817-004-9
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PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC's Reply
				upon dispatch of equipment from manufacturer's works on pro-rata basis	
45.	SECTION-III	BDS Item No-20.2, Pg No – 95/416	The amount of Bank Guarantee(s)/Insurance Surety Bond from associate(s)/collaborator(s) : Two percent (2%) of the total value of the contract(s), as awarded by the Employer.	<p>Under Route 3 of technical qualification.</p> <p>It is requested that the condition of submitting the Bank Guarantee by the collaborator may kindly be waived off as the technical collaborators are reluctant to do so.</p> <p>We would kindly request that Bank Guarantees may be allowed to be submitted by the Primary Bidder.</p>	Provisions of bidding document shall prevail.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Commercial Portion of Bidding Documents DOCUMENT NO: RE-CS-5817-004-9-CLRF-01	Page 33 of 33
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ADDENDUM NO. 02 TO BIDDING DOCUMENTS

**NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)**

CONTRACTS SERVICES

**PACKAGE: EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC
RAMAGUNDAM.**

ETS Portal Tender Search Code: NTPC-2024-TN000013

Bidding Document No: RE-CS-5817-004-9

The following Clarification(s) and Amendment(s) to the Bidding Documents of the subject package are being issued:

1	RE-CS-5817-004-9-AMDT-03:	Amendment No-01 to TECHNICAL SPECIFICATION (TS)
3	RE-CS-5817-004-9-CLRF-02:	Clarification No-01 to Technical Portion of Bidding Documents

The above Clarification(s) and Amendment(s) to Bidding Documents shall be read in conjunction with and shall form integral part of Bidding Documents. The Clarification(s) and Amendment(s) will be binding on Bidders, and it will be assumed that the information contained therein have been taken into account by the Bidder in his bid.

All other terms and conditions of the Bidding Documents shall remain unchanged.

Date: 08.01.2025

**(Ghazanfer Munam)
Dy. General Manager (CS)**

DOCUMENT NO.	RE-CS-5817-004-9-AMDT-03
TITLE	AMENDMENT NO. 01 TO SECTION-VI (TECHNICAL SPECIFICATION)
PACKAGE	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
IFB NO.	RE-CS-5817-004-9
ETS PORTAL TSC	NTPC-2024-TN000013
DATE	08.01.2025

Sl. No.	Volume/ Section/ Clause No.	Existing Clause		Amended Clause	
1	Part A Subsection -2-A Clause 1.0 (i)	a) Metering:. As per SLD. ABT Meter has to be provided at following locations 1. Main and Check meters at Final 33 kV block feeder . 2. Standby meter at individual 33 KV breakers within the DC Block		a) Metering:. As per tender SLD. Additional 08 No. of 0.2s Class energy meters to be provided for Owner's Use (for modification in existing Solar Breaker Panels)	
2	Part A Subsection -2 Clause 3.1.4	Year wise BESS MWh capacity shall be as quoted by bidder in bid document. BESS capacity for particular year shall be maintained throughout the year for operating ambient temperature of 0°-50° C and under all other extreme ambient condition. Bidder shall install HVAC and other equipment's in case BESS capacity is dependent ambient condition		Year wise BESS daily dischargeable capacity in MWh shall be as quoted by bidder in bid document. BESS capacity for particular year shall be maintained throughout the year (from start to end of year without any degradation during the year) for operating ambient temperature of 0°-50° C and under all other extreme ambient condition. Bidder shall install HVAC and other equipment's in case BESS capacity is dependent on ambient condition	
3	Part A Subsection -2 Clause 3.1.4	Use case requirements. (Any other control/application mode if required during O&M ,it is to be configured by Contractor to meet special requirement. During FAT, these control modes is to bechecked and ensured.)	a. Peak Management b. Grid Ancillary services c. VAR support to Grid / voltage Regulation d. Black Start application e. Frequency Regulation /Grid support f. Energy Arbitrage/energy shifting operation/Solar Smoothening (With existing Solar plant)	Use case requirements. EMS system should have mentioned functionalities for desired utilization of BESS. Normal operation of BESS shall be for daily single cycle charging and discharging.	a. Peak Management b. Grid Ancillary services c. VAR support to Grid / voltage Regulation d. Black Start application e. Frequency Regulation /Grid support f. Energy Arbitrage/energy shifting operation/Solar Smoothening (With existing

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO TECHNICAL SPECIFICATION (SECTION-VI: TS) DOCUMENT NO. RE-CS-5817-004-9-AMDT-03	Page 1 of 7
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DOCUMENT NO.	RE-CS-5817-004-9-AMDT-03
TITLE	AMENDMENT NO. 01 TO SECTION-VI (TECHNICAL SPECIFICATION)
PACKAGE	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
IFB NO.	RE-CS-5817-004-9
ETS PORTAL TSC	NTPC-2024-TN000013
DATE	08.01.2025

Sl. No.	Volume/ Section/ Clause No.	Existing Clause		Amended Clause	
			g. Ramp rate support h. Power Quality mitigation to Grid i. Interaction on real-time with IEX for schedule of charging and discharging. Inertia Support to Grid as virtual Synchronous Generator.	Any other control/application mode if required during O&M is to be configured by Contractor to meet special requirement on instruction of owner. During FAT, these control modes is to be checked and ensured. No extra Battery/PCS sizing is envisaged to meet these additional operation modes.	Solar plant) g. Ramp rate support h. Power Quality mitigation to Grid i. Interaction on real-time with IEX for schedule of charging and discharging. Inertia Support to Grid as virtual Synchronous Generator.
4	Part A Subsection -2 Clause 3.1.4	Identification and Traceability	Battery Cells/Racks/Packs assembly shall meet the seismic requirement for the plant location of the BESS. Labeling of cells/batteries shall include manufacturer's name, cell type, name-plate rating, date of manufacture and date of expiry of parts and labor warranty	Identification and Traceability	Battery Cells/Racks/Packs assembly shall meet the seismic requirement for the plant location of the BESS. Labeling of cells/batteries shall include manufacturer's name, cell type, name-plate rating, date of manufacture etc (details to be decided during detailed Engineering).

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO TECHNICAL SPECIFICATION (SECTION-VI: TS) DOCUMENT NO. RE-CS-5817-004-9-AMDT-03	Page 2 of 7
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DOCUMENT NO.	RE-CS-5817-004-9-AMDT-03
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IFB NO.	RE-CS-5817-004-9
ETS PORTAL TSC	NTPC-2024-TN000013
DATE	08.01.2025

Sl. No.	Volume/ Section/ Clause No.	Existing Clause	Amended Clause
5	Part A Subsection -2 Clause 3.1.12	The BESS shall be integrated with the existing/under implementation NTPC solar project at 33kV. There are four numbers of 33kV Solar Block feeders identified each with approx. 25MW rating. The BESS Bidder scope includes measuring active and reactive power (with 0.2 class transducer/EM) of these 33kV solar incomers and outgoing feeders to pooling switchgear and integrating measured data into the BESS EMS/SCADA. All required materials and services are in the BESS Bidder scope.	The BESS shall be integrated with the existing/under implementation NTPC solar project at 33kV. There are four numbers of 33kV Solar Block feeders identified each with approx. 25MW rating. The BESS Bidder scope includes measuring active and reactive power (with 0.2 class transducer/EM) of these 33kV solar incomers and outgoing feeders to pooling switchgear and integrating measured data into the BESS EMS/SCADA. All required materials and services are in the BESS Bidder scope. Note: Below mentioned application modes are required in EMS as functionalities to enable use of BESS in other modes within the available BESS capacity, if needed. However, BESS sizing shall be done as per requirement of daily single cycle operation of charging and discharging.
6	Part A Subsection -2 Clause 3.1.14.2	Where full-scale testing of larger systems at the factory may be difficult or impossible due to the large system, the FAT shall be carried out at a subsystem or module level and shall consist of tests of 100% of the subsystems or modules that comprise the complete BESS, to the extent possible. In the FAT plan, the Contractor shall clearly state what is being tested and shall fully explain any features or functions of the fully assembled BESS that would not be fully tested in the reduced-scale testing proposed. In such a case, the SAT plan shall further describe how	Where full-scale testing of larger systems at the factory may be difficult or impossible due to the large system, the FAT shall be carried out at a subsystem or module level and shall consist of tests of suitable % of the subsystems or modules (to be decided during detailed engineering) that comprise the complete BESS, to the extent possible. In the FAT plan, the Contractor shall clearly state what is being tested and shall fully explain any features or functions of the fully assembled BESS that would not be fully tested in the reduced-scale testing proposed. In such a case, the SAT plan shall further describe how the tests that could not be carried out in the factory will instead be carried out at the site
EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9		AMENDMENT NO. 01 TO TECHNICAL SPECIFICATION (SECTION-VI: TS) DOCUMENT NO. RE-CS-5817-004-9-AMDT-03	Page 3 of 7

DOCUMENT NO.	RE-CS-5817-004-9-AMDT-03
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IFB NO.	RE-CS-5817-004-9
ETS PORTAL TSC	NTPC-2024-TN000013
DATE	08.01.2025

Sl. No.	Volume/ Section/ Clause No.	Existing Clause	Amended Clause
		the tests that could not be carried out in the factory will instead be carried out at the site	
7	Part A Subsection -2 Clause 3.1.14.6	Factory testing shall demonstrate operation at expected temperature extremes at the independent laboratory certification of operation of critical components and subsystems in the battery, PCS, and control systems shall be submitted at the time of the FAT. The Contractor shall submit to the Employer for approval, 90 days before the FAT, a list of components and subsystems for which independent lab testing certification will be	Factory testing shall (preferably) demonstrate operation at expected temperature extremes at the independent laboratory. Certification of operation of critical components and subsystems in the battery, PCS, and control systems shall be submitted at the time of the FAT. The Contractor shall submit to the Employer for approval, 90 days before the FAT, a list of components and subsystems for which independent lab testing certification will be sought
8	Section VI- Chapter B-6 (Energy Management System and SCADA) Clause 1.7	<p>1.7. EMS System shall have the provision to perform the following functions:</p> <ul style="list-style-type: none"> i. Provision to operate the BESS as per following minimum application requirement including Ancillary services but not limited to; a. Integrated control with solar power plant at Ramagundam for smoothening and energy Time shifting application b. VAR support to Grid / voltage Regulation c. Black Start application d. Frequency Regulation /Grid support e. Energy Arbitrage/energy shifting operation 	<p>1.7. EMS System shall have the provision to perform the following functions:</p> <ul style="list-style-type: none"> i. Provision to operate the BESS as per following minimum application requirement including Ancillary services but not limited to; a. Integrated control with solar power plant at Ramagundam for smoothening and energy Time shifting application b. VAR support to Grid / voltage Regulation c. Black Start application d. Frequency Regulation /Grid support
EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9		AMENDMENT NO. 01 TO TECHNICAL SPECIFICATION (SECTION-VI: TS) DOCUMENT NO. RE-CS-5817-004-9-AMDT-03	Page 4 of 7

