

POWER GRID CORPORATION OF INDIA LIMITED

TECHNICAL SPECIFICATION

FOR

**Setting up of Battery Energy Storage System of 150 MW/ 300
MWh Battery Energy Storage System at Kalikiri, Andhra
Pradesh**

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SECTION - PROJECT

1.0 GENERAL

- I. Power Grid Corporation of India Limited (POWERGRID), a Govt. of India Enterprise, is responsible for Bulk Power Transmission of electrical energy from various central Govt. Power Projects to various utilities/ beneficiaries and interconnecting regional grids, operating and maintaining the National Electrical Grid of India. It is established with mission of “We will become a Global Transmission Company with Dominant Leadership in Emerging Power Markets with World Class Capabilities by:
 - World Class: Setting superior standards in capital project management and operations for the industry and ourselves
 - Global: Leveraging capabilities to consistently generate maximum value for all stakeholders in India and in emerging and growing economies.
 - Inspiring, nurturing and empowering the next generation of professionals.
 - Achieving continuous improvements through innovation and state-of-the-art technology.
 - Committing to highest standards in health, safety, security and environment.
- II. Transmission Corporation of Andhra Pradesh Limited (hereinafter referred to as “APTRANSCO”) issued a Request for Selection (RfS) on 25 August 2025 for “Setting up of 1,000 MW / 2,000 MWh Battery Energy Storage System (BESS) in Andhra Pradesh under Tariff-Based Competitive Bidding with Viability Gap Funding supported through PSDF.”

POWERGRID participated in the aforesaid RfS process and emerged as the successful bidder for setting up 150 MW / 300 MWh BESS capacity at the 400/220 kV Kalikiri Substation of APTRANSCO, to be operated on an “on-demand basis” in accordance with the instructions issued by the concerned SLDC / DISCOM(s) as per the terms, conditions and provisions of the RfS and BESPA, as mentioned elsewhere in the specifications, shall mean the RfS issued by APTRANSCO along with all other associated documents like BESPA (Battery Energy Storage Purchase Agreement) including amendment(s)/clarification(s) thereof.
- III. It is the intent of this specification to describe primary features, materials and design & performance requirements and to establish minimum standards for the work. The specification is not intended to specify the complete details of various practices of manufactures/ bidders, but to specify the requirements with regard to performance, durability and satisfactory operation under the specified site conditions.
- IV. The complete scope of the proposal for the Design, Engineering, Supply, Construction, Erection, Testing & Commissioning works for development of BESS at identified location of POWERGRID and its integration with the existing Grid substation at applicable voltage level (400 kV/ 220 kV /132 kV /33 kV, as specified in subsequent section) shall be on the basis of single point responsibility, completely covering the following activities and services in

respect of all the equipment & works specified and covered under the Technical specification:

- a) Basic Engineering of the system.
- b) Detailed design of all the equipment and equipment system(s) including civil, & structure steel works included in bidder's scope.
- c) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings and other information.
- d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required.
- e) Complete manufacturing including shop testing/type testing (as applicable).
- f) Complete Civil, Structural and Architectural works, including survey, Geotechnical Investigation, providing construction offices, and construction Equipment, construction water supply, etc. from owner's Terminal Point, infrastructure works etc.
- g) Packing and transportation from the manufacturer's works to the site including logistic studies, customs clearance & port clearance, port charges, if any.
- h) Receipt, storage, preservation, handling and conservation of equipment at the site.
- i) Fabrication, pre-assembly, if any, erection, testing, commissioning and completion of facilities including putting into satisfactory operation, all the equipment including successful completion of initial operation.
- j) Performance/Demonstration tests after commissioning.
- k) Reconciliation with customs authorities, as required.
- l) Conclusion of the contract.
- m) Insurance and other requirements for the BESS in accordance with the provisions of general conditions of contract of the bidding document.

The requirements, conditions, appendices etc. given in Technical Specifications shall apply to and shall be considered as a part of this volume as completely. The work to be carried out as per the above scope shall be all in accordance with the requirements, conditions, appendices, etc., stated in Section GCC, which shall be considered as a part of the Technical Specification as completely. The Contractor shall be responsible for providing all material, equipment, and service, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. It is not the intent to specify herein all aspects of design and construction; nevertheless, the equipment and civil works shall conform in 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 to Indian/ International standards mentioned elsewhere in this specification.

- V. Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions.

However, if the bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately.

- VI. Before proceeding with the construction work the Contractor shall fully familiarize himself with the site conditions and General arrangements & scheme etc. Though the Employer shall endeavour to provide the information, it shall not be binding for the Employer to provide the same. The bidders are advised to visit the sites and acquaint themselves with topography, infrastructure and also the design philosophy. The bidder shall be fully responsible for providing all equipment, materials, system and services specified or otherwise which are required to complete the construction and successful commissioning, operation & maintenance of the substation in all respects. All materials required for the Civil and construction/installation work including cement and steel shall be supplied by the Contractor. Complete design (unless specified otherwise in specification elsewhere) and detailed engineering shall be done by the Contractor.
- VII. The contractor shall, in the execution of all the works required under the specification, provide highly skilled and experienced site supervisory personnel to ensure smooth and satisfactory execution for all aspects of the works. The Contractor shall be responsible, to make a careful examination of access roads/ railways/ports to site to confirm the practical permissible maximum weight and dimensions.

2.0 SCOPE OF WORK

The scope of works of this specification covers setting up of BESS at selected substation of APTRANSCO in Andhra Pradesh. The BESS also termed as “Project” shall include Battery System, Power Conversion System (PCS), PCS Transformers (as per Contractor’s design) and Interconnection with 33 kV MV bus developed by APTRANSCO. The BESS shall be implemented on a turnkey basis at the defined locations. The project requirements are mentioned in Table 1:

Table 1: Project Requirements

Sr. No.	Attribute	Value
1.	Location of Battery Energy Storage System for Base Capacity / Interconnection Point	400/220KV SS Kalikiri
2.	Output/Input Power Rating of BESS at the delivery point (Power Capacity of Project)#	150 MW
3.	Initial Design Output Energy Capacity of BESS at the delivery point*	300 MWh
4.	Approx. land allocation in sq. meters	18,000
5.	Charge/Discharge (C-Rate)	0.5

Sr. No.	Attribute	Value
6.	Rated Duration of BESS Discharge	2 Hours
7.	Recovery Time (Maximum allowed cooling time between Complete Charge to Complete Discharge or Complete Discharge to Complete charge)	<p>The maximum cooling time permitted between complete charge to complete discharge, or complete discharge to complete charge, shall be 1 hour.</p> <p>For one complete operating cycle, the total recovery time shall not exceed 2 hours.</p> <p>For partial cycle operation, the recovery time shall be proportionate to the extent of charging or discharging involved and shall not exceed the corresponding limit specified for a complete cycle.</p>
8.	Energy content value at the end of the duty cycle	As per design of Contractor
9.	Rated DoD / Min. SOC level	As per design of Contractor
10.	Nominal Energy Capacity	As per design of Contractor
11.	Input and output power rating	As per design of Contractor
12.	AC to AC Roundtrip efficiency	Minimum 87%
13.	Nos. of Cycles (Charging/Discharging) /Per day###	2 operational cycles/day (i.e. 2 complete charge-discharge cycles per day) for a period of 12 years.
14.	Interconnection Voltage level of BESS	33 kV
15.	Delivery Point	Measurement/Metering Point of APTRANSCO/Employer at 33 kV
16.	Term and definitions of terminology related to BESS	IEC 62933-2-1.

* The nameplate/design ratings shall be achievable during discharge for the full range of environmental conditions at the project site when the battery is fully charged. In any case, the BESS

shall be capable of being discharged at reduced power levels from that specified above. However, the energy discharged from the battery shall not require to be greater than the Output Energy Capacity of BESS at the delivery point specified herein.

#Additionally, the BESS must be capable of being charged or discharged either in blocks of 50MW/100MWh or 75 MW / 150 MWh upto the total rated capacity specified as above. Each BESS block must be operated / responded independently to comply DISCOMs/SLDC instructions. For operational purposes, each BESS block will be treated as a separate project and schedules and operating instructions will be issued accordingly.

SLDC/DISCOM, at its discretion, may split the charging and discharging of each block of BESS into one or more sessions, with a minimum session duration of 15 minutes, depending on system requirements. The total time required to complete each full depth charge-discharge cycle shall be proportionately adjusted according to the number of sessions. Furthermore, if the BESS transitions from charging to discharging, or vice versa, before reaching full depth charge or discharge (i.e., during intermediate stage), such partial cycles shall also be considered to count as Full Cycle for the purpose of contract.

Note:

- Land allocation for the project shall be under scope of the Employer.
- The present scope shall include termination of 33 kV cable, including associated support structures (as required), from 33 kV switchgear upto 33 kV line Bay(s) of APTRANSCO. Six (6) Nos. of 33 kV line bays are being provided by APTRANSCO to integrate the BESS with Grid. Scope of work under APTRANSCO is depicted in the enclosed SLD at **Annexure I** for reference.

The detailed scope of work is brought out in subsequent clauses of this section.

2.1 Battery Energy Storage System

Design, engineering, manufacture, testing, supply on FOR destination site basis, including transportation & insurance, loading, unloading, storage, erection, commissioning, safety of equipment /personnel, operation and maintenance of the following equipment/items, complete in all respects as mentioned in subsequent paras:

- a) BESS capacity with nos. of charge/discharge cycles as per Table 1: Capacity of the Project on an "On Demand" basis including associated housing (container type design), Battery Management System (BMS), Power Conditioning System (PCS), Fire protection System, Battery Cooling System , Illumination system, civil works, furniture, over ground cable laying / cable trench and any other required components complete in all respect as applicable up to termination of MV cables at bays/substation build by APTRANSCO.
- b) Energy Management System (EMS) with SCADA & Control and Communication system for Monitoring and Controlling Battery-BMS, PCS etc. suitable for Batteries along with LT/FO/Special cables & associated accessories.
- c) The Contractor shall make adequate provision for storage, retention, and retrieval of all operational information generated during the execution and operation of the project for the entire Contract Period, in accordance with the requirements specified in the subsequent sections of this document.

Technical Specification: Section-Project Rev-00

- d) Power Conversion System (PCS) Transformers / Inverter Duty Transformers (IDT) including all associated fittings and nitrogen injection type fire protection system (as applicable), interconnection of PCS Transformers with PCS and complete MV bus work (MV level shall 33 kV) including switch gear, Clamps, Connectors, Earthing Material, Support structures, LT/HT/FO/Special cables along with associated accessories, illumination system, lightning protection, civil works etc., as applicable, complete in all respect for interconnection of PCS transformers with 33 kV Bay/substation of APTRANSCO through Under Ground cable.
- e) Visual Monitoring System for BESS area fitted with High mast Thermal & Surveillance Camera and streaming of the same shall be provided at Control Room of Sub Stations/BESS. Technical specification for VMS enclosed as Annexure-II.
- f) Auxiliary Power supply arrangement suitable for BESS including associated MV to LT Transformer with N-1 redundancy, MV switchgear equipment, UPS, AC/DC Distribution boards, Automatic Power Factor Correction (APFC) Panel on one of the 33 kV utility/DISCOM feeder to improve the auxiliary power factor to 0.99, LT/HT/FO/Special cables along with associated accessories, steel structures, insulator string & hardware, clamps, connectors, earthing materials, bus bar materials, buried cable trenches, illumination system, firefighting system, lightning protection, control & protection system, civil works etc., as applicable, complete in all respect.
- g) 100 kVA Diesel generator for critical auxiliary power supply
- h) Metering arrangement for Energy accounting, System Availability, Round-trip-Efficiency (RtE) etc. calculation.
- i) The configuration and internal layout of the BESS shall provide suitable safe access to all equipment for installation, operation, maintenance, and repair in all weather conditions. Layout shall also adhere to the latest CEA safety regulations/guidelines regarding BESS. All equipment, materials and services, whether explicitly stated or otherwise and that are necessary for the satisfactory operation of BESS and its integration with the existing system as described in the technical specification read in conjunction with the scope of supply and services shall be deemed to be included in the scope of work of the contractor. The contractor shall ensure that the BESS and associated systems comply with the latest applicable acts, regulations, and guidelines relating to cyber security, Public Procurement Circulars, and any other requirements as issued by the Government of India/CEA or other Statutory authorities.
- j) The Contractor shall be responsible for implementing comprehensive fire protection and safety measures for the BESS installation/operation, in accordance with the provisions of the applicable State/Central statutory rules/ regulations. Fire Hydrant System, including water supply and storage arrangements, shall be supplied & installed by the contractor for the BESS area, and necessary approval shall be obtained from the appropriate authority of Andhra Pradesh.
- k) The contractor shall make his own arrangements to meet the water requirements during construction and O&M period.

- l) Contractor shall provide necessary details like System Particulars etc. asked in contract documents.
- m) Bidder is advised to thoroughly assess the suitability and adequacy of the land identified and provided by Employer during the bidding stage. No requests for reduction in project capacity or scope due to land inadequacy shall be entertained after submission of the bid.
- n) The Delivery Point(s) under this project shall be a single point as indicated in Clause 2. It is hereby clarified that Interconnection of the Project at any other substation is not permitted for the Project being set up under this contract.
- o) All losses upto the metering point (from BESS side) shall be accounted by contractor and the AC round-trip efficiency shall be guaranteed at the 33 kV metering point.
- p) Contractor shall also comply with the requirements mentioned in the First Time Charging (FTC) regulations/rules issued by the Government, as amended from time to time.
- q) Contractor shall also comply with the requirements of relevant authority regarding charging and synchronization.
- r) Physical security and safety of the site
- s) Submission of engineering drawings, design calculations, performance test procedures, single line diagrams, electrical layouts, Equipment layout, Drawings/Data sheets of bought out items, Civil Drawings, Operation & Maintenance manuals/instruction manuals etc. to POWERGRID for review/approval. Further, submission of list of sub-vendors, manufacturing quality plans and Field quality plans/ material quality plan for approval of POWERGRID.
- t) Conduction of all type, routine, and acceptance tests of the equipment as per relevant codes/standards and relevant chapters of technical specifications.
- u) Submit PSSE and PSCAD model of Inverter/PCS etc. as detailed in Sub Section of Technical Specifications.
- v) Providing warranty of BESS along with its associated equipment's as per technical specification.
- w) All preventive and annual maintenance activities, up to and including the 33 kV pooling switchgear, shall be in the Contractor's scope for the entire contract period.
- x) Complete unused set of all special tools and tackles, which are necessary or convenient for erection, commissioning and O&M of any equipment, covered under the scope.
- y) The use of refurbished or secondhand battery cells in the project is strictly prohibited. An undertaking to this effect shall be given by contractor to Employer/APTRANSCO in a format to be prescribed by Employer/APTRANSCO.
- z) Any other equipment/material required to complete the specified scope.

2.2 Civil works

- a) The design of foundation shall be based on the soil investigation report, site requirement and other parameters as per relevant IS codes & technical specification. The Contractor shall in general follow
- b) The scope of civil work shall include but shall not be limited to the following based on design and drawings developed by the contractor:
 1. Contouring and site levelling (as required in all kinds of soils)
 - a) Dismantling of existing structure (if any) on plot area
 - b) Site clearance including cutting of trees, removal and disposal of roots of trees of all girths (including trees of girth less than 30cm or more) and other vegetation is in Bidder's scope
 - c) The item site levelling works include Contouring of plot area as per Technical Specification.
 - d) The quantity of earthwork in cutting & filling (in all kinds of soils), borrowed earth and disposal of surplus earth/boulders outside site boundaries shall be deemed to be included in contractor's scope.
 - e) Site Preparation: Site grading including slope protection, ground preparation/filling/levelling (if required), Ground improvement (if required) of the identified area.
 - f) FGL (Finished Ground Level) shall be at least 300 mm higher than the highest flood level (HFL) of the site. If HFL is not available, then nearby road level shall be assumed as HFL. Contractor shall submit the FGL level for Employer's approval based on the approved contour level drawing, site HFL data, topography of land and natural drainage. HFL data is required to be arranged by contractor
 2. Geotechnical investigation as technical specification. Plate load test is not in the scope of contractor.
 3. Construction of all required foundations and structure for BESS containers and associated equipment, including raised platform and PEB (Pre-Engineered building) canopy structures for PCS, RCC/PEB structures for auxiliary systems & HT switchgear building, Foundations/structures for any other components of the BESS system like firefighting system etc. shall be within the Contractor's scope. This scope shall include supply of materials, execution, and all other related activities necessary for completion.
 4. Reference drawings for Inverter platform with canopy and PEB (enclosed) structures for auxiliary system & switchgear are enclosed with the tender documents
 5. Civil and structural works associated with foundations for Inverter Duty Transformers with fire walls (as per design requirement), including oil soak pit, sump pit, stone filling, concrete encasement of pylon supports, pipe, manhole, rail cum road extending up to unloading point in peripheral road, common oil retention /Oil- water separation pit etc. as required, all complete.
 6. Civil, structural and architectural works associated with RCC framed control room building including substructure, superstructure and all other related works like internal cable trench

etc., complete as per system requirement and technical specification. Control room building shall be provided for the BESS installation, which shall accommodate Battery Management Systems (BMS), Energy Management System (EMS), SCADA, communication equipment, UPS and other common auxiliary systems required for operation and monitoring. The control room shall also include Operator Workstations (OWS) and Engineering Workstations (EWS) for local monitoring, control, diagnostics, and facilities/gateways required for integration with the plant's existing control architecture.