DOCUMENT NO.	RE-CS-5817-004-9-AMDT-03
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Sl. No.	Volume/ Section/ Clause No.	Existing Clause	Amended Clause
		f. Ramp rate support g. Power Quality Application to Grid h. Interaction on real-time with IEX for schedule of charging and discharging. i. Inertia Support to Grid as virtual Synchronous Generator	e. Energy Arbitrage/energy shifting operation f. Ramp rate support g. Power Quality Application to Grid h. Interaction on real-time with IEX for schedule of charging and discharging. i. Inertia Support to Grid as virtual Synchronous Generator
9	Chapter -D-6 Clause 2.02	<p>For cameras to be located in remote areas where the UPS power supply can not be extended due to voltage drop etc., then such cameras can be grouped and fed from mini-UPS. Individual mini-UPS shall be provided for the cameras which cannot be grouped. Mini UPS are to be provided by the contractor within his quoted lumpsum price. The contractor shall also provide local power distribution boxes as required for sub-distribution of supply from these mini-UPS to cameras. The location of mini-UPS & power distribution scheme shall be finalized during detail engineering.</p>	<p>For cameras to be located in remote areas where the UPS power supply cannot be extended due to voltage drop etc., then such cameras can be grouped and fed from mini-UPS. Individual mini-UPS shall be provided for the cameras which cannot be grouped. Mini UPS are to be provided by the contractor within his quoted lumpsum price. The contractor shall also provide local power distribution boxes as required for sub-distribution of supply from these mini-UPS to cameras. The location of mini-UPS & power distribution scheme shall be finalized during detail engineering. Alternatively, the bidder may offer Reliable supply through POE however acceptability of the same shall</p>

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO TECHNICAL SPECIFICATION (SECTION-VI: TS) DOCUMENT NO. RE-CS-5817-004-9-AMDT-03	Page 5 of 7
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DOCUMENT NO.	RE-CS-5817-004-9-AMDT-03
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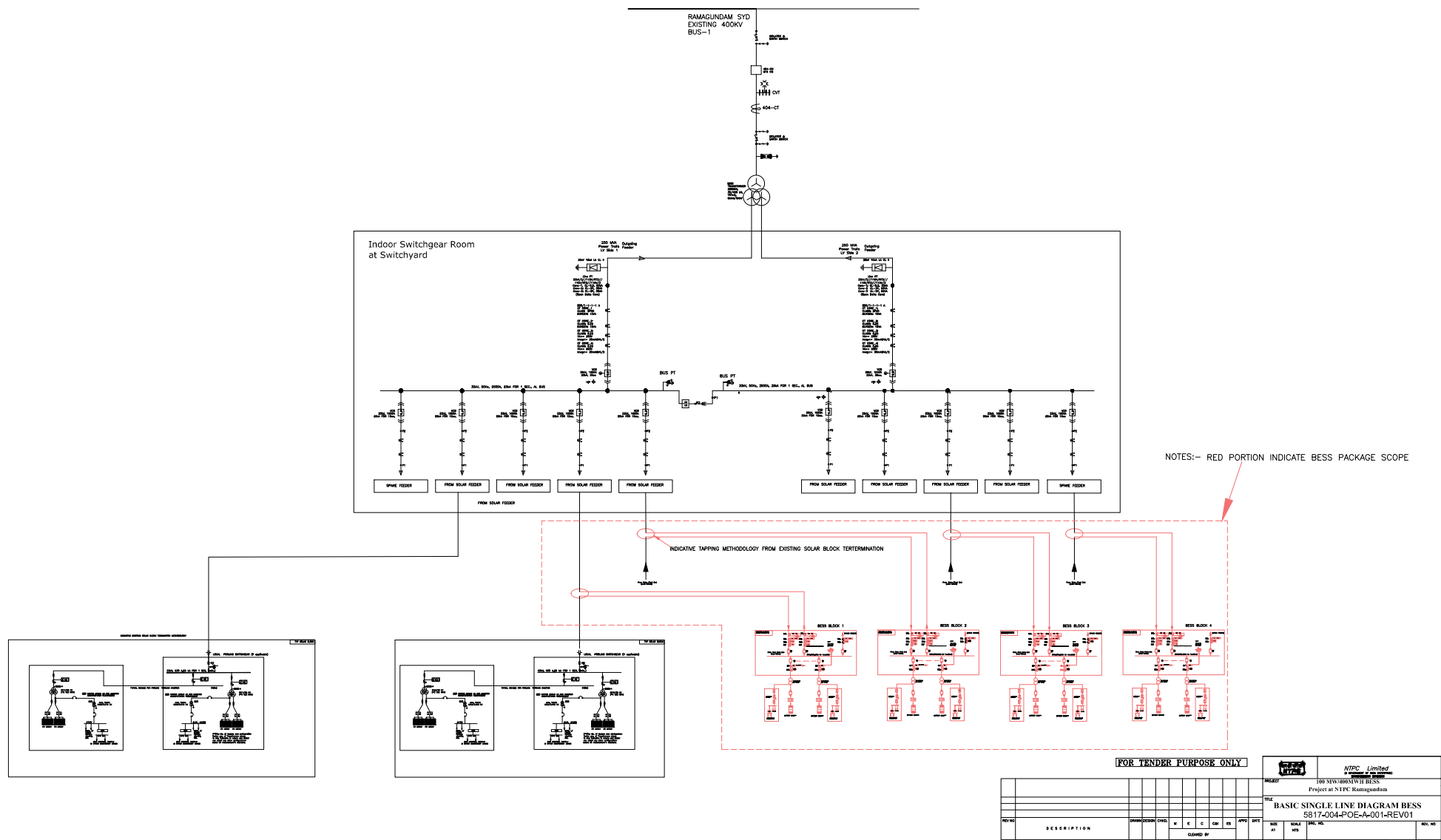
Sl. No.	Volume/ Section/ Clause No.	Existing Clause	Amended Clause																																	
			be confirmed based on reliability during detailed engineering.																																	
10	Chapter-D8 clause 4.05	Workstation Operator workstation & network switch station shall be in Control Room or as finalized during the detailed engineering.	Workstation Operators’ workstation & network switch station shall be placed in Control Room as finalized during the detailed engineering. The size of the display screen shall be minimum 50 inches/ inline to the requirement for the complete camera coverage in the screen. Bidder must ensure that the LED screen pixel density shall match with the offered camera pixel density or higher.																																	
11	Chapter I-1 Tender Drawings	<table><tr><th>SL. NO.</th><th>DRAWING NO.</th><th>TITLE</th></tr><tr><td>1.</td><td>5817-004-POE-A-001</td><td>Basic Single Line Diagram- Indicative</td></tr><tr><td>2.</td><td>5817-004-POE-A-002</td><td>Vicinity Map- Tentative Available Land Area</td></tr><tr><td>3.</td><td>5817-004-POE-A-003</td><td>Indicative Cable Route Of Existing Solar And Tapping/Rerouting Methodology</td></tr><tr><td>4.</td><td>5817-004-POC-A-001</td><td>Typical Details Of Approach Roads</td></tr></table>	SL. NO.	DRAWING NO.	TITLE	1.	5817-004-POE-A-001	Basic Single Line Diagram- Indicative	2.	5817-004-POE-A-002	Vicinity Map- Tentative Available Land Area	3.	5817-004-POE-A-003	Indicative Cable Route Of Existing Solar And Tapping/Rerouting Methodology	4.	5817-004-POC-A-001	Typical Details Of Approach Roads	<table><tr><th>SL. NO.</th><th>DRAWING NO.</th><th>TITLE</th></tr><tr><td>1.</td><td>5817-004-POE-A-001-REV01</td><td>Basic Single Line Diagram-Indicative</td></tr><tr><td>2.</td><td>5817-004-POE-A-002-REV01</td><td>Vicinity Map- Tentative Available Land Area</td></tr><tr><td>3.</td><td>5817-004-POE-A-003</td><td>Deleted</td></tr><tr><td>4.</td><td>5817-004-POC-A-001</td><td>Typical Details Of Approach Roads</td></tr><tr><td>5.</td><td>5817-004-POC-A-002</td><td>Details Of Chain Link Fencing</td></tr></table>	SL. NO.	DRAWING NO.	TITLE	1.	5817-004-POE-A-001-REV01	Basic Single Line Diagram-Indicative	2.	5817-004-POE-A-002-REV01	Vicinity Map- Tentative Available Land Area	3.	5817-004-POE-A-003	Deleted	4.	5817-004-POC-A-001	Typical Details Of Approach Roads	5.	5817-004-POC-A-002	Details Of Chain Link Fencing
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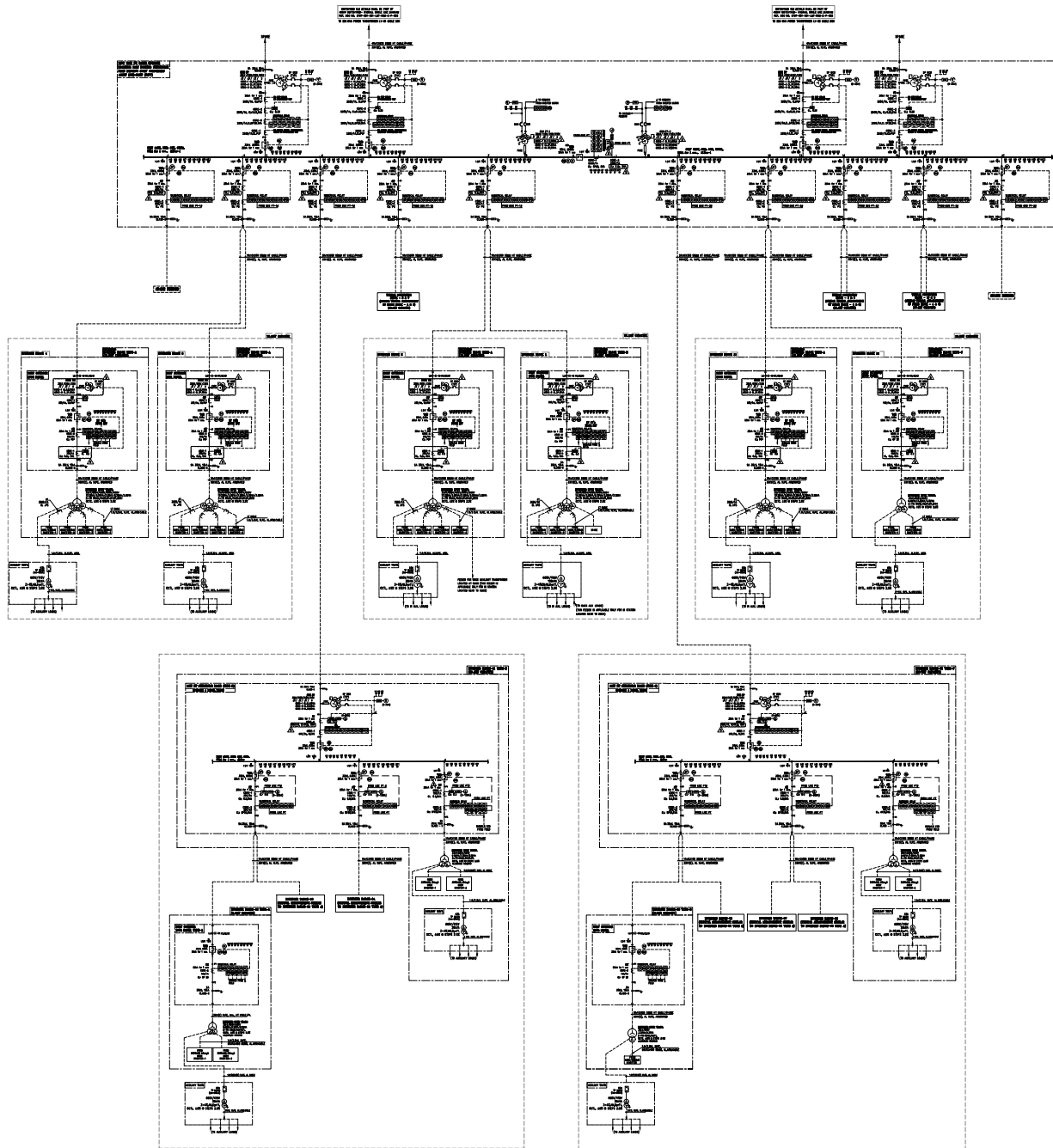
EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO TECHNICAL SPECIFICATION (SECTION-VI: TS) DOCUMENT NO. RE-CS-5817-004-9-AMDT-03	Page 6 of 7
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IFB NO.	RE-CS-5817-004-9
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Sl. No.	Volume/ Section/ Clause No.	Existing Clause			Amended Clause		
		5.	5817-004-POC-A-002	Details Of Chain Link Fencing	6.	5817-004-POE-A-004	Indicative Existing Solar project Switchyard SLD
					7.	5817-004-POE-A-005	Indicative Existing Solar Project AC SLD

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	AMENDMENT NO. 01 TO TECHNICAL SPECIFICATION (SECTION-VI: TS) DOCUMENT NO. RE-CS-5817-004-9-AMDT-03	Page 7 of 7
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SYMBOLOGY LEGEND:	
SYMBOL	DESCRIPTION
	VACUUM CIRCUIT BREAKER (VCB) DRAW OUT TYPE
	CURRENT TRANSFORMER (CT)
	VOLTAGE TRANSFORMER (VT) - DRAWOUT
	FIVE WINDING TRANSFORMER (5WFL)
	THREE WINDING TRANSFORMER (3WFL)
	TWO WINDING TRANSFORMER (2WFL)
	AUXILIARY TRANSFORMER
	MINIATURE CIRCUIT BREAKER
	BREAKER CONTROL SWITCH
	CABLE TERMINATION
	SURGE ARRESTER
	INDICATION LAMP
	EMERGENCY PUSH BUTTON
	DRAW OUT TYPE FUSE
	LINE LINE INDICATION

RELAY LEGEND:	
SYMBOL	DESCRIPTION
	UNDER VOLTAGE PROTECTION
	NUMERICAL INSTANTANEOUS OVERCURRENT PROTECTION
	NUMERICAL INSTANTANEOUS EARTH FAULT PROTECTION
	NUMERICAL INSTANTANEOUS CURRENT PROTECTION
	OVER VOLTAGE PROTECTION
	PT FUSE FAILURE RELAY
	SECTIONAL OVER CURRENT PROTECTION
	SECTIONAL EARTH FAULT PROTECTION
	MAGNETIC INRUSH CURRENT
	MASTER TRIP RELAY
	SYNCHRONIZING RELAY
	TRIP CIRCUIT SUPERVISION PROTECTION
	LOCAL BREAKER BACKUP
	NITROGEN INJECTION FIRE PROTECTION SYSTEM
	WINDING TEMPERATURE PROTECTION FOR HV WINDING & FOR LV WINDING
	OIL TEMPERATURE PROTECTION
	BUCHHOLZ RELAY
	MAGNETIC OIL LEVEL GAUGE
	PRESSURE RELIEF VALVE

INSTRUMENT LEGEND:	
SYMBOL	DESCRIPTION
	DIGITAL AMMETER
	DIGITAL VOLTMETER
	MULTI FUNCTION METER
	ANALOG SELECTOR SWITCH
	VOLTMETER SELECTOR SWITCH

ELECTROMECHANICAL RELAYS:	
SYMBOL	DESCRIPTION
	AC FAILURE RELAY
	DC FAILURE RELAY
	ANTI-PUMPING RELAY

Tende Drawing No: 5817-004-POE-A-005

CLIENT:	NTPC LIMITED
NTPC JOB No.:	5797-001-001
PROJECT:	NTPC 120MW GROUND MOUNTED + 56MW FLOATING SOLAR PROJECT AT NTPC RAMAGUNDAM STPS TELANGANA
TITLE:	SLD - SINGLE LINE DIAGRAM AC
NTPC DRG. No.:	
RELEASED FOR:	<input type="checkbox"/> PRELIMINARY <input type="checkbox"/> TENDER <input type="checkbox"/> INFORMATION <input checked="" type="checkbox"/> APPROVAL <input type="checkbox"/> CONSTRUCTION

Untitled Map

Write a description for your map.

Legend

- Available BESS AREA
- HT Cable Feeder Corridor
- HT FEEDER SOLAR Cable 100MW (Not to be tapped)
- HT Feeder Solar Cable 176 MW (To be tapped for BESS)
- Proposed Road (Scope of Bidder)



Google Earth

Image © 2024 Airbus

600 m

Document No.:	RE-CS-5817-004-9
TITLE:	Clarification No-01 to Technical Portion of Bidding Documents (SECTION-VI)
PACKAGE:	EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM.
ETS Portal Tender Search Code:	NTPC-2024-TN000013

Date:08.01.2025

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
1.	SECTION-VI_TS	Appendix 3A, 1.0 (i) Page No: 15/404	Round the Trip Efficiency	Guarantee is to be provided monthly or annually?	Provisions of technical specifications are amply clear. However, for sake of better clarity, following is again highlighted from referred clause : "The contractor shall also ensure the yearly round trip efficiency as declared during Bid"
2.	SECTION-VI_TS	TECHNICAL SPECIFICATIONS Clause 1.0, i Page No: 34/404	Metering: As per SLD. ABT Meter has to be provided at following locations 1. Main and Check meters at 33 kV block BESS Incomer. 2. Standby meter at incoming solar and outgoing feeder.	Will ABT meter be part of the HT panel or separate unit as per CEA guidelines? Is this a tariff meter?	To be provided as part of HT panel as indicated in Tender SLD.
3.	SECTION-VI_TS	Provenness Criteria 1.0 Page No: 30/404	Power Conversion Systems: (a) The bidder/ sub vendor should have manufactured grid-interactive bidirectional PCS of cumulative installed capacity of 40	For Made in India PCS (more than 60% local content), the criteria to be relaxed as per below: The Sub-vendor should have 1.Manufactured more than 40MW	Bidder to comply provisions of Technical Specifications

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Technical Portion of Bidding Documents (SECTION-VI) DOCUMENT NO: RE-CS-5817-004-9-CLRF-02	Page 1 of 58
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
			MW or higher, out of which PCS installation at one location at least should be of 10 MW capacity or higher. The reference PCS installation of 10 MW or higher capacity must have been in successful operation for at least six (6) months prior to the following reference date: Date of submission of proveness documents to NTPC or (LOA date + 6 months), whichever is earlier. (And) (b) The Bidder/sub-vendor should have in-house PCS routine testing facility as per relevant standard of PCS application to BESS	capacity of PCS (AND) 2.Supplied 1MW or more capacity of PCS for NTPC projects (OR) 3.Supplied 2 MW or more capacity of PCS for PSU projects (NTPC, ONGC, CEA etc) (OR) 4. Supplied 5 MW or more capacity for single project at least six (6) months prior to the following reference date: Date of submission of proveness documents to NTPC or (LOA date + 6 months), whichever is earlier. AND (b) The Bidder/sub-vendor should have in-house PCS routine testing facility as per relevant standard of PCS application to BESS	
4.	SECTION-VI_TS	11.0 OTHER DETAILS Page No: 11/404	Water/Power Requirement during construction to be arranged by the bidder	We kindly request NTPC to provide the water and power during construction and O&M.	Bidder to comply provisions of Technical Specifications

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Technical Portion of Bidding Documents (SECTION-VI) DOCUMENT NO: RE-CS-5817-004-9-CLRF-02	Page 2 of 58
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
5.	SECTION-VI_TS	Technical Specifications, 11.0 Page no: 11/404	5 MNRE Clearance To be facilitated by bidder. 6 Chief Electrical Inspector Clearance To be facilitated by bidder. 7 Tree Cutting Permission To be facilitated by bidder.	Facilitation means only documentary/ technical support? Or the actual charges/ costs (of e.g., Tree cutting) will have to be paid by the Bidder?	Provisions of Bidding Documents are clear in this regard.
6.	SECTION-VI_TS	2.0 Liquidated Damages, Page no. 18/404	a) LD applicable due to shortfall of Yearly Round Trip Efficiency:	In the given formula, 'BESS Availability' to be considered is actual BESS availability OR 95%?	BESS availability, as actual, shall be used. Provision of bidding Documents are amply clear in this regard.
7.	SECTION-VI_TS	2-A ELECTRICAL SCOPE OF SUPPLY & SERVICES 1.0 Page no. 33/404	b) PCS Capacity: The continuous combined rating of all PCSs shall not be less than respective BESS Plant capacity with 0.95 p.f. at 50-degree temperature. However, PCS capacity used in plant may be chosen such that it can comply the 0.95 power factor capability as per CEA regulation of the total plant at 400kV POI of thermal plant switchyard.	Kindly confirm if PCS capacity is to be designed to comply with 0.95 PF capability as per CEA regulations of the total plant at 400 kV POI. CEA regulations of the total plant at 400 kV POI. If yes, we will need details such as active/reactive power compensation to be provided by the BESS system as measure at 33 kV Point of Connection.	Provisions of Technical specifications are clear in this regard. Kindly refer revised tender drawings in technical amendment for required additional system details. [Ref Document No-RE-CS-5817-004-09-AMDT-03]

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Technical Portion of Bidding Documents (SECTION-VI) DOCUMENT NO: RE-CS-5817-004-9-CLRF-02	Page 3 of 58
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC Reply															
8.	SECTION-VI_TS	Appendix 3A 1.0 (i) Page no: 15/404	Monthly Round Trip Efficiency Formula	With reference to SLD shared, the charging energy will be measured by the standby TEM in the incoming solar feeder and discharging energy measured by standby TEM in the outgoing feeder going to NTPC 33 kV Switchgear?	Both Charging and discharging energy shall be measured in BESS incomer feeders at BESS Pooling Switchgears. Other meters shall serve as standby/backup. Kindly refer revised tender SLD for better clarity. [Ref Document No-RE-CS-5817-004-09-AMDT-03]															
9.	SECTION-VII_FP	Book 1, Attachment 9, Page 1 of 2 Page No. 61	<table><thead><tr><th>O&M Year (nth) (After Successful Commissioning)</th><th>Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh</th><th>Declared BESS AC/AC Round Trip Efficiency (%) at Metering Point (Including auxiliary Consumption)</th></tr></thead><tbody><tr><td>01</td><td>400</td><td></td></tr><tr><td>02</td><td></td><td></td></tr><tr><td>03</td><td></td><td></td></tr><tr><td>04</td><td></td><td></td></tr></tbody></table>	O&M Year (n th) (After Successful Commissioning)	Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh	Declared BESS AC/AC Round Trip Efficiency (%) at Metering Point (Including auxiliary Consumption)	01	400		02			03			04			Is BESS deliverable capacity to be 400 MWh at the end of first year OR at COD with certain degradation allowed in 1 st year?	Daily Dischargeable capacity of each year has to be maintained throughout the year (From start of year to end of year). So For 1st year, Daily dischargeable capacity of minimum 400 MWH will have to be maintained from commissioning to end of 1st year.
O&M Year (n th) (After Successful Commissioning)	Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh	Declared BESS AC/AC Round Trip Efficiency (%) at Metering Point (Including auxiliary Consumption)																		
01	400																			
02																				
03																				
04																				

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ETS Portal Tender Search Code:	NTPC-2024-TN000013