7. Overground ladder type cable tray system /underground cable trenches along with covers, road crossings, sump pits etc. shall be provided by contractor as per design requirement and technical specification. All pipes required in cable laying work shall deemed to be included under the Contractor's scope. Cable trenches route to be finalized in consultation with Employer/Beneficiary.
8. Antiweed treatment and stone spreading over non-woven geosynthetic fabric (min 200gsm) layer is to be provided in levelled areas in and around BESS facilities/ structure as per Technical Specifications and approved Layout drawing.
9. Bore well and pumps for water supply are in the scope of Contractor meeting the day-to day requirement of the water supply.
10. Drains:
 - i. Drainage system includes all drains, crossings and culverts. Storm water drains in BESS area to be connected with existing nearby drain. Design and construction of drainage system as per General Layout & topography
 - ii. The drains in BESS yard shall be trapezoidal, or rectangle section made of in-situ 75mm thk cement concrete lining
 - iii. Drainage layout, drain crossing and drain section drawings shall be prepared by contractor and submitted for Employer's approval.
 - iv. Rainwater harvesting system is not in the scope of contractor.
11. Roads:
 - a) Construction of approach road connecting to the existing nearby access road is in the scope of contractor.
 - b) Bitumen roads include all crossings and culverts as per technical specifications and tender drawing, as required.
 - c) Road layout and section drawing shall be prepared by contractor and shall be submitted for Employer's approval.
12. Chain link Fencing including gates along with guard room to be provided as boundary wall for BESS yard, the layout for fencing shall be developed by the contractor for Employer's approval. Fence shall also be provided as per CEA guidelines for the various equipments (if) mounted on ground or a height lower than 2.5m.
13. All materials required for the Civil and construction/installation work including cement & steel shall be supplied by the Contractor.

14. M25 Grade Design Mix concrete shall be used for all RCC work.
15. Excavation in Hard rock (requiring blasting), if encountered and its disposal outside side boundary, shall deemed to be included under Contractor's scope of works.
16. For foundations in filling area, soil improvement shall be carried out either by boulder soling or stone column or any other suitable method as recommended in geotechnical investigation
17. Any other items/ designs/ drawings/ components of buildings and other installations not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

2.3 Provision of Power during construction & commissioning stage

Contractor shall make his own necessary arrangements of power for construction activities. In case of failure of power due to any unavoidable circumstances, the Contractor shall make necessary arrangements like diesel generator sets etc. at his own cost so that progress of work is not affected and Employer shall in no case be responsible for any delay in work because of non-availability of power.

In addition, the contractor at its own risk and cost, will be required to arrange for the charging and discharging of power for carrying to carry out operational/ functional test prior to commercial operation as well as for commissioning of the Project. For avoidance of doubt, it is clarified that Synchronization / Connectivity of the Project with the grid shall not to be considered as Commissioning of the Project.

2.4 Provision of Water

The contractor shall make his own arrangement of water for construction/other use at his own cost and the Employer shall in no case be responsible for any delay in works because of non-availability or inadequate availability of water.

2.5 Training to Employer's Personnel

The Contractor shall submit details of a comprehensive training program for training activities starting immediately after the contract within a period of 60 days from award of contract and for all other training activities starting later, for which the schedule shall be furnished within 4 months from award of contract.

The training shall be carried out at the Contractor's office/works (as agreed by the Employer) and at site for which price shall be quoted in the BPS. The traveling and living expenses of Employer's personnel, if any, shall be borne by Employer. The scope of training shall be limited to Man-days as specified in the BPS. The detailed training module shall be approved during engineering stage.

The broad break up of Training shall be as follows:

- a) System Engineering design and equipment Specification
- b) Operation and maintenance
- c) Operation and maintenance (hands on Training at site)

During the development of system engineering and detail design phases, the Employer may participate in the works as practical training as well as verification of design and factory system testing.

The training programs shall be arranged and conducted in a thorough manner with instructions given by the Contractor's fully qualified staff. Each part or section of the training program shall also be prepared in written form, fully documented, referenced and furnished to the Employer for future use by the Employer in the training of operating and maintenance personnel. In addition to the written materials, two sets of training aids (e.g. CD/DVD/Pen-Drive etc.) shall be supplied. The written material shall be supplied to each trainee during training. Training material for operation/maintenance of the various items shall be furnished as a guide for future reference of the Employer's personnel

The Contractor shall endeavor to make available technical literature/technical papers etc. if requested by Employers' engineers for their reference & application.

The Contractor shall furnish full updated technical documentation in the form of brochures, drawings, films, literature etc. to enable the Employer to train his engineers and to enable the Employer to regenerate and update the training program.

2.6 Project Management

The Contractor's scope includes overall management and supervision of the works. The Contractor shall establish a suitable project office and facilities for this purpose, if already not available. For performing the project management functions, the Contractor shall provide experienced and knowledgeable personnel in this office for the purposes of works. The said personnel shall be skilled and competent in all phases of management, execution, operation & maintenance of the project, the engineering, construction, in detail system analysis and design engineering for BESS, building sub and superstructures, mechanical and electrical auxiliary systems, communication systems and all other skills necessary for the proper completion of the Works.

2.7 System Design, Engineering and Studies

The Contractor's scope includes overall system studies, engineering and detailed design for all elements, systems, facilities and equipment.

During detailed designing & engineering, the contractor shall provide a list containing description of all foreseeable technical studies that shall be carried out to comply with the design performance and operating requirements for the works as set forth in the specification and shall indicate the date of commencement & completion of various studies.

The Employer shall have right to observe and participate in the studies performed as a part of the Contract and shall have access to all data necessary for complete understanding of the purpose of such studies as well as the validity of the results. The Contractor shall give the Employer at least thirty days prior notice before commencement of the above studies.

The employer presently uses PSSE Version 36 & PSCAD version 5. The contractor shall provide data & model compatible in these formats along with detailed descriptive manual detailing how to configure & utilize the model so that employer can perform further studies.

2.8 Spares

2.8.1 General

The spare parts and maintenance accessories shall be classified into the following:

- a) Availability Spares
- b) Mandatory Spares (if specified in BPS), Testing & Maintenance equipment (if specified in BPS) in addition to (a) above
- c) Optional Spares/ Testing & Maintenance equipment recommended by the contractor in addition to a) and b) above.
- d) Commissioning Spares

All spares shall be of the same materials and workmanship as the corresponding parts of the equipment furnished and shall be fully interchangeable with those parts. A spare part intended for use as a replacement for any one of several similar parts, for example a capacitor unit, shall be a replacement to any one of those parts without resulting in a deterioration in the performance of the equipment / system. All spares meant for outdoor use, such as bushings, transformers etc. shall be suitable for prolonged outdoor storage without being energized. Contractor shall keep spare battery at site so as to replace them with defect batteries and also to ensure required system availability.

Contractor shall make necessary arrangements at site to store the spares in such an environment that the spares shall be readily available/usable during their service life. Contractor shall store the spare batteries in OEM specified environment with an adequate charger to charge the batteries during storage period. PCS transformer & PCS shall be stored on proper foundation.

2.8.2 Availability Spares

The Contractor shall supply the spare parts required to meet the specified guaranteed availability and shall include such spare parts in the scope of supply. The detailed lists of spare parts to meet the guaranteed reliability & availability requirements shall be part of the contract documents. However, if it is found during detailed engineering and/or Reliability & Availability prediction calculation that additional spares are required to meet target values, the same shall be made available by the Contractor without any additional cost to the Employer.

2.8.3 Mandatory Spares (if specified in BPS), Testing & Maintenance equipment (if specified in BPS) and Optional Spares/Testing & Maintenance equipment

The bidder shall quote for the Mandatory spare parts and testing & maintenance equipment as per bid price schedule, if specified.

In addition, bidder may also recommend optional spare parts and testing & maintenance equipment for the specified operation period.

2.8.4 Commissioning Spares

The Contractor shall supply additional spares which he expects to consume during installation, testing and commissioning of the systems. The quantity of these spares shall be decided based on his previous experience, such that site work shall not be hampered due to non-availability of these spares.

2.9 Warranty/Guarantee/AMC & Performance Parameters

2.9.1 General

The scope of work under Comprehensive Maintenance Contract includes Warranty and Annual Maintenance Contract for maintaining performance as per performance parameter/criteria for all the software and hardware provided by the contractor under this project. The essence of the Comprehensive Maintenance Contract is to carry out all necessary activity to ensure that the BESS shall meet following guarantees during the entire contract period of 12 years:

- A. Guaranteed System Availability
- B. Guaranteed Dispatchable Capacity
- C. Guaranteed AC to AC Roundtrip Efficiency (RtE)

Employer shall use Monitoring Points like, DSM/UI Reports published by the SLDC or measurement at the Main ABT Meter at the delivery point for the purpose of verifying any data used by Contractor to determine whether the Performance Parameters have been met. The ABT Meters shall be provided by the Employer. Installation, Commissioning of the ABT meters along with collection & processing of data received from ABT meters in EMS shall be in the scope of Contractor.