S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder`s Queries	NTPC Reply															
10.	RE-CS-5817-004-9_SECTION-VI_TS	Clause 1.0, i Page no. 34	Metering: As per SLD. ABT Meter has to be provided at following locations 1. Main and Check meters at 33 kV block BESS Incomer. 2. Standby meter at incoming solar and outgoing feeder.	Main and Check meters at 33kB Block BESS incomer is not shown on the SLD. Since there are 4 blocks of BESS, will there be 4 sets of main and check meters at 33 kV block BESS incomer? Calculation of Dispatchable capacity and Round-Trip Efficiency measurements will be done individually by these 4 sets of meters and added up?	Tender SLD has been updated for better clarity. Kindly refer technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03] Required parameters have to be demonstrated at complete project (100 MW) level.															
11.	SECTION-VII_FP	Book 1, Attachment 9, Page No. 61	<table border="1"><thead><tr><th>O&M Year (nth) (After Successful Commissioning)</th><th>Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh</th><th>Declared BESS AC/AC Round Trip Efficiency (%) at Metering Point (Including auxiliary Consumption)</th></tr></thead><tbody><tr><td>01</td><td>400</td><td></td></tr><tr><td>02</td><td></td><td></td></tr><tr><td>03</td><td></td><td></td></tr><tr><td>04</td><td></td><td></td></tr></tbody></table>	O&M Year (n th) (After Successful Commissioning)	Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh	Declared BESS AC/AC Round Trip Efficiency (%) at Metering Point (Including auxiliary Consumption)	01	400		02			03			04			Declared Daily Dischargeable BESS Energy capacity should be applicable for all the days in the year OR only at the end of the year?	Daily Dischargeable capacity of each year has to be maintained throughout the year (From start of year to end of year). So For 1st year, Daily dischargeable capacity of minimum 400 MWH will have to be maintained from commissioning to end of
O&M Year (n th) (After Successful Commissioning)	Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh	Declared BESS AC/AC Round Trip Efficiency (%) at Metering Point (Including auxiliary Consumption)																		
01	400																			
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					1st year.
12.	VI – Tender Drawing	5817-004-POE-A-001/ Page No. 3	Basic Single Line Diagram- Indicative	Tender Drawing- SLD As per SLD a single 25-30MW solar feeder gets connected to BESS 33kV bus bar charging. Kindly clarify whether 100MW power shall be provided by NTPC for charging of BESS on daily basis or balance 75 MW power has to be drawn from Grid for charging of BESS?	Tender SLD has been updated for better clarity. Kindly refer technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
13.	VI – Tender Drawing	5817-004-POE-A-002/ Page No. 4	Vicinity Map- Tentative Available Land Area	As per tender drawing of layout – 5 areas are identified for installation of BESS. Kindly clarify whether installation of 100MW can be restricted on single or 100MW capacity has to be distributed at 4 locations with 25 MW capacity.	BESS can be installed in one or more plots within the area provided as per Bidder's proposal. Kindly refer technical amendment for revised tender drawings indicating Vicinity map and area details.

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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
					[Ref Document No-RE-CS-5817-004-09-AMDT-03]
14.	TS PART - B AC SYSTEM	1.7 / Pg No. 69 of 404	EMS System shall have the provision to perform the following functions: i. Provision to operate the BESS as per following minimum application requirement including Ancillary services but not limited to; a. Integrated control with solar power plant at Ramagundam for smoothening and energy Time shifting application b. VAR support to Grid / voltage Regulation c. Black Start application d. Frequency Regulation /Grid support e. Energy Arbitrage/energy shifting operation f. Ramp rate support g. Power Quality Application to	We understand that virtual Synchronous Generator is functionality of Power Conversion System (PCS), but it is mentioned under Energy management System section. Kindly confirm	Kindly refer technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03]

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Technical Portion of Bidding Documents (SECTION-VI) DOCUMENT NO: RE-CS-5817-004-9-CLRF-02	Page 7 of 58
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
			Grid h. Interaction on real-time with IEX for schedule of charging and discharging. i. Inertia Support to Grid as virtual Synchronous Generator		
15.	PART - A SECTION -2	1 / Pg No. 33 of 404	a) Plant Capacity: 100 MW/400 MWh Dispatchable capacity at COD at 33 KV metering point b) PCS Capacity: The continuous combined rating of all PCSs shall not be less than respective BESS Plant capacity with 0.95 p.f. at 50-degree temperature. However, PCS capacity used in plant may be chosen such that it can comply the 0.95 power factor capability as per CEA regulation of the total plant at 400kV POI of thermal plant switchyard.	Even though the final power evacuation is at 400kV level for BESS, we understand that EMS monitoring & control of BESS plant shall be at 33 kV voltage level. Kindly Confirm.	Bidder's understanding is in line with provisions of technical specifications
16.	PART-A SUBSECTION – 2 2-A	3.1.12. APPLICATION REQUIREMEN T- / Pg No. 45	Bidder to operate the BESS plant as per NTPC requirement.	NTPC to provide the load cycle for optimizing the battery sizing.	Kindly refer Technical Amendment-01 [Ref Document No-RE-

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Technical Portion of Bidding Documents (SECTION-VI) DOCUMENT NO: RE-CS-5817-004-9-CLRF-02	Page 8 of 58
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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
	ELECTRICAL SCOPE OF SUPPLY & SERVICES	of 404			CS-5817-004-09-AMDT-03]
17.	PART-A SUBSECTION – 2 2-A ELECTRICAL SCOPE OF SUPPLY & SERVICES	3.1.4. / Pg No. 38 of 404	MWh rating (dispatchable Capacity at POI) for full range of environmental condition at project Site Dispatchable capacity at any time during the project design life shall not be less than 65% of dispatchable capacity at beginning of project life (at COD)	Battery degradation shall be recommended as per OEM.	Bidder to comply provisions of Technical Specifications.
18.	PART-A SUBSECTION – 2 2-A ELECTRICAL SCOPE OF SUPPLY & SERVICES	3.1.4. / Pg No. 37 of 404	Round-Trip ac-dc-ac efficiency at POI- BESS. Annual average round trip AC/AC efficiency shall not be less than 80% for 1st year. Degradation in efficiency in subsequent years shall be allowed. However, RTE including auxiliary consumption shall not be	Round trip efficiency shall be maintained as per the vendor recommendation. Please accept.	Bidder to comply provisions of Technical Specifications.

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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
			les than 75 % in any year (upto 20 years).		
19.	-		General	Please provide the solar evacuation single line diagram for all FSPV and GSPV.	Refer Technical Amendment for revised tender drawings. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
20.	-		General	Bidder will be proposing 1hr fire rating of the container. Please accept.	Bidder to comply provisions of Technical Specifications.
21.	-		General	Employer to provide ERT, soil thermal resistivity report.	Whatever data is available has been furnished. Successful bidder shall conduct the test before designing the plant
22.	SECTION – VI TECHNICAL SPECIFICATIO NS	1.0 SCOPE OF WORK FOR BATTERY ENERGY STORAGE SYSTEM: / Pg	1.26.Rerouting of Underground Cabling (including additional cable lengths, if required) of identified four no. of 33KV solar blocks of FSPV & GSPV Project of approx. 23 MW Capacity each	Bidder request to provide the details of dismantling of existing cable and rerouting laying details lite size of the cable and quantity	Indicative existing cable route details are provided in revised tender drawings. Kindly refer technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-

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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
		No. 27 of 404			03]
23.	SECTION – VI TECHNICAL SPECIFICATIONS	2.00 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM / Pg No. 221 of 404	Contractor has the option of supplying either Nickel Cadmium type batteries or Lead Acid Plant type batteries.	Allow bidder to consider VRLA type batteries	Bidder to comply provisions of Technical Specifications.
24.	SECTION – VI TECHNICAL SPECIFICATIONS	3.0 POWER EVACUATION SYSTEM, TELEMETRY & SCADA / Pg No. 49 of 404	Telemetry System: The arrangement to transmit data required by the Load Dispatch Centre (LDC) from BESS system to NLDC/RLDC as per extant regulations and procedures for grid management is in contractor's scope. The bidder may integrate the BESS data telemetry system with existing/under implementation telemetry system of Thermal/Solar Plant.	Bidder request to provide the distance of telemetry system with existing/under implementation telemetry system of Thermal/Solar Plant.	Available details are already provided. Bidder to comply provisions of technical specifications.

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S. No.	Section	Clause No. / Page No.	Description as per Tender	Bidder's Queries	NTPC Reply
25.	-		General	Is any redundancy is required for BESS container Liquid cooling system / Air cooled HVAC system. Please confirm	Provisions of technical specifications are amply clear. Bidder to comply provisions of Technical specifications
26.	-		General	Whether the bidder can select the type of Fire protection system like veddas and fire suppression system shall be as per battery OEM recommendation for BESS container, or any specific requirement is there for NTPC. Please confirm.	Provisions of technical specifications are amply clear. Bidder to comply provisions of Technical specifications.
27.	TECHNICAL SPECIFICATION N BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 1.0 / Pg No. 34 of 404	I)EMS/SCADA: Licenses for Remote Monitoring of EMS/SCADA - 2 Nos with provision of Concurrent viewing for all users. Include provision of data telemetry/remote communication to NTPC PI server and REAMC Jaipur	Bidder understand that: a. Bidder to consider necessary web client licenses for remote monitoring. b. Any hardware and software required at remote location is not part of bidder's scope. c. NTPC to consider necessary internet connectivity at remote location for this monitoring. Kindly confirm that bidder's	Bidder's understanding is in line with provision of technical specifications.

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				understanding is correct.	
28.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 1.7 / Pg No. 171 of 404	vii) Remote monitoring of essential parameters of plant on the web using popular web browser without requirement of additional software. Same shall be authorised with user id and password using standard modem. User ID and password for remote view can only be changed by EMS/SCADA Administrator. Internet connection for transferring data to web shall be taken by Contractor in the name of NTPC Site for O & M period.	Bidder understand that: a. Bidder to consider necessary web client licenses for remote monitoring. b. Any hardware and software required at remote location is not part of bidder's scope. c. NTPC to consider necessary internet connectivity at remote location for this monitoring. Kindly confirm that bidder's understanding is correct.	Bidder's understanding is in line with provisions of technical specifications.
29.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-	Clause: 1.8 / Pg No. 171 of 404	1.8 The contractor shall provide at least one GPS clock at each Thermal Plant, which shall be synchronized with the SCADA/EMS system. All devices	Bidder wishes to clarify that the time synchronization of field devices (such as Meters etc.) with SCADA / GPS shall be subject to provision available in the field	Bidder to comply provisions of Technical specifications..

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	004-9_SECTION-VI_TS		having real-time clock (RTC) with time synchronization facility and are communicating with BESS EMS/SCADA shall be synchronized with GPS Clock through SCADA or directly with GPS Clock. The technical details of GPS have been specified elsewhere in the specification	device's features. The same shall be confirmed during detailed engineering. Kindly provide your acceptance for the same.	
30.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 1.13 / Pg No. 172 of 404	Power plant controller (PPC) shall be provided with two processors (main processing unit and memories), one for normal operation and one as hot standby. In case of failure of working PPC processor, there shall be an appropriate alarm and simultaneously the hot standby PPC processor shall take over the plant control function automatically. The transfer from main	Bidder understand that as PPC & PQM meters is in the scope of NTPC, hence PPC requirement mentioned at Clause: 1.02 is in the scope of NTPC. Please confirm the scope of PPC and PQM, whether Bidder or NTPC.	PPC and relevant requirements for BESS system is in scope of the bidder.

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			processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. It shall be possible to keep any of the PPC processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor. The BESS plant SCADA and PPC networks shall be suitably designed, so that PPC shall directly and independently able to control the individual PCS. Detailed control logic in the PPC shall be finalized during detailed engineering stage		
31.	TECHNICAL SPECIFICATION N BID DOC. NO:	Clause: 3.0 - DATA COMMUNICATION SYSTEM	The DCS shall have the following minimum features: i) Redundant communication controllers shall be provided to	Bidder understands and proposes to consider the following a. Redundant PLC at CMCS (Main Control room).	a. Bidder understanding is correct. b. Bidder understanding is correct.

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	RE-CS-5817-004-9_SECTION-VI_TS	(DCS) / Pg No. 174 of 404	handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station.	b. Non- Redundant PLC RIO/RTU at each Inverter Room. c. Hot swappable IO modules for CMCS (Main Control room) d. Non-Hot swappable IO modules at each Inverter room. Kindly provide your acceptance for the same.	c. Bidder understanding is correct. d. Bidder to provide hot swappable IO modules.
32.	TECHNICAL SPECIFICATION N BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 4.0 - HUMAN MACHINE INTERFACE SYSTEM (HMIS) / Pg No. 176 of 404	iii) For communicating the generation data of plant in NTPC, the SCADA system shall be interfaced/ connected with PI server of NTPC on OPC Protocol. The details of NTPC PI server shall be furnished during the detailed engineering	Bidder understand that: a. Bidder to consider necessary OPC protocol in offered SCADA System for interfacing with PI Server of NTPC. b. Existing NTPC PI Server (in scope of NTPC) is located in remote location. c. Bidder to consider necessary internet connectivity at solar plant end for this interfacing. d. Updation & configuration work in existing NTPC PI Server for Solar plant related tags shall be carried out by NTPC and same is not part of bidder's scope.	Bidder's understanding is in line with provisions of technical specifications

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				e. Any hardware and software required at existing NTPC PI server end is not part of bidder's scope. Kindly confirm that bidder's understanding is correct.	
33.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 13.0 - HMIPIS HARDWARE / Pg No. 189 of 404	A3 Type Heavy duty, at least 50000 pages/month	Bidder wishes to clarify that, in Market, there are no printers available to meet this requirement given. Hence during detailed engineering, Bidder shall propose the standard printer available in the market for which NTPC approval shall be provided. Kindly confirm the same.	Bidder has stated that there are no printers available to meet this requirement given. Hence during detailed engineering, Bidder shall propose the standard printer available in the market for which NTPC approval shall be provided.
34.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 2.02 / Pg No. 273 of 404	For cameras to be located in remote areas where the UPS power supply can not be extended due to voltage drop etc., then such cameras can be grouped and fed from mini-UPS. Individual mini-UPS shall be provided for the cameras which	Cameras in remote location will be getting power through POE cable. Hence separate mini UPS not required for cameras. Kindly confirm the same.	Bidder to refer to the Amendment in this regard. [Ref Document No-RE-CS-5817-004-09-AMDT-03]

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			cannot be grouped. Mini UPS are to be provided by the contractor within his quoted lumpsum price. The contractor shall also provide local power distribution boxes as required for sub-distribution of supply from these mini-UPS to cameras. The location of mini-UPS & power distribution scheme shall be finalized during detail engineering.		
35.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 3.01 / Pg No. 273 of 404	The CCTV system shall be able to provide surveillance of different locations in the plant, entry gate and all across periphery. The exact locations shall be decided during detailed engineering.	Bidder understand and proposes to consider the following locations for CCTV, a. MCR Room b. ICR Room c. Entry & Exit Gates D. Periphery Kindly provide your acceptance for the same.	Bidders understanding is correct and inline to the TS specification.
36.	TECHNICAL SPECIFICATION BID DOC. NO:	Clause: 4.05 / Pg No. 279 of 404	Workstation : Operator work station & network switch station shall be in Control Room or as finalized during the detailed	Bidder understand and proposes to consider the following accessories for CCTV, a. OWS-1 no	Provisions of bidding documents are clear and shall prevail.

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37.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	- / Pg No. -	General	Kindly provide the detailed specification on CCTV Operators work station & network switch station.	The OWS specification shall be evaluated as per the OEM proposal and shall be reviewed and finalized during the detailed engineering.
38.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 9 - QUALITY ASSURANCE PROGRAMME / Pg No. 372 of 404	a) Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems	Bidder understand that CCTV and PA systems are not required for the project. Kindly confirm that bidder's understanding is correct.	Please refer to the chapter 1-B INTENT OF SPECIFICATION which clearly states the scope of supply. Refer clause 1.28 where it is specified that CCTV is in the scope of bidder.

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			etc. shall be necessarily furnished for any sub vendors proposed for vendor assessment and approval for this contract.		
39.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 3.13 / Pg No. 72 of 404	All-important alarm and trip signals shall be configured in the PCS and their corresponding modbus address shall be provided for SCADA/EMS configuration.	Bidders confirms to provide 1.Hot swappable IO Cards at MCR 2.Non Swappable IO Cards at ICR 3.Redundant PLC at MCR 4.Non redundant PLC at ICR Please confirm the same	Bidder to comply provisions of Technical Specifications.
40.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9_SECTION-VI_TS	Clause: 1.0 - BASIC ENGINEERING DESIGN PARAMETER OF SOLAR PV PLANT / Pg No. 33 of 404	e) Licenses for Remote Monitoring of EMS/SCADA: 2 Nos with provision of Concurrent viewing for all users	a. Bidder to consider necessary web client licenses for remote monitoring. b. Any hardware and software required at remote location is not part of bidder's scope. c. ReNew to consider necessary internet connectivity at remote location for this monitoring. Kindly confirm that bidder's understanding is correct.	Bidder to comply provisions of Technical Specifications.

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41.	-		General	Kindly provide geotechnical investigation report of the proposed site.	Whatever data is available is already furnished. Successful bidder shall conduct the test before designing the plant
42.	-		General	Kindly provide Topography report and Hydrology report of the proposed site.	is already furnished. Successful bidder shall conduct the test before designing the plant
43.	-		General	Kindly confirm whether the storage shed is required.	As per Bidder's proposal required for meeting Project requirement.
44.	-		General	Kindly confirm whether One CMCS building is required for the whole BESS plant or One CMCS building is required per each plot.	Requirement of containerized One Main Control Room (MCR) for complete BESS system is mentioned in Technical Specification.
45.	-		General	Proposed plots are having access issues as they are present between railway tracks. Kindly confirm the accessibility to site .	Kindly refer Technical amendment for revised Tender drawings. [Ref Document No-RE-CS-5817-004-09-AMDT-03]

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46.	Section 6-Part A	Sub-section 3A 2.02/ pg.no.57	EXCLUSION The following Civil works are excluded from the scope of Contractor under this contract:	This section is empty. Please specify if applicable.	Provision of Bidding Documents are clear.
47.	Part B-1	I-1	Drawing No. 5817-004-POE-A-003	Please share autocad file of layout.	Kindly refer Technical Amendment [Ref Document No-RE-CS-5817-004-09-AMDT-03]
48.				For 400kV substation study please share SLD or other details available.	Kindly refer Technical amendment for revised Tender drawings with additional details. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
49.	H-1		Mandatory spare details	It shows deleted. Please specify.	Mandatory spares (to be handed over to Owner) are not envisaged as 10 year O&M is in scope of bidder. However. Any and all spares required by bidder for O&M of BESS system to meet

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					performance requirements shall be considered by bidder as inclusive.
50.	Section 6-Part B D- General Systems	D-1 FIRE FIGHTING AND ALARM SYSTEM/260		Type of fire suppression system (Aerosol or Clean agent) to be used for BESS system not specified.	Bidder to comply provisions of Technical Specifications
51.	Technical Section-VI		INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL	Kindly specify the exact makes/OEMs to be used wherever mentioned as "NTPC Approved Sources" especially for Battery cell, BMS, EMS, Container, HVAC Systems	In the Indicative vendor list wherever "NTPC Approved Sources" is mentioned, presently no NTPC approved vendor for that item is available. For that Item Bidder has to submit the proposal and take approval from NTPC as per Technical Specification during detailed Engineering.
52.	Technical Section-VI		INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL	Kindly confirm if the Bidder is free to select his choice of vendor/subcontractors for all the items indicated with "Main Contractor Approved Sources".	Bidder understanding is correct

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53.	Technical Section-VI		General	Kindly let us know if all of the proposed BESS sites are inside the NTPC Ramagundam power station boundary.	Bidders understanding is in line with tender documents
54.	Technical Section-VI		General	Kindly confirm if the proposed BESS sites are "ash dykes" or normal ground surface.	Proposed sites are not on Ash dyke
55.	Technical Section-VI		General	In case the land parcels are "ash dykes", kindly share the details of the land parcel like depth of ash filling and all pertaining dimensions.	Proposed sites are not on Ash dykes
56.	Technical Section-VI	General	General	Kindly confirm if all of the proposed BESS sites/land parcels are owned and controlled by NTPC.	Bidders understanding is in line with tender documents
57.	General	General	General	Kindly confirm, in case the proposed land parcels are within the NTPC's plant boundary, is Bidder required to keep dedicated security guards during the construction and the O&M phase.	Bidder to comply provisions of Tender documents
58.	Technical Section-VI	General	General	In case, there is requirement of dedicated security, is it required for each BESS plot individually or it	Bidder to comply provisions of Tender documents

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				can be a common for all the plots.	
59.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9	1.0	<p>PERFORMANCE PARAMETERS AND LIQUDATED DAMGES FOR DURING PG TEST AND O&M PERIOD (PERFORMANCE PARAMETER OF BESS FOR COMPLETE LIFE)</p> <p>The declared RTE shall be as per consideration one daily single cycle operation. However, if the BESS is not operated as per this schedule, suitable corrections shall be provided in calculating RTE to account for continuous auxiliary consumption, self-discharge losses etc.</p>	Please clarify the correction calculation in case of increasing cycle operation in a day.	Envisaged use case is daily single cycle operation. However, in case the actual use is different, suitable corrections shall be provided as per mutual discussion which shall be worked out as and when such situation arises.
60.	TECHNICAL SPECIFICATION BID DOC. NO:	3.1.12.	<p>APPLICATION REQUIREMENT:</p> <p>The BESS shall be integrated with the existing/under implementation</p>	As per our understanding Bidder to connect Solar feeder at main HT Panel placed near by BESS plant where Solar (feeder 1 no 25~30	Tender SLD has been updated for better clarity. Kindly refer technical amendment.

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	RE-CS-5817-004-9		NTPC solar project at 33kV. There are four numbers of 33kV Solar Block feeders identified each with approx. 25MW rating. The BESS Bidder scope includes measuring active and reactive power (with 0.2 class transducer/EM) of these 33kV solar incomers and outgoing feeders to pooling switchgear and integrating measured data into the BESS EMS/SCADA. All required materials and services are in the BESS Bidder scope. Bidder to operate the BESS plant as per NTPC requirement.	MW)+ Grid (Load) + Spare feeder will connect with refer to tender drawing SLD. However as per this clause it mentioned there are four no's 33 kV Solar Feeder each of 25 MW of four no's. please clarify that Bidders need to connect only one solar feeder at Main HT Panel capacity of 25~30 MW with refer to tender drawing.	[Ref Document No-RE-CS-5817-004-09-AMDT-03]
61.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9	3.1.6.	Auxiliary Power: The auxiliary power system and/or control system design shall provide for whatever emergency power is necessary for an orderly system shutdown during abnormal conditions such as a loss of grid	We understand that the system supports emergency control and communication of BESS and PCS.	Provisions of bidding documents are clear.

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			power.		
62.	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5817-004-9	6	Grid Compliance Requirement Dynamic Model: The simulation study has to be carried out as per POI data (like SCR, X/R etc.) shared by NTPC/RLDC/CTU.	As per our understanding bidder scope is limited to 33 kV Switchgear (Main HT Panel), We request you to limit our scope upto 33 kV Simulation study. In case of Complete study upto POI point we need complete SLD interconnection point. Power Transformer rating etc.	Bidder to comply provisions of tender documents. Kindly refer revised tender drawings for additional details. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
63.	VI	33	Same size and same make of PCS are recommended for the whole plant.	Having flexibility of multiple make of PCS limited to 3-4 will ease for life cycle maintenance and mitigates risk of single vendor. Request to consider multiple make and size.	Provisions of technical specification is only a recommendation for ease of maintenance.
64.	VI	35	It comprises of unit batteries, battery management system (BMS), auxiliaries, such as HVAC and fire suppression systems, ac switchgear, Control Systems etc.	Please clarify the meaning of unit batteries, is it single cell, pack or rack?	Provisions of bidding documents are clear.