If, Employer finds that, the data, timing etc. measured by identified Monitoring points are different to the Performance Parameter calculation data, Employer shall notify Contractor immediately about the discrepancy with all relevant supporting details to Contractor.

After considering such evidence, Contractor shall, at its cost, re-calculate whether the relevant Performance Parameter(s) have been met (or if necessary, repeat the relevant Performance Parameter test) using the Employer's Monitoring point data. Upon reaching the conclusion Contractor shall

- do necessary rectification in its devices to align the calculation procedure with the Contractor's identified Monitoring point.
- Submit a report clarifying the cause for discrepancy in data and rectifying measures taken to bring alignment between the data.

Data collected from the Monitoring Points (Interconnection points with the Grid) shall be considered as final reference points for the purpose of evaluating Performance Parameter and corresponding Liquidated Damage (LD) calculation. The LD calculation method is defined in forthcoming sections for each Performance Parameter factor.

For timely resolution of issues, for all bought out major items (hardware as well as software), the Contractor shall have back-to-back support/warranty/guarantee along with supply of spare with appropriate response time from OEM/OEM Authorized representatives. Contractor shall be responsible for coordination with the OEM for all matters related to these items and shall be responsible for meeting the overall response times and availability requirements specified in the Specification.

2.9.2 Guaranteed Monthly System Availability

The Contractor shall guarantee a minimum system availability of 95% on monthly basis for BESS

Project. The Contractor shall pay the liquidated damages for shortfall in meeting the minimum system availability as set-out in forthcoming section.

Availability of the Project shall mean the ability of the BESS to execute a function, i.e. charging or discharging, when called upon to do so, as per the schedule or signal provided by the off-taker (SLDC/DISCOM/Employer), subject to the minimum system ratings specified herein.

The availability guarantee shall commence from the date of commissioning of the system and shall be calculated as below:

Monthly System Availability = Mean of the System availabilities of all time-blocks during the month in which the off-taker has scheduled power for charging/discharging the BESS.

Where,

$$\text{System Availability in a timeblock} = \frac{\text{Actual Injection/Drawal } MUI(A)}{\text{Scheduled Injection/Drawal } MUI(B)}$$

Where,

- i is ith time-block in the month where Scheduled Injection/Drawal MUI ≠ 0.
- Actual Injection/Drawal MUI is the Energy Scheduled for Charging/Discharging in the ith time block, in MUs
- Scheduled Injection/Drawal MUI is the Energy Scheduled for Charging/Discharging in the ith time block, in MUs
- A and B shall be as per the DSM/UI Reports published by the SLDC or measurement at the Main ABT Meter at the Point of Interconnection.

Measurement of the Availability shall be recorded each Month by the Contractor and retrievable from Contractors remote monitoring system, together with Contractor's inspection and maintenance log.

2.9.3 Guaranteed Dispatchable Capacity

Taking into consideration capacity degradation, Contractor shall warrant and guarantee that BESS, once fully charged, shall be capable of delivering Energy Capacity at or above the “Guaranteed Dispatchable Capacity” for the full range of environmental conditions at the project site as per Table below at the Delivery point throughout the Contract Period individually for BESS.

Year	Min. Dispatchable Capacity of BESS Project at the end of Year (as a % of Capacity at the Beginning of Life/COD)
1	97.5%
2	95.0%
3	92.5%
4	90.0%
5	87.5%
6	85.0%
7	82.5%
8	80.0%
9	77.5%

Year	Min. Dispatchable Capacity of BESS Project at the end of Year (as a % of Capacity at the Beginning of Life/COD)
10	75.0%
11	72.5%
12	70.0%

Contractor shall also demonstrate, on monthly basis, 100% of the minimum dispatchable Capacity of the BESS as required above.

Available energy test

Contractor shall also submit Available energy Test Report for the Project capacity as per IEC 62933-1 on Annual basis.

Available energy is defined as energy that can be output at the delivery point by operating at the rated output power from the current state. Full available energy is equal to nominal energy capacity, and the state of the lower limit at which the BESS can be discharged to output the available energy is defined as the minimum available energy level. The unit of available energy should be Wh. The ABT meters shall be used as reference device to measure available energy.

Contractor shall conduct a Dispatchable Capacity Test for the BESS annually on the identified date by the Employer. Annually, the dispatchable capacity required to demonstrate shall be equal to “Rated energy capacity of the system x Min. Dispatchable Capacity at the end of corresponding Year (as a % of Capacity at the Beginning of Life/COD; as tabulated above)”. In between the year, if Employer feels like the Dispatchable capacity is not up to the mark, the Dispatchable Capacity test may also be conducted with available data from the EMS.

Employer shall give Contractor prior written notification to conduct the Guaranteed Capacity Test. Contractor & Employer shall mutually schedule the test to minimize any disruption to the commercial operation of the BESS.

If there is need for calibrated metering instruments it shall be supplied by Contractor. All such equipment is to be validated by accredited laboratories and the test reports to be finally approved by the Employer.

Calculation of Energy Capacity

If the Energy Capacity as determined by the Dispatchable Energy Test is greater than or equal to the Guaranteed Energy Capacity as demonstrated in above Table, the BESS passes the Test.

If the Energy Capacity as determined by the Dispatchable Energy Test is less than the Guaranteed Energy Capacity, or the BESS cannot maintain a discharge rate, then the BESS shall not have met the Guaranteed Energy Capacity.

If BESS fails to meet the Guaranteed Energy Capacity during the Performance Test, Contractor shall promptly remedy the failure to ensure that the BESS meets the Guaranteed Energy Capacity, at Contractor sole discretion

If the BESS does not achieve the Minimum Capacity Threshold, Contractor shall

- a) at its expense replenish, adjust and modify the system incl. equipment to enable the BEES to achieve the Minimum Capacity Threshold; and

- b) Arrange and repeat the Performance Test at Contractor's cost within 5 business days of the completion of all adjustments and modifications.

It shall be the responsibility of the Contractor to make periodic replacements/replenishments of system capacities at its own cost 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.

Periodic Checking

On monthly basis, with the operational data available from the BESS, Contractor shall estimate the Available Energy in the BESS. Where,

- the BESS system shall be charged to energy levels, such as 25 % or 50 % or 75 % or 100% (on Employer's discretion) of the full available energy level.
- The BESS shall be discharged at the rated power (and continuous discharging should also be done at the minimum available energy level).
- Discharged energy to be measured with the Monitoring Point as mentioned above.

The test should confirm that the measured value matches or higher than the desired available energy of the system. Calculations in this regard shall be performed by the Contractor and validated by Employer. In detailed Engineering all such calculation procedure shall be provided by the Contractor and shall be approved by Employer.

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.

2.9.4 Guaranteed Roundtrip Efficiency

The Contractor shall Guarantee AC to AC Round trip Efficiency (RtE) of the BESS on monthly basis for BESS. In this regard, the RtE for BESS shall remain at or above 87% from beginning till end of life i.e.; throughout the tenure of the contract.

Calculation of RtE

AC to AC Round trip Efficiency of BESS

$$= \frac{\text{Sum Total of Actual Injection/Discharging } MU_{sj} \text{ in a month } (C)}{\text{Sum Total of Actual Drawal/Charging } MU_{sj} \text{ in a month } (D)}$$

Where,

j refers to the jth month in a year;

D ≠ 0;

$D \leq n \times E_{\text{bess}} \times (MD_{n-1} - (MD_{n-1} - MD_n) \times j/12) / RtE_g$;

E_{bess} refers to Energy Rating of BESS in MWh;

n= Total no. of operational cycle during the jth month

MDn-1 refers to minimum guaranteed dispatchable energy at the end of the previous year (as a % of Capacity at the COD specified in Clause 2.11.3 above);

MDn refers to minimum guaranteed dispatchable energy at the end of the current year;

RtEg (Guaranteed Round-Trip Efficiency) = 87%;

C and D shall be as per the DSM/UI Reports published by the SLDC or measurement at the Main ABT Meter at the Point of Delivery Point.

Auxiliary power consumption of BESS shall not be part of RtE calculation. Separate metered connection for the Auxiliary Power load of BESS is detailed in forthcoming section. The Contractor shall declare RtE on Day Ahead Basis.

If the monthly RtE as determined by the test is less than 87% for the BESS, then the corresponding BESS shall not have met the Guaranteed RtE, and Contractor shall:

- pay liquidated damages to Employer as per corresponding section of this specification.
- promptly remedy the failure to ensure that the BESS meets the Guaranteed RtE in subsequent month.