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65.	V	40	Maximum BESS recovery time:- The Contractor shall clearly specify the maximum recovery times required to restore the BESS for functional availability between duty cycles.	Please confirm if "rest time" and "recovery time" are considered the same? Which means non-operation time after charging or after discharging.	Provision of bidding documents are clear in this regard.
66.	VI	40	Maximum BESS recovery time:- The Contractor shall clearly specify the maximum recovery times required to restore the BESS for functional availability between duty cycles.	Please clarify the definition of duty cycle.	Provision of Bidding Documents are clear.
67.	VI	3	Tender Drawing	Bidder scope and owner scope to be clearly marked in the SLD. And it will be further useful if key BOM table with scope of supply of owner or bidder mentioned precisely.	Tender SLD has been updated for better clarity. Kindly refer technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
68.	VI	113	O-3 minute-CO-3 minute – CO	Please explain “O-3 minute-CO-3 minute – CO” in detail.	Provision of Bidding Documents are clear.

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69.	VI	37	As bidder is allowed to quote BESS Dischargeable capacity for every year based on actual degradation	Degradation for every year should be constant or can vary year wise. Please clarify.	Provision of Bidding Documents are clear.
70.	VI-Tender Drawing	3	from Solar Plant End	Cable specification and no. of runs to be provided.	Indicative Cable route details are provided in revised tender SLD. Kindly refer technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
71.	VI	20	EQUIPMENT PERFORMANCE BANK GUARANTEE	Is Equipment performance bank guarantee and Life cycle performance bank guarantee (mentioned in document RE-CS-5817-004-9_SECTION-I to V) is same? Please clarify	Kindly Refer issued commercial amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-01]
72.	Sec-VI	Part 1-A, Cl 3.0 / Page 3	3.0 AREA AVAILABILITY Land will be provided by NTPC Ramagundam on "as is where is basis" to the successful EPC Bidder.	Bidder Presume that complete encumbrance free land parcel for BESS is in possession of NTPC & shall be handed over to bidder immediately after LOA & in case of delay in handover of land parcel,	Bidder to comply provisions of Tender documents

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				same shall be added in commissioning period without LD & compensation of such delay shall be given to bidder. Kindly confirm.	
73.	Sec-VI	Part 1-A, Cl 3.0 / Page 3	3.0 AREA AVAILABILITY Land will be provided by NTPC Ramagundam on "as is where is basis" to the successful EPC Bidder.	Request to provide following; ✓ KMZ file of proposed land parcel with complete marking of usable land. ✓ Topographical survey report (in Auto-cad as well as PDF). ✓ Geotech survey report. ✓ Autocad drawing of vicinity map/demarcated land boundary.	Refer Technical amendment for revised tender drawings [Ref Document No-RE-CS-5817-004-09-AMDT-03]
74.	Sec-VI	Part 1-A, Cl 6.0 (9) / Page 11	6.0 Grid Compliance Requirements :- 9) Bidder shall install suitable reactive compensation equipment for compliance of dynamic reactive power compensation at rated capacity at POI under CEA technical standard of connectivity to Grid and Report of the Working Group in respect of Data	As per this Cl 6.0 (9), bidder shall install reactive power equipment at 400kV POI. But this tender is of BESS & termination point is 33 kV only. Hence it is requested to exclude the scope of reactive power compensation from bidder scope.	Provisions of Bidding documents are clear. Bidder to comply provisions of technical specifications.

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			Submission Procedure And Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid by RE Generators July 2022 and it's amendments/clarifications thereof.		
75.	Sec-VI	Part 1-A, CI 1.0 / Page 11	APPENDIX – 3A 1.0 PERFORMANCE PARAMETER OF BESS FOR COMPLETE LIFE: - i. Round Trip AC-AC Efficiency: - ii. MW and MWh Capacity Demonstration of BESS: - iii. BESS ANNUAL AVAILABILITY: -	Bidder understanding is POI is 400 kV level, however as the scope of bidder is upto 33 kV, hence metering is at 33 kV level & all performance parameters mentioned under CI 1.0 are at Main ABT meter of this 33 kV level. Kindly confirm.	Bidder's understanding is in line with provisions of technical specifications.
76.	Sec-VI	Part 2-A, CI 1.0 / Page 41	3.1.12. APPLICATION REQUIREMENT Solar Energy Time Shifting: - BESS shall automatically charge the battery with power from the solar PV plant and discharge the battery by supplying power to the grid during peak load demand	Bidder understanding is that BESS battery shall be charged with power from Solar PV plant of NTPC. But in case sufficient power from solar is not available for battery charging then how batteries shall be charged? Kindly confirm.	Responsibility of providing charging power and discharging schedule lies with the owner.

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			periods or as per NTPC requirements. The operation in this mode shall be based on the BESS charge and discharge schedule.		
77.	Sec-VI	Part 2-A, Cl 3.0 / Page 45	<p>3.0 POWER EVACUATION SYSTEM, TELEMETRY & SCADA</p> <p>3.1 Power Evacuation System: Power Evacuation shall be through tie transformers at 400 kV Voltage level to get connected to existing 400 kV Switchyard through 33 KV system of existing/under construction Solar PV Plant. However, bidders scope of supply and services is only till 33 KV interconnection point as indicated in tender SLD. Supply and installation of metering system along with control cable shall be in bidder's scope. ABT/SEM metering arrangement shall be as per CTU</p>	To have a fare idea of 33 kV termination point, it is requested to share the switchyard location of existing, under construction Solar PV Plant & 400kV Thermal plant.	<p>Tender SLD has been updated for better clarity. Kindly refer technical amendment.</p> <p>[Ref Document No-RE-CS-5817-004-09-AMDT-03]</p>

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			requirement/standard.		
78.	Sec-VI	Part E, / Page 325 of 404	<p>QA Annexures and Indicative Vendor List</p> <ol style="list-style-type: none"> 1. Battery Cell 2. Battery Management System (BMS) 3. PCS (Power Conditioning System) 4. Energy Management System (EMS) 	For these BESS material it is just mentioned as "NTPC Approved Sources". It is requested to provide name of approved sources, so that bidder can contact them for evaluation.	In the Indicative vendor list wherever "NTPC Approved Sources" is mentioned, presently no NTPC approved vendor for that item is available. For that Item Bidder has to submit the proposal and take approval from NTPC as per Technical Specification during detailed Engineering.
79.	Section VI	5.0, 7/404	The proposed BESS system may be commissioned as integrated part of Solar PV plant at NTPC Ramagundam or as standalones BESS.	Execution of the offered BESS as integrated part of Solar PV plant or as standalone BESS shall have impact on system design and have different scope work. Further, it shall have impact on the offered performance guarantees and warranty of the system. Bidder request that clarity on	BESS System design and construction are envisaged to be as per tender provisions. EMS system should have capability of operating BESS as integrated with Solar plant or as standalone system.

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				commissioning of the BESS as part of Solar PV plant or as Standalone BESS may please be provided at this Bidding stage itself as same may have price implication as well. Please clarify.	
80.	Section VI	2.0, 18/404	Liquidated Damages In case the LD recovery amount exceeds above limiting value, the balance amount shall be recovered through Bank Guarantees (CPBG/EPBG/BPBG), as applicable, submitted by successful bidder. The value of amount encashed from above BG shall have to be replenished by EPC contractor within three months.	Bidder requests NTPC to recover the LD during O&M from running bills of the contractor and not by liquidation of BG. In case the LD recovery amount exceeds above limiting value, any shortfall may be replenished by the contractor at such request of the owner without devaluing the BG. Pls accept.	Bidder to comply provisions of Tender Documents
81.	Section VI	1.0, 30/404	Power Conversion System (PCS) (a) The bidder/ sub vendor should have manufactured grid-interactive bidirectional PCS of cumulative installed capacity of 40	Development of BESS projects in India is in its nascent stage with just couple of large scale BESS projects getting commissioned so far and major projects are still	Bidder to comply provisions of Tender Documents

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			<p>MW or higher, out of which PCS installation at one location at least should be of 10 MW capacity or higher. The reference PCS installation of 10 MW or higher capacity must have been in successful operation for at least six (6) months prior to the following reference date: Date of submission of proveness documents to NTPC or (LOA date + 6 months), whichever is earlier. And (b) The Bidder/sub-vendor should have in-house PCS routine testing facility as per relevant standard of PCS application to BESS</p>	<p>under execution. In view of the same, Bidder requests following may please be accepted: 1. Cumulative installed capacity may please be reduced to 20MW or higher, installation at one location capacity may please be reduced to 5MW. Please accept. 2. Since PCS (bi-directional) is primarily a PCU (uni-directional) with minor modification and software changes, it is requested that desired cumulative installed capacity and installation at one location capacity of either PCS or PCU may please be accepted.</p>	
82.	Section VI	2.0, 30/404	<p>Engineering Consultant/ System Integrator:- If the bidder itself has not done integration of grid interactive battery energy storage system of cumulative installed capacity of 24</p>	<p>Development of BESS projects in India is in its nascent stage with just couple of large scale BESS projects getting commissioned so far and major projects are still under execution. In view of the</p>	<p>Bidder to comply provisions of Tender Documents</p>

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			MW or higher, out of which at least one project should be of 6 MW capacity or higher, in that case the bidder shall employ Engineering Consultant/ system integrator who should have done integration of grid interactive battery energy storage system of cumulative installed capacity of 24 MW or higher, out of which at least one project should be of 6 MW capacity or higher. The reference project of 6 MW or higher capacity must have been in successful operation for at least six (6) months prior to the following reference date:	same, Bidder requests following may please be accepted: 1. Cumulative installed capacity may please be reduced to 20MWh or higher, installation at one location capacity may please be reduced to 5MWh. Please accept.	
83.	Section VI	3.0, 31/404	Battery System: The Bidder qualified under 'clause 1.2 or 1.4 of main QR' shall associate/collaborate for procurement/sourcing of batteries from Battery Manufacturer who	Development of BESS projects in India is in its nascent stage with just couple of large scale BESS projects getting commissioned so far and major projects are still under execution. As a result, BESS	Bidder to comply provisions of Tender Documents.

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			has manufactured and supplied Batteries for grid interactive battery energy storage system(s) of cumulative installed capacity of 40 MW or higher, out of which at least one grid interactive battery energy storage system should be of 10 MW capacity or higher. The reference grid interactive battery energy storage system of 10 MW or higher capacity must have been in successful operation for at least six (6) months prior to the following reference date.	battery suppliers in India are unable to meet the 40MW/10MW criteria of the qualification requirement/proveness criteria desired by NTPC. Also, battery suppliers across the globe are largely sourcing cells for battery manufacturing from countries sharing land border with India. Since tender imposes restrictions on procurement from a country sharing land border with India (as per Cl. no. 40.1 of ITB which states, "the successful bidder shall not be allowed to sub-contract supplies/services/works to any "Sub-contractor" from a country which shares a land border with India"), battery system for NTPC requirements under this tender cannot be sourced from battery suppliers sourcing sub-components from such countries.	