Periodic Checking

On fortnight basis, with the operational data available from BESS, Employer shall calculate the RtE. The method of calculation shall be same as mentioned above. If the BESS fail to achieve the minimum RtE, the Guaranteed RtE is not met and Contractor shall be intimated to meet the RtE.

The LD for shortfall in meeting the minimum RtE as per provisions stipulated in this clause shall be calculated monthly and shall be applicable for entire month. Details of LD on account of shortfall in meeting annual guaranteed dispatchable capacity is mentioned in subsequent section.

2.9.5 Comprehensive Maintenance Charges

The Comprehensive Maintenance Contract shall be applicable for a period of 12 years. Equal amount of comprehensive maintenance charges shall be paid to the Contractor throughout the Contract Period as mentioned in BoQ.

2.9.6 Claim Procedure

- If the BESS Project has failed or is failing to meet any of the Performance Parameters during the Contract Period, the Employer shall be entitled to impose liquidated damages on the Contractor in accordance with this specification.
- If Employer finds that the BESS has failed or is failing to meet any of the Performance Parameters, Employer shall immediately notify Contractor in writing along with a copy of the up-to-date Operating Records.
- Contractor shall within 5 working days of receipt of such notification, calculate any adjustments that should be made to the BESS and report in writing on the same to Employer. After making such adjustments, if the BESS has failed to meet any of the Performance Parameters, Contractor shall notify Employer within 2 working days of the level of LD Contractor deems to be due in accordance with this section and pay to Employer the LD in accordance with this section.
- Any LD which accrues under this section shall be payable by Contractor to Employer within 15

days of receipt of an invoice from Employer.

- Employer shall be entitled to deduct LD amount from the monthly payable Comprehensive Maintenance Contract cost as mentioned above to Contractor.
- If the liquidated damages payable to Employer exceed any monthly payment sums, then employer shall notify the excess amount to contractor. Contractor shall be liable to pay excess amount within 15 days of invoicing by employer.
- If the Liquidated Damage payment is not received from Contractor within One months from date of invoicing, then Employer is entitled to deduct the pending amount from the CPG available with the Employer.
- LD for the Performance Parameter shall be calculated by the Employer and the Contractor jointly.
- If any event subsequent to issuance of a relevant invoice results in a change in the amount of liquidated damages, as applicable, the additional liquidated damages shall be included in a subsequent payment by Contractor.

2.9.7 Liquidated Damages Calculation

The Liquidated Damage (LD) calculation shall be for Project individually corresponding to Performance Parameter.

2.9.7.1 LD Calculation w.r.t. Guaranteed Monthly System Availability

Liquidated damages on account of shortfall in meeting the Guaranteed System Availability mentioned in Clause 2.11.2 shall be calculated as follows:

$$\text{LD for shortfall in monthly System Availability (in ₹)} = (A - B) \times 0.022 E$$

where,

A is Guaranteed Monthly System Availability (95%)

B is Actual Monthly System Availability

E is Evaluated cost (₹) to be quoted by the Contractor = EPC cost + Comprehensive Maintenance charges

The LD calculation for shortfall in System Availability shall be applicable only for $A > B$.

2.9.7.2 Liquidated Damages Calculation w.r.t. Guaranteed Roundtrip Efficiency

Liquidated damages on account of shortfall in meeting the Monthly Guaranteed RtE mentioned in 2.9.4 shall be as follows:

- a) For $\text{RtE} < 72\%$, there shall be a liquidated damage @ Average Power Purchase Cost (APPC) tariff (including transmission charges) at Andhra Pradesh state level of all DISCOMs, of previous financial year of the Discoms of excess conversion losses considering system $\text{RtE} = 87\%$ and Comprehensive Maintenance charges for the corresponding month shall not be made to the Contractor.
- b) For $72\% \leq \text{RtE} < 87\%$, there shall be a liquidated damage levied @ APPC tariff (including transmission charges) at Andhra Pradesh state level of all DISCOMs, of previous financial year of the Discoms of excess conversion losses considering system $\text{RtE} = 87\%$

2.9.7.3 Industrial All Risk Insurance during Maintenance Period

During the Comprehensive Maintenance period the Contractor shall take Industrial All Risk insurance policy covering risks against any loss or damage. The Insurance value shall be equal to the cost quoted for the Project Cost excluding maintenance charges of the contract, the insurance amount can be reduced Y-o-Y straight line depreciation method. However, the Contractor is free to take insurance of value more that of the Project Cost excluding maintenance charges .

2.9.7.4 Service Response Requirements

Various state of operation / problems of BESS have been categorized under severity levels. The contractor shall submit an appropriate problem / defect reporting procedure to meet the requirement of all severity levels to get the approval of the same from Employer. Severity levels and their resolution time are defined below:

Category	Definition	Resolution Time
Severity 1 (Urgent)	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability. Failure of application software, cyber security issues shall also come under this category.	24 Hours
Severity 2 (Serious)	Degradation of services or critical functions such as to negatively impact system operation. Coverage under this severity would not affect complete system but subsequently could result into Severity-1 category problem.	48 Hours
Severity 3 (Minor)	Any other system defect, failure, or unexpected operation not covered in severity 1 & 2.	72 Hours
Severity 4 (General / Technical Help)	Request for information, technical configuration assistance, "how to" guidance, and other requests.	48 Hours

Above problems can be registered by Employer to contractor through any media like letter, email, message or telephonic call etc. Support for the same shall be provided within the resolution period described above. The contractor can also provide on-call support. Key objective would be to restore the system to normal operational state as quickly as possible, including by a temporary workaround. After passage of resolution time any delay in attending the problems shall be considered as non-availability period (rounded to hours) under respective severity levels.

3.0 Specific Exclusions

The following items of work are specifically excluded from the scope of the specifications:

- a) Procurement of Land/site
- b) Employer's site office

4.0 Schedule Of Quantities

- a) The requirement of various items/equipment and civil works are indicated in Bid price Schedules.
- b) Wherever the quantities of items/works are indicated in Lot/Set, the bidder is required to estimate the quantity required for entire execution and completion of works and incorporate their price in the Bid price schedules.

5.0 PHYSICAL AND OTHER PARAMETERS

I. **Location of the Substation** – As per Clause 2.0 of this Specification.

II. **Meteorological data** -

S. No	Station Meteorological Parameters	Reference/Remarks
1	Snow Fall	No
2	Wind Zone	As per National Building Code (NBC) 2016
3	Seismic Zone	As per IS 1893
4	Design Ambient Temperature	50°C
5	Altitude	< 1000 m
6	Coastal area consideration	As applicable

III. **Audible Noise**

Primary equipment noise levels shall be as specified in the relevant equipment specifications. The Contractor shall limit the audible noise in various areas of the BESS buildings and Containers to the following values.

- Inside battery containers or building - 90 dBA.
- Mechanical equipment areas indoor 75 dBA (measured at 2 metre distance).
- Mechanical equipment outdoor 75 dBA (Measured at 15 m distance).
- At the limits of BESS installation perimeter fence 80 dBA.

6.0 DIFFERENT SECTIONS OF THE TECHNICAL SPECIFICATIONS

For the purpose of present scope of work, Technical Specification (Vol. II) shall consist of following parts/sections and they should be read in conjunction with each other.

1.	Section-Project	Rev 00
2.	Section-General Technical Requirement (GTR)	Rev 15
3.	Section-Battery & Battery Management System (BMS)	Rev 00
4.	Section- Power Conditioning / Conversion System (PCS)	Rev 00

5.	Section- Energy Management System (EMS) with SCADA	Rev 00
6.	Section- PCS / IDT Transformer	Rev 00
7.	Section- Auxiliary Transformer	Rev 00
8.	Section- 33 kV Switch Gear	Rev.00
9.	Section-Switch Gear-Monitoring, Control & Metering	Rev 00
10.	Section- Structures	Rev 06
11.	Section-BESS-Civil Works	Rev 00
12.	Tender Drawings	--
13.	Section- Switchyard Erection	Rev 10

In case of any discrepancy between Section-PROJECT, Section-GTR and other technical specifications on scope of works, Section-PROJECT shall prevail over all other sections.

In case of any discrepancy between Section-GTR and individual sections for various equipment, requirement of individual equipment section shall prevail.

7.0 SPECIFIC REQUIREMENTS

The specific requirements mentioned at relevant/applicable clauses of SPECIFIC REQUIREMENT'S (Section- Project) REV NO 10 enclosed at **Annexure III** shall be referred for the specified scope of works.

7.1 General/Equipment Specific Requirements

7.1.1 Battery including Battery Containers

Battery/ Battery Containers 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 battery cooling system and fire suppression systems, ac switchgear, Control Systems etc. Any proven battery technology with totally maintenance free characteristic suitable for operation in site-specific climatic conditions and meeting the requirements specified in the technical specifications may be used. BESS containers shall be suitable for outdoor conditions, diverse climatic conditions and corrosion resistance. Doors, gaskets, and panel construction shall prevent dust, water, and rodents.

a) Battery Management System (BMS):

The BESS shall be equipped with a comprehensive Battery Management System to ensure safe, efficient, and reliable operation of the battery throughout its service life. The BMS shall provide multilevel (module/rack/system) monitoring and control, including real time measurement and

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logging of key parameters such as SoC (State of Charge), SoH (State of Health), voltage, current, temperature, charge/discharge cycles etc. It shall be capable of automatically isolating faulted cells or strings under abnormal conditions (e.g., over/undervoltage, overtemperature, imbalance, or internal faults) and shall incorporate redundancy to avoid single-point failures. The BMS shall interface seamlessly with the EMS/SCADA using open and standard communication protocols, thereby enabling coordinated control and system-level optimization.

b) Battery Cooling System

The BESS shall include battery cooling system designed to maintain battery temperatures at levels acceptable to the Battery Manufacturer'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 ensure temperature uniformity within the battery. The battery cooling system shall be designed as per applicable codes/standards for such applications and in line with relevant CEA regulations (as applicable).

7.1.2 Power Conversion/Conditioning System (PCS)

PCS 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 switches along with all associated control & protection, filtering, measuring instruments and data logging devices. It shall be equipped with a Grid Forming Inverter (GFM) mode which can provide supply during Black Start Restoration. The inclusion of such capability will significantly enhance system reliability and resilience during contingency conditions. The PCS shall be bi-directional inverter with four quadrant operation.

BESS including PCS shall be designed for providing ancillary services (primary, secondary and tertiary reserve ancillary service), reactive power support, synthetic inertia and black start capability. Technical parameters and design of system shall be as per the technical specifications. Necessary safety provision shall be provided to prevent inadvertent operation in islanded mode.

7.1.3 Power Conversion System Transformers / Inverter Duty Transformers

Inverter duty transformers shall be provided to ensure galvanic isolation of the PCS/BESS from the grid and to step up the PCS output voltage for interconnection with the 33 KV pooling switchgear. IDT shall be oil immersed transformer suitable for outdoor operation and shall comply with relevant IS/IEC. Multi-winding IDT are acceptable as per standard practice of the bidder. Voltage ratio shall be as per system requirements and vector group shall be as per PCS manufacturer recommendation. IDT shall have off Circuit Tap Changer with range of +/-5% in steps of 2.5%. One number IDT with same rating shall be provided as spare for EACH location. Necessary transformer maintenance and monitoring equipment's shall be provided.

7.1.4 Auxiliary transformer

Adequate number of auxiliary transformers shall be provided as required to meet the total auxiliary power demand of BESS system. Auxiliary transformers may be fed from 33kV pooling switchgear or LV side of the Inverter Duty Transformer as per standard practice of the system Integrator. Oil

filled transformer with outdoor application OR Dry type transformers with indoor application shall be acceptable. Necessary redundancy shall be maintained such that there is no loss of auxiliary power supply in case of outage of Single Auxiliary Transformer.

7.1.5 Energy Management System (EMS) with SCADA

Energy Management System (EMS) with SCADA & Control and Communication system for Monitoring and Controlling Battery-BMS, PCS etc. suitable for Batteries along with LT/FO/Special cables & associated accessories. The EMS along with the Power Plant Controller (PPC) shall provide real time monitoring and control of BESS, with provision for standalone operation as well as coordinated operation with Grid. It shall coordinate charging from standalone mode and State of Charge (SoC), to optimize readiness for peak discharge. The EMS, PPC shall interface with existing SCADA of pooling/grid substation or SLDC for coordinated operation of BESS.

EMS, PPC shall also enable standalone operation and interface with SLDC/RLDC for independent BESS operation. EMS shall be capable for BESS functionalities as detailed in the technical specifications. EMS control shall follow a layered structure—system level (grid interface, scheduling, ancillary services), supervisory (SoC management, system health), and device level (PCS, BMS, auxiliaries, fast grid response). Standard communication protocols (IEC 61850, IEC 608705101/104, OPC, etc.) with redundancy and cybersecurity provisions shall be adopted. Protection, control, and SOE data for associated 33 kV system shall be integrated with EMS of the system. Following minimum equipment shall be included for EMS interface:

Sl. No.	Description	Quantity
1	Engineering cum Operator Workstation (EWS + OWS) – Server with 29-inch Monitor	2
2	Operator Workstation (OWS) – Server with 29-inch Monitor*	1
3	Portable (Laptop-based) EWS	1
4	Gateways	2
5	Historian (Desktop)	1
6	50-inch LED Display	1
7	Time Synchronization Equipment	1
8	Control Desk	4
9	Chairs for Control Desk	4
10	Laser Printer (A4)	1

*- the same shall be placed at Employer's/Grid substation control Room. However, exact place shall be decided during detailed engineering.

The EMS with SCADA shall comply with following requirements:

- I. EMS with SCADA system shall communicate with PCS on IEC 61850 / IEC 60870-5-104
- II. EMS with SCADA shall communicate with SLDC/Pooling substation on secure IEC 60870-5-104 / Inter-Control Center Communications Protocol (ICCP) protocol configured for four control centers with redundant firewalls, cyber security features, AGC feature at BESS end to control from SLDC.

- III. The 33 kV pooling switchgear shall be interfaced with the BESS EMS/SCADA system for monitoring, control and metering. Provision shall also be made for signal exchange between the BESS EMS/SCADA and the SCADA of the Pooling substation to enable seamless integration and centralized supervision. The list of signals for such interfacing shall be finalized during detailed engineering.
- IV. The project shall comply with an Energy Management System (EMS), a technology platform that optimises the use and operation of energy-related assets and processes. In line with the “Amendment in Operational Guidelines for viability Gap Funding Scheme for development of Battery Energy Storage System supported through Power System Development Fund (PSDF)” notified by the Ministry of Power on 4th August 2025, the application software of the Energy Management System (EMS) of the BESS shall be developed indigenously within India.

Contractor to telemeter data from the BESS plant to APSLDC/ RLDC(RSCC)/NLDC/identified POWERGRID remote control center through optical fibre based SDH communication link at their own cost. This includes the arrangement and installation of necessary Optical Fibre Connectivity, RTUs/Gateways, SDH equipment, routers, switches etc, and integration work as per the prevailing regulations, standard practices/protocols of APTRANSCO/POWERGRID. Firewall shall be Next Generation Firewalls (NGFW) as per specifications at GTR.

CEA (Cyber Security in Power Sector) Guidelines, 2021 updated till date shall be applicable for System Integrators, Equipment Manufacturers, Suppliers/Vendors, Service Providers, IT Hardware and Software OEMs engaged in the Indian Power Supply System. Further the data list, architecture and SAT/FAT testing procedure to be finalized as per GTR which also includes detailed cyber security requirements.

7.1.5.1 EMS with SCADA Integration with APTRANSCO Substation SCADA & SLDC

The BESS shall be connected and integrated with the grid through the APTRANSCO substation, which is further connected to the Intra State Transmission System. A SCADA system is available at the APTRANSCO substation for this purpose.

The Contractor shall ensure that the BESS Energy Management System (EMS) is equipped with the capability to onboard and execute scheduling of power and energy to/from the SCADA system at the pooling substation and to operate strictly in accordance with the schedules so received. The EMS shall also provide secure remote access through two-level password protection and shall operate only from designated IP addresses.

As the BESS system is co-located and integrated with the pooling substation at the 33 kV level, the Contractor shall integrate all required digital and analog status signals, protection data, relay information, and IED (Intelligent Electronic Device) data from the BESS SCADA system with the pooling substation SCADA system.

The Contractor shall map, within the EMS with SCADA, the alarms, events, and status information of the 33 kV IEDs/relays of the incoming feeder from the pooling substation. Such mapping shall be performed without any additional cost to POWERGRID/Employer.

The Contractor shall make all necessary arrangements, modifications, and integrations to ensure that the EMS with SCADA operates seamlessly and efficiently with the Employer's substation SCADA system, with no additional financial implication to the Employer.

7.1.5.2 Storage & System Hardware

The contractor shall provide redundant station HMI in hot standby mode. The servers used in these workstations shall be of industrial grade. Contractor shall use industrial grade components. Processor and RAM shall be selected in such a manner that during normal operation not more than 50% of the capacity of processing and memory are used. Suppliers shall demonstrate these features. The capacity of hard disk should be selected such that the following requirement should occupy less than 50% of disk space:

Sr. No.	Parameter	Time Interval	Duration
1	Real and reactive power generation, Current, voltage, frequency, Main Meter and Back up Meter Readings	15 Minutes	36 Months
2	Digital data including alarm, event	15 Minutes	36 Months
3	Active power, reactive power, frequency, event logger, disturbance recorder and triggering data of low voltage ride through and high voltage ride through, during tripping and protection operation at plant level	1 ms	90 days
4	Battery Management System Data	As per OEM requirement	As per OEM requirement
5	Chart & printout of event loggers, if any, for system disturbances /outages	15 minutes	36 Months

Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

7.1.6 AC and DC Cables for Interconnection of BESS

All AC and DC power and control cables required for interconnection within the BESS system and all equipment in the contractor's scope shall be provided.

DC cables between the battery system and PCS shall be of suitable grade to withstand the maximum DC voltage of the battery strings and shall not be less than 1.5 kV (DC) grade. In case a 1500 V DC system is offered, 3.3 kV (E) grade cables shall be provided. DC power cables shall be of compacted aluminum/copper conductor, XLPE insulated, PVC inner sheathed (as applicable), armoured, and FRLS PVC outer sheathed, conforming to IS: 7098 (Part2) or equivalent standards. The insulation grade shall comply with the PCS manufacturer's recommendations based on the DC

side waveform. Power cable from PCS to IDT shall be 3.3 kV (E) grade, XLPE insulated, PVC inner sheathed, armoured with compacted aluminum conductor.

Sizing of all AC and DC cables shall be carried out by the Contractor during detailed engineering, considering current-carrying capacity, derating factors (temperature, grouping, soil conditions, etc.), and voltage drop requirements. The sizing calculations shall be submitted to the Employer for review and approval. All cable construction parameters shall conform to the relevant IS/IEC standards and the requirements specified in the applicable chapters of this specification

7.1.7 LT Switchgear for BESS Auxiliaries

The Contractor shall provide LT switchgear and associated systems for powering all auxiliary loads of the BESS, including battery cooling system, fire detection and suppression, lighting, control systems, communication systems, and other ancillary loads. The complete auxiliary power supply for the BESS installation shall be sourced through BESS Tie Transformer itself with no dependency on external auxiliary supply.

The auxiliary power system shall include energy metering capable of measuring and electronically recording real-time auxiliary power consumption (at the actual tapping point) in EMS, independently of the operation of the PCS or the net active/reactive power flows to and from the battery system.

Additionally, the auxiliary and/or control system design shall ensure provision of necessary emergency backup power to enable safe and orderly system shutdown during abnormal conditions, including total loss of grid power.

The auxiliary power system shall be designed with adequate redundancy such that failure of any single BESS container/PCS shall not affect the continuity of auxiliary power supply.

Spares (MCCB Modules less than 100 A): All Switchgears, Motor Control Centres (MCCs) & AC/DC distribution boards, etc. shall have at least twenty per cent (20%) or minimum two (whichever is higher) fully equipped MCCB/MPCB modules of each rating as spares which shall be uniformly distributed over different vertical sections.

Spares (MCCB modules—100A and higher): In addition, all Switchgears, MCCs and AC distribution boards shall have as spares at least twenty per cent (20%) or at least one module (whichever is higher) of each rating range of the selection table, equipped for the rating of the largest auxiliary fed from that range.

Contractor's scope also include supply and laying of the Insulating mat in front of LT Switchgears.

7.1.8 MV Switchgear (33 kV Pooling Switchgear)

The scope shall include Switchgear boards as required (as per typical key single line diagrams of various projects enclosed in Tender drawings). The design and sizing criteria of the Switchboards shall be as detailed in the specification.

The switchgear(s) shall be suitably rated to handle the total BESS capacity and configured with the required number of feeders based on the system requirements and same shall be finalised during detail engineering.

For all the Switchboards, each section shall have minimum 1 nos. of spare modules of each rating. It is preferable to supply MV Switchgear from a single manufacturer. Contractor's scope also includes the implementation of dielectric epoxy-based coating as indicated in the specifications.

It is to be noted that control and supervision of all circuit breakers shall be envisaged through SCADA on dual redundancy network over IEC -61850 network. Same network to be used for integrating BESS SCADA. All the processors used for SCADA shall be of industrial grade server-based processor only.

DC Supply shall generally be used for control and protection system of switchgear. However, In case AC supply is considered for auxiliary control and protection supply for switchgear, then suitably rated UPS shall be used to meet the control supply requirement of switchgear panels.

7.1.9 Switchgear /Numerical Relay Networking:

The Contractor's scope of work shall include the following for all the 33KV and LV Switchgears under this package. The communication architecture and design criteria shall be finalised during detail engineering.

The Contractor's scope of work shall include complete design, engineering, supply, installation, testing and commissioning of the following:

- Communicable Numerical Relays (with IEC 61850) in all MV Switchgears & LV Switchgears.
- IEC 61850 Ethernet switches in Switchgear panels – Sufficient quantity of Ethernet switches as per requirement for all boards. At least 2 ports per switch shall be kept as spare ports.
- Cat5e Ethernet cable / FO cable for connection of Numerical Relays to Ethernet switches in all Switchgears.
- Optical Fibre Cable with fire-retardant outer sheath as required for the complete numerical relay network.
- Optical Fibre Cable termination equipment such as LIU, patch cord, etc. for the complete network.
- suitable arrangement for integration to BESS DCS/EMS.
- All other equipment required to meet the intended specification.
- Relay Test Equipment. 1 Nos.

For control/Aux supply to 33KV MV switchgear including breaker circuit, spring charging motor, numerical relays, Data Concentrator, SCADA, HMI, GPS clock, Energy meters etc 220V AC or 220 DC both are acceptable.

- For 220V DC, 2x100% redundant DC sources to be provided with sealed maintenance free batteries for at least 30 minutes back-up and SMPS based charger with input current harmonic less than 5%. The power output shall be distributed by 220V DCDB of suitable fault rating with 2 incomer and 1 bus coupler arrangement. Charger should have the facilities of online monitoring in SCADA.
- For 220V AC supply, Online UPS (2x100%) with remote monitoring having a battery backup of at least 30 min to be provided. The batteries for UPS System shall be Sealed Maintenance Free type. The power output shall be distributed by 220V AC UPS with 2 incomer and 1 bus coupler arrangement.

- Both UPS and DC system must have a margin of at least 20% of the connected load and designed accordingly. The system shall be designed for indoor mounting with ambient temperature of 50-degree C. The AC source for both Charger/UPS shall be wired to LT switchgear/ACDB which is under bidder's scope. All equipment's shall comply to relevant IEC/IS standards.

7.1.10 Cables

HT Power Cables:

HT power cables required for all feeders as indicated in typical key single line diagrams along with necessary termination, lugs and glands.

LT Power and Control Cables:

Supply of LT Power and Control cables required for all feeders along with interplant control and protection as indicated in typical key single line diagrams along with necessary termination, lugs and glands.

Cabling:

The scope of the contractor for all areas including building, equipment's etc. covered under this package: -

- Supply and installation of Laying of EHV, HT power, LT power and control cables.
- Supply and installation of Cable trays, fittings, and their accessories, along with support system
- Supply and installation of cable glands and lugs for all the cables in its scope of supply
- Supply, installation of Straight-through jointing kits for, HT XLPE power cable, LT power and control cables.
- Supply and installation of Cable termination kits for, HT XLPE power cables.
- Supply and installation of Welding receptacles.
- Supply and installation of Trefoil cable clamps.
- Supply and installation of Junction boxes.
- Supply and installation of Galvanized steel pipes/ HDPE/ Hume pipes/ PVC pipes
- Supply and installation of Miscellaneous items like M.S. sections etc. as required
- Complete cable erection includes supply and erection of all the accessories such as rigid/flexible conduits, fittings, junction boxes, tying materials, cable tags, and markers, support structures, cable trays, cable termination, junction boxes etc. shall be under the scope of contractor.
- Contractor shall furnish the cable schedule.
- Control interconnection charts/ diagram/equipment layout/layout for cables between Contractor's equipment's shall also be prepared by bidder
- Cable dressing for all cables laid by bidder along the complete length of the cable shall be under bidder's scope
- All cables upto 33kV Pooling switchgear shall be laid in cable trenches. Cables beyond 33kV pooling switchgear upto identified Pol including all EHV cables shall be finalized during detail engineering.

7.1.11 Earthing and Lightning Protection:

Below and above ground earthing mat/Grounding and lightning protection for the complete buildings, structures, foundations, and equipment's is in the Contractor's scope including development of layout drawing. Bidder's scope shall also include interconnection of Earth grid at various locations and with the Owner's main plant earth grid and below ground earth mat (along with earth pit) for the Tie transformer, PCS/Inverter Duty transformer, Auxiliary Transformers, Neutral Earthing, lightning arrestor, cable sealing end, bus post insulator, accessories etc. All

earthing pits shall be treated earth pits as per latest Indian Standard and IEEE guidelines. Earthing of Battery/PCS shall be as per OEM recommendation.

7.1.12 Illumination System

- Design and Supply of Station lighting system for the plant, buildings and equipment under Bidder's area.
- Lighting fixtures complete with lamps & accessories, LED lighting fixture complete with driver circuit & accessories, Lighting Panels, Receptacles, Switch boxes, Conduits. Lighting Wires, Ceiling fans or Wall mounted fans with regulators, lighting poles, Lighting masts, Earth wires and rods, Junction boxes, Battery operated automatic self-contained lighting fixture, Maintenance ladders as required.
- Scope shall also cover all interior and exterior lighting such as area lighting, street lighting, security lighting etc.
- LED type lighting fixtures shall be provided for Lighting Mast.
- Flame proof fluorescent fixtures shall be provided for hazardous areas.
- Normal lighting of the plant will operate with the normal AC supply. About 20% of these fixtures will also have arrangements for being fed from UPS/DC system on failure of the station AC supply. Self-contained rechargeable type fixtures shall be employed at important locations. Bidder shall provide indoor and outdoor emergency lighting at each inverter room, main control room, security room and main gate.
- Contractor shall prepare complete lighting layout drawings of all the areas covered under this contract. Mandatory spare parts and maintenance equipment as required

7.1.13 Fire Detection and Protection System:

- The Contractor shall design and install a fire protection system that conforms to national and local codes. The fire protection system design and associated alarms shall take into account that the BESS will be unattended at most times. For high energy density technologies, the Contractor shall also obtain thermal runaway characterization of the battery storage systems.
- As Battery Energy Storage System is prone to fire hazards, the contractor shall provide suitable means such as fire barrier between surrounding area and BESS to avoid fire spreading from BESS to surrounding area. The safety of the equipment / personnel related to BESS operations will be in the scope of the Contractor. Employer/Beneficiary will in no way be responsible for any loss/ damage due to any fire accidents.
- The Contractor shall share cell-level thermal runaway propagation testing from OEM. Also, integrate fire safety logic into SCADA/EMS enabling automated shutdown, isolation and suppression triggering. Fire Hydrant system with approval from Fire Force Department, Andhra Pradesh shall be installed in the BESS area.
- Fire detection & protection system for BESS including automatic NOVEC/AEROSOL fire protection system with cylinders, piping, fire/gas detectors, fire control panel, fire dampers, manual call points, abort & emergency release switches, cabling & integration with fire alarm panel provided in BESS control room along with trays, switches & racks. Fire protection system shall be provided as per IEC 62897/NFPA 72.A/NFPA 855 compliance as per proven & standard practice of industry/OEM meeting statutory/regulatory requirements in India/latest CEA regulations.
- Fire Detection & Protection System for BESS Control Room, Switchgear Room, etc. comprising of multi-sensor detectors, Manual Call Points, hooters, Fire Alarm panel, Cabling, portable fire extinguishers, etc. as detailed out in Technical Specification.
- Further, Nitrogen Injection Fire Prevention & Extinguishing System (NIFPES) shall be provided for all oil filled transformers/reactors of rating 10MVA/10MVR & above.

- The Contractor shall be responsible for implementing comprehensive fire protection and safety measures for the BESS installation/operation, in accordance with the provisions of the applicable in State/Central statutory rules/ regulations. Fire Hydrant System, including water supply and storage arrangements, shall be provided by the contractor for the BESS area as applicable and approval shall be obtained from the appropriate state/ central authority.

7.1.14 UPS and / or DC system:

- UPS system(s) and / or DC system of suitable rating shall be provided for the entire Battery Energy Storage System (BESS) plant for each location in the auxiliary/control room building. The UPS/DC shall be configured for full redundancy (2×100 %) to ensure that each unit can independently support the entire critical load in the event of failure of the other, enabling uninterrupted control power supply for critical systems of BESS, 33 kV Pooling switchgear, relays, and emergency lighting. UPS sizing including battery runtime, overload capacity etc. shall be finalized during detailed engineering based on actual critical loads, ambient conditions, and project requirements.
- UPS system shall comprise of 2 x 100% UPS with 30 minutes backup. 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 if the auxiliary power supply requirement of the loads is in DC. In case of DC system, Each Battery with charger system shall consist of 1 x 100% charger and 1 x 100% Battery bank for required back up, but 30 minutes minimum) and 1 x 100% DCDB, and other necessary protective devices and accessories. DC supply system voltage shall be 220V DC.

7.1.15 Interconnection from BESS To Pooling Substation

Scope of supply and services for interconnection from the 33 kV Pooling Switchgear to the Point of Interconnection (PoI) / Grid at Pooling substation is included in the scope of Contractor.

7.1.16 Metering

7.1.16.1 Meters

- 1) Contractor shall do supply & installation of meters (main, check & standby meters), meter testing, meter calibration & meter reading and all matters incidental thereto as per Central Electricity Authority (Installation and Operation of Meters) Regulations, 2014, the Grid Code or equivalent state regulations (as applicable)
- 2) Contractor shall bear all costs pertaining to installation, testing, calibration, maintenance, renewal and repair of meters at BESS side of Delivery Point for injection and drawl of power from the Grid during discharging and charging of BESS.
- 3) All relevant parameters of energy injected and drawn by the project shall be measured and continuously recorded by means of a main meter, check meter and standby meter as per the applicable CEA metering regulations and its amendments from time to time.
- 4) Power Quality Meter shall also be provided as per extant regulations.
- 5) All associated equipment such as CTs, PTs, communication equipment etc. as per requirement for meter installation.

7.1.16.2 Reporting of Metered data and Parameters

- 1) Online arrangement would have to be made by the contractor for submission of metering data regularly for the Operation & Maintenance period to the SLDC and DISCOMs as per applicable regulation / directions.

7.2 Technical and Regulatory Requirements

7.2.1 Codes and Standards

The BESS shall comply with the following Codes and Standards or equivalent Indian Standards, as applicable.

Standard/ Code (or equivalent Indian Standards)	Description	Certification Requirements
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 only for Lead Acid and NiCd/NiMH batteries
UL 1642 or UL 1973, Appendix E (cell) or IEC 62619 (cell) + IEC 63056 (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
UL 1973 (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 non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications	Either UL 1642 or UL 1973 or (IEC 62619 + IEC 63056) for the Battery level
IEC 62281 / UN38.3	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.
IEC 61850/ DNP3	Communications networks and management systems. (BESS control system communication)	

Standard/ Code (or equivalent Indian Standards)	Description	Certification Requirements
UL 9540 or (IEC TS 62933-5-1 + IEC 62933-5-2)	Electrical energy storage (EES) systems - Part 51: 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 62933-2-1	Electrical energy storage (EES) systems - Part 21: Unit Parameters and testing methods - General Specification	Tests for Class B applications: <ol style="list-style-type: none"> 1. Duty Cycle Round Trip Efficiency Test 2. Equipment and Basic Function Test 3. Available energy Test 4. Insulation test
Power Conditioning Unit Standards for BESS		
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 1 000 V AC or 1 500 V DC up to 36 kV AC or 54 kV DC	
IEC 61000-6-2 Ed. 2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments	
IEC 61000-6-4 Ed. 2.1	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	
IEC 62116 Ed. 2	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures	
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	
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)	

The Battery Energy Storage System:

- a) shall follow the relevant CEA/CEIG Standards and CERC/SERC Regulations
- b) Before grid integration, Contractor/OEMs shall furnish standard PSS/E or IEEE dynamic models of the proposed system for evaluation of its dynamic performance. This evaluation will enable proper validation of system stability under different operating conditions, as per the provisions of CERC (IEGC) Regulations, 2023, Clause 40.
- c) shall be responsible for complying with the “First Time Energization” procedure available at Grid India website as per the IEGC Regulations 2023 (If applicable).
- d) Comply with the grid-interfacing requirements as mentioned in following standards:
 - i. IEEE Std. 2800 -2022: IEEE Standard for Interconnection and Interoperability of Inverter -Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems
 - ii. IEC TS 62786-1: Distributed energy resources connection with the grid – Part 1: General requirements
 - iii. IEC TS 62786-3: Distributed energy Resources connection with the grid: Part 3, Additional requirements for stationary battery energy storage systems.
 - iv. Further, CEA Technical Standards for Connectivity to the Grid, Regulations 2007, Part-1 (General), Standards and Codes for Practice, mentions the following:

“The equipment including overhead lines and cables shall comply with the relevant Indian Standards, British Standard (BS), or International Electro technical Commission (IEC) Standard, or American National Standards Institute (ANSI) or any other equivalent International Standard:

Provided that whenever an International Standard or International Electro technical Commission Standard is followed, necessary corrections or modifications shall be made for nominal system frequency, nominal system voltage