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				Considering the above facts, NTPC is requested to relax the qualification/provenness requirements desired in this tender to "cumulative installed capacity of 20MWh or higher, one grid interactive BESS should be of capacity 5MWh or higher". Please accept.	
84.	Section VI	3.0, 31/404	Battery System: The Bidder qualified under 'clause 1.2 or 1.4 of main QR' shall associate/collaborate for procurement/sourcing of batteries from Battery Manufacturer who has manufactured and supplied Batteries for grid interactive battery energy storage system(s) of cumulative installed capacity of 40 MW or higher, out of which at least one grid interactive battery energy storage system should be of 10 MW capacity or higher. The reference grid interactive battery	With very limited Battery manufactures in India, battery manufacturers usually not directly executing grid interactive BESS (supplying batteries through BESS Solution providers) and the restriction on procurement from a country sharing land border with India in this tender, Bidder understands that the Bidder qualified under 'clause 1.2 or 1.4 of main QR' can associate/collaborate for procurement/sourcing of batteries/BESS Solution from Battery Manufacturers/BESS	Provisions of tender documents are clear.

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			energy storage system of 10 MW or higher capacity must have been in successful operation for at least six (6) months prior to the following reference date.	Solution providers who have manufactured/integrated and supplied Batteries/BESS Solution for grid interactive battery energy storage system(s) of desired cumulative installed capacity and one grid interactive BESS capacity. Please confirm.	
85.	Section VI	3.1.11, 44/404	<p>Warranty</p> <p>The Contractor shall provide warranty for the entire BESS and its constituent equipment as per standard warranty conditions of the respective equipment. However warranties for Battery and associated system is envisaged for complete life of project (20 years) as per desired operational requirement.</p>	Optimum O&M of BESS plays crucial part in the performance of the system. Since, O&M till 10th year is in Bidder scope, Bidder shall be responsible for the performance and warranty of the BESS till 10th year. Further, as an industry practice extended warranties upto 10th year are available for Electrical and Electronic equipment involved in BESS. It is requested that the warranties in Bidder's scope may please be kept till 10th year only. Please accept.	Bidder to comply provisions of Tender Documents.

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86.	Section VI	325/404	INDICATIVE VENDOR LIST	Bidder request that, for vendors meeting the tender specifications/requirements, sub-contracting to those vendors beyond vendors specified in the Vendor list may please be allowed, subject to prior approval of NTPC. Please accept.	Bidder understanding is correct.
87.	Section VI	6.0 Grid Compliance Requirements, 10/404	6) Bidder shall provide the PSSE and PSCAD model and related study report at least 12 months before the schedule commissioning date of the project and Final Updated dynamic model after COD of the entire station (within one month of COD declaration) after site verification and site testing.	Bidder shall provide PSSE and PSCAD and related study report at least 6 months before the schedule minimum 50MW commissioning date of the project and Final Updated dynamic model after COD of the entire station (within one month of COD declaration) after site verification and site testing. NTPC may consider the same.	Bidder to comply provisions of Tender Documents.
88.	Section VI	2-A ELECTRICAL SCOPE OF SUPPLY & SERVICES, 33/404	PCS Capacity: The continuous combined rating of all PCSs shall not be less than respective BESS Plant capacity with 0.95 p.f. at 50-degree temperature. However, PCS capacity used in plant may	Bidder understanding is PCS capacity at each individual pooling station shall not be less than respective BESS individual pooling rated capacity (25MW x 4) with 0.95 p.f. at 50-degree temperature.	Provisions of Bidding documents are clear.

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			be chosen such that it can comply the 0.95 power factor capability as per CEA regulation of the total plant at 400kV POI of thermal plant switchyard.	<p>However, PCS capacity used in plant may be chosen such that it can comply and deliver the 0.95 power factor capability as per CEA regulation of the total plant at 400kV POI of thermal plant switchyard.</p> <p>Bidder understanding is PCS will deliver 0.95PF at 400KV POI , need not be the rated BESS capacity.</p>	
89.	Section VI	3.1.12 APPLICATION REQUIREMENT, 45/404	<p>APPLICATION REQUIREMENT</p> <p>The BESS shall be integrated with the existing/under implementation NTPC solar project at 33kV. There are four numbers of 33kV Solar Block feeders identified each with approx. 25MW rating.</p>	<p>Bidder understanding is BESS is solar based charging. If any issues in Solar power then same shall be considered as GRID unavailable period from customer end and accordingly compensation will be provided to successful bidder. NTPC may confirm the same.</p>	<p>Responsibility of providing charging power and discharging schedule lies with the owner.</p>

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90.	Section VI	1-B INTENT OF SPECIFICATIO N, 27/404	Evacuation of power as per tender drawing. 1.26 Rerouting of Underground Cabling (including additional cable lengths, if required) of identified four no. of 33KV solar blocks of FSPV & GSPV Project of approx. 23 MW Capacity each	Bidder understanding is Each approx 23MW capacity shall be with max three numbers single core 33KV cables and all rerouting will be in Ground. If rerouting involves work in Water body - same shall be in NTPC scope.	Indicative Cable route details are provided in revised tender SLD. Kindly refer technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
91.	Section VI	3.1.4. BESS Parameter	Dispatchable capacity at any time during the project design life shall not be less than 65% of dispatchable capacity at beginning of project life (at COD)	Dispatchable capacity at any time during the project design life shall not be less than 65% of dispatchable capacity at beginning of project life (at COD) till 10 years of O&M . From 10 th to 20 th Year - as per Battery OEM degradation rate. NTPC may accept the same.	Bidder to comply provisions of Tender Documents
92.	Section VI	3.1.4. BESS Parameter, 38/404	Declared efficiency shall be the annual average round trip AC/AC Efficiency (%) of BESS system at Metering Point	If schedule for discharging is not allotted , then RTE may differ for that month , same shall be relaxed /considered as per actuals by NTPC.	Envisaged use case is daily single cycle operation. However, in case the actual use is different, suitable

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			considering the energy loss (including auxiliary power requirement) of BESS. Annual average round trip AC/AC efficiency shall not be less than 80% for 1st year. Degradation in efficiency in subsequent years shall be allowed. However, RTE including auxiliary consumption shall not be less than 75 % in any year (upto 20 years).	After 10th Year of O&M , regular maintenance practice needs to be followed by the owner and any malfunctions / Generation loss raised due to non following of O&M procedures will be in owner scope.	corrections shall be provided as per mutual discussion which shall be worked out as and when such situation arises.
93.	General			NTPC may clarify - whether during grid issues /33KV BESS to switchyard cable issues , BESS will be operated in grid forming mode ?	Provisions of bidding documents are clear in this regard.
94.	General			BESS system (say 25MW) 33KV cable to switchyard -maintenance is with NTPC/ solar vendor scope. NTPC may clarify the same.	Provision of Bidding documents are clear.

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95.	Section VI	3.1.11. Warranty, 44/404	The Contractor shall provide warranty for the entire BESS and its constituent equipment as per standard warranty conditions of the respective equipment. However warranties for Battery and associated system is envisaged for complete life of project (20 years) as per desired operational requirement.	Warranty for entire and its constituent equipment shall be as per Standard warranty conditions and extended warranty for maximum period of 10 years till O&M completion. (In market as many extended BESS warranty is limited to 10-12 years.) NTPC may accept the same.	Bidder to comply provisions of Tender Documents
96.	Section VI	7.0 CIRCUIT BREAKERS, 89/404	Operating duty O - 3 M I N - C O - 3 M IN-OC	Operating duty O - 3 M I N - C O - 3 M IN-CO may be accepted.	Bidder to comply provisions of Tender Documents
97.	General			All the transformers (Aux , PCS duty) may be also acceptable with mineral oil filled with radiators . NTPC may accept the same.	Bidder's understanding is in line with provisions of technical specifications.
98.	Section VI	D-2 PROJECT COMMISSIONING AND OTHER GENERAL	Minimum capacity for acceptance of first and subsequent part(s) commissioning shall be 50 MW.	NTPC may accept - Minimum capacity for acceptance of first and subsequent part(s) commissioning shall be 25 MW.	Bidder to comply provisions of Tender Documents

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		REQUIREMENTS, 264/404			
99.	Section VI	D-2 PROJECT COMMISSIONING AND OTHER GENERAL REQUIREMENTS	Consecutive one month/30 days period for conducting performance guarantee test shall be chosen on the discretion of NTPC. PG test may be concluded as early as possible after trial run.	As re routing of solar cables and readiness of solar power involved , NTPC may accept the minimum capacity for trail run and PG test shall be 25MW.	Bidder to comply provisions of Tender Documents
100	Section VI	3.1.4. BESS Parameter, 38/404	Declared efficiency shall be the annual average round trip AC/AC Efficiency (%) of BESS system at Metering Point considering the energy loss (including auxiliary power requirement) of BESS. Annual average round trip AC/AC efficiency shall not be less than 80% for 1st year. Degradation in efficiency in	NTPC may accept as follows. BESS system at Metering Point considering the energy loss (including auxiliary power requirement) of BESS. Annual average round trip AC/AC efficiency shall not be less than 80% for 1st year. Degradation in efficiency in subsequent years shall be allowed . RTE including auxiliary consumption shall be as per Battery OEM degradation and same shall be mentioned till 20th	Bidder to comply provisions of Tender Documents

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			subsequent years shall be allowed. However, RTE including auxiliary consumption shall not be less than 75 % in any year (upto 20 years).	year	
101	Section VI	MWh rating (dispatchable Capacity at POI) for full range of environmental condition at project Site, 38/404	Dispatchable capacity at any time during the project design life shall not be less than 65% of dispatchable capacity at beginning of project life (at COD)	Since the BESS life is taken for 20 years. Dispatchable capacity at any time / EOL during the project design shall be as per battery OEM degradation philosophy.	Bidder to comply provisions of Tender Documents
102	Section VI	Use case requirements, 39/404	Interaction on real-time with IEX for schedule of charging and discharging.	Necessary approvals/ interaction with IEX and other formalities is in NTPC scope.	Bidder's understanding is in line with provisions of tender documents. Bidder to comply provisions of Tender Document.

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103	Section VI	Aux Power, 41/404	The BESS shall include an auxiliary power system with metering so that auxiliary power consumption can be measured and electronically recorded in real time, independently of operation of the PCS or of net power flows to and from the battery.	Since Aux power will be tapped from multiple PCS /Transformer LV windings - MFM in all the LT panels will be integrated with scada , accurately check in presence of customer and same data will be used for RTE calculation. NTPC may accept the same.	Shall be reviewed during detailed Engineering. Bidder to comply provisions of Tender Document
104	Section VI	Solar Plant Generation Smoothing, 45/404	Solar Plant Generation Smoothing: The BESS shall have at least three different solar plant-generated power smoothing algorithms. (i) Smoothing algorithm based on moving average method. It shall be possible to select the moving average window to 60 minutes, 30 minutes, and 15 minutes through HMI. (ii) Smoothing algorithm based on ramp-rate control. It shall be possible to freely select the ramp-rate percentage value	If BESS topology is 25MW x 4. In many occasions if the BESS system is used for solar smoothing then at variable power constant voltage - charging and discharging will be present. Degradation may slightly vary as mentioned in above condition , NTPC may accept the variation if any as per Battery OEM recommendations.	Required functionality is for EMS System. Kindly refer technical amendment for better clarity. [Ref Document No-RE-CS-5817-004-09-AMDT-03]

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			(20%/ 15%/ 10%/ 5%/ or any other value) through HMI. (iii) Any other smoothing algorithm as per the Bidder choice. The algorithm shall be suitable for optimizing battery uses and generating better solar plant power smoothing curve/profile to the grid. In all the smoothing algorithms, the BESS battery SOC shall be controlled in such a manner that the BESS shall operate continuously without tripping due to low battery SOC value.		
105	Section I	2.0, 7/416	BRIEF SCOPE OF WORK: Further the bidder has to obtain site-specific data from the owner in preparation for developing installation implementation plans.	Bidder requests that all the requirements and information NTPC is intending to share with Bidders during site visit, may please be documented and shared as part of tender corrigendum for uniform understanding of all Bidders. Please accept.	Available information has already been shared as part of tender documents. Bidder to comply provisions of Tender documents

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106	Section VII	Attachment 9, 61/257	ATTACHMENT – 9 Declaration of Year-Wise BESS Daily Dischargeable Capacity and BESS Round Trip AC/AC Efficiency at PCC/Metering Point Table Column 2: Declared Daily Dischargeable BESS Energy Capacity at Metering Point in MWh	Bidder understands that, in Column 2 - Bidder to declare the Dischargeable BESS Energy Capacity at the beginning of each year. Please confirm.	Daily Dischargeable capacity of each year has to be maintained throughout the year (From start of year to end of year). So For 1st years, Daily dischargeable capacity of minimum 400 MWh will have to be maintained from commissioning to end of 1st year.
107	Section V	10.4, 355/416	Table: Modification of EPBG Release of each 20% of BPBG Value - From 10th year to 20th year. At the end of each two year, after successful performance of battery.	Bidder request that 10% of BPBG value shall be released from 11th year to 20th year, at the end of each year of successful operation. Please accept.	Bidder to comply provisions of Tender Document
108	SECTION – VI	Cl.18/Pg.B-5/119	E. Software Documentation & Listings: All technical manuals, reference manuals, user's guide etc. in English required for modification/	In EMS, EWS and its related Editing features for EMS/SCADA will not be provided to the owner/employer (NTPC). This is in alignment with standard	Bidder to comply provisions of Tender Documents and provide all the features of editing for EMS and SCADA to the

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			editing/ addition/ deletion of features in the software of the EMS System shall be furnished.	industry practices and OEM recommendations, as granting access to these features could potentially lead to misuse or unintended operational risks that may compromise the safety and performance of the battery system. We kindly request approval for this deviation.	employer
109	SECTION – VI	Cl.1.0/Pg.D1-2	GENERAL: The BESS plant shall be equipped with suitable Fire Alarm systems meeting the CEIG requirement for Battery yard/ Container, Switchgear room, Equipment room, Store room/ shed & Control room etc as required in the scope or offered by the contractor..	The BESS containers will be equipped with a fire detection system located only within themselves, in line with typical industry practices. Kindly clarify	Bidder to comply provisions of Tender Document.
110	SECTION – VI	Cl. 3.1.12/Pg.2A - 41	APPLICATION REQUIREMENT: The BESS shall be integrated with the existing/under implementation NTPC solar project at 33kV. There are four numbers of 33kV Solar Block feeders identified	We have selected a single EMS unit to cover all four (4) solar blocks, while maintaining all the necessary engineering components for accurate measurement and integration of	Provisions of Bidding documents are clear.

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			each with approx. 25MW rating. The BESS Bidder scope includes measuring active and reactive power (with 0.2 class transducer/EM) of these 33kV solar incomers and outgoing feeders to pooling switchgear and integrating measured data into the BESS EMS/SCADA.	active and reactive power from the 33kV solar incomers and outgoing feeders. Kindly approve.	
111	SECTION – VI	Cl. 3.1.4/Pg. 2A-33	MWh rating (dispatchable Capacity at POI) : Dispatchable capacity at any time during the project design life shall not be less than 65% of dispatchable capacity at beginning of project life (at COD)	The minimum dispatchable energy year on year at the Interconnecting Point is not mentioned. Please confirm energy to proceed for sizing.	Provisions of Bidding documents are clear. Kindly refer technical amendment for better clarity.
112	SECTION – VI	Cl. 1.7.i/Pg. B5-95	EMS System shall have the provision to perform the following functions: c. Black Start application. i. Inertia Support to Grid as virtual Synchronous Generator	Please provide detailed information on both the Black Start and Inertia Support applications (e.g., power surge, duration of power surge, frequency, etc.), as these are crucial for the project scope. Additionally, in line with OEM	Kindly Refer Technical amendment.

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				recommendations and standard industry practices, providing VSG (Virtual Synchronous Generator) support may present technical challenges. Therefore, we kindly request the removal of this requirement.	
113	SECTION – VI	Cl. 3.1.4/Pg. 2A-36	Identification and Traceability: Battery Cells/ Racks/ Packs assembly shall meet the seismic requirement for the plant location of the BESS. Labeling of cells/batteries shall include manufacturer's name, cell type, name-plate rating, date of manufacture and date of expiry of parts and labor warranty	As per standard industry practice, labor warranty and expiration date details are not provided. All other details will be shared as required. Please confirm.	Kindly Refer Technical amendment.
114	SECTION – VI	Cl.B/Pg.1A-9	SEISMIC DATA & DESIGN CRITERIA – All structures and equipment shall be designed for seismic forces adopting the information provided in this document and in accordance with the provisions of	Please provide the KMZ file of the locations. Based on the seismic zone and other details, further analysis can be conducted for a more comprehensive evaluation.	Kindly Refer Technical amendment for additional details.

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			IS:1893 (Part 1):2002 and IS:1893 (Part 4):2005.		
115	SECTION – VI	Cl.3.1.14.2/Pg 2A-38	Factory Acceptance Testing of BESS: Where full-scale testing of larger systems at the factory may be difficult or impossible due to the large system, the FAT shall be carried out at a subsystem or module level and shall consist of tests of 100% of the subsystems or modules that comprise the complete BESS, to the extent possible.	Since conducting a 100% test of all subsystems or modules is not feasible, we kindly request that the requirement be relaxed to testing 9 battery packs out of the total battery packs. This approach aligns with OEM recommendations and standard practices. We appreciate your understanding and request confirmation on this proposed approach.	Kindly Refer Technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03]
116	SECTION – VI	Cl.3.1.14.6/Pg 2A-39	Factory testing shall, if required, demonstrate operation at expected temperature extremes at the independent laboratory.	The FAT will be conducted as per OEM policies and under ambient temperature conditions during the inspection, as performing tests at extreme temperatures is not feasible according to OEM standards and industry practices. Kindly consider this.	Kindly Refer Technical amendment. [Ref Document No-RE-CS-5817-004-09-AMDT-03]

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117	SECTION – VI			There is no mention of a cooling period for the BESS in the tender. Is there a specified maximum limit? Kindly confirm.	Provisions of Bidding Documents are clear.
118	Sec-I	Cl. 2.1 (1.2) / P 1 of 8	2.1 SCOPE OF WORK FOR BATTERY STORAGE SYSTEM: 1.2. Comprehensive Operation and Maintenance (O&M) works of BESS system for 10 years from the date of successful completion of trial run.	10 years of O&M period is too long. Request to keep the O&M period as 3 years from the date of successful completion of trial run.	Bidder to comply Provisions of Tender Documents
119	Sec-I	Cl. 2.1 (1.10) / P 2 of 8	2.1 SCOPE OF WORK FOR BATTERY STORAGE SYSTEM: 1.10. Provide documentation for design and expected performance through design calculations, software, design drawings, equipment drawings, and modifications to the existing drawings.	Kindly elaborate modifications to the existing drawings means what is expected from bidder?	Bidder to comply Provisions of Tender Documents
120	Sec-V	Cl 10.4 / P 5 of 27	10.4 For ensuring declared performance of BESS System, the Contractor shall provide Equipment Performance Bank	EPBG period of 10 years & BPBG period of 20 years to too long. Request to keep as 5 years & 10 years respectively.	Bidder to comply Provisions of Tender Documents

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			Guarantee (EPBG) for initial 10-years of O&M and Battery Performance Bank Guarantee (BPBG) for 11th to 20th year of O&M.		
121	RE-CS-5817-004-9_SECTION-VI_TS	11.0 Other Details / Pg No. 11 of 404	Tree Cutting Permission	Bidder request to kindly consider this clause under the scope of owner	Bidder to comply Provisions of Tender Documents
122	RE-CS-5817-004-9_SECTION-VI_TS	Trial Run / Pg No. 264 of 404	During the trial operation, BESS plant shall perform trouble-free operation for at least cumulative 24 hours during which functionality of all plant components shall be demonstrated and the system shall be in Charging/Discharging Mode. During Trial run, Bidder should successfully demonstrate all the control function of Power Plant Controller (PPC)/EMS of whole solar Plant.	Bidder understands that the BESS shall be operated only for 8 Hours (4 Hours of Charge & 4 hours of Discharge) only. Kindly clarify.	Provisions of tender documents are clear.

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123	SECTION – VI	Cl. 3.1.4./ Pg 2A -35/53	Charging/Discharging rate/Ramp rate /Response time	As per CEA guidelines, the ramp rate is specified as 10%/minute. However, the tender mentions a ramp rate of 100%/second, which would be challenging to achieve. Hence, we kindly request a revision of this requirement to align with the guidelines.	Bidder to comply Provisions of Tender Documents
124	SECTION – VI	Cl. 3.1.12/ Pg 2A -41/53	Solar Plant Generation Smoothing: The BESS shall have at least three different solar plant-generated power smoothing algorithms. (i) Smoothing algorithm based on moving average method. It shall be possible to select the moving average window to 60 minutes, 30 minutes, and 15 minutes through HMI. (ii) Smoothing algorithm based on ramp-rate control. It shall be possible to freely select the ramp-rate percentage value (20%/ 15%/ 10%/ 5%/ or any other value) through HMI. (iii) Any	To optimize the BESS for the 15-minute solar power smoothing algorithm, requesting NTPC to provide the GHI data with 15 mins interval for the site covering all available past years.	Available data shall be shared during detailed engineering.

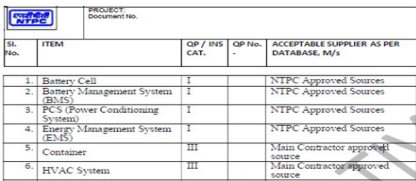
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			other smoothing algorithm as per the Bidder choice. The algorithm shall be suitable for optimizing battery uses and generating better solar plant power smoothing curve/profile to the grid. In all the smoothing algorithms, the BESS battery SOC shall be controlled in such a manner that the BESS shall operate continuously without tripping due to low battery SOC value.		
125	SECTION – VI	Cl. 3.1.12/ Pg 2A -41/53	Solar Energy Time Shifting: - BESS shall automatically charge the battery with power from the solar PV plant and discharge the battery by supplying power to the grid during peak load demand periods or as per NTPC requirements. The operation in this mode shall be based on the BESS charge and discharge schedule.	As per the project requirements, the BESS is designed to provide 100 MW for 4 hours to evacuate power to the grid during peak times. Additionally, for the PV smoothening application, the BESS is expected to perform smoothening actions based on a target reference power derived from a 15-minute moving average algorithm of the solar PV plant's output. These two requirements	Required functionality is for EMS System. Kindly refer technical amendment for better clarity.

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				are contradictory, as the BESS cannot simultaneously follow the 15-minute moving average and perform energy shifting. We request that the primary application be limited to energy shifting only. Therefore, no additional BESS capacity should be considered for other applications by the bidder.	
126	SECTION VI, PART-B	Indicative Vendor List. Sub-System: Electrical/ Pg: 1		Please provide the list of NTPC approved sources.	n the Indicative vendor list wherever “NTPC Approved Sources” is mentioned, presently no NTPC approved vendor for that item is available. For that Item Bidder has to submit the proposal and take approval from NTPC as per Technical Specification during detailed Engineering.

EPC PACKAGE FOR DEVELOPMENT OF 100MW/400MWh BESS AT NTPC RAMAGUNDAM BIDDING DOCUMENT NO. RE-CS-5817-004-9	Clarification No. 01 to Technical Portion of Bidding Documents (SECTION-VI) DOCUMENT NO: RE-CS-5817-004-9-CLRF-02	Page 58 of 58
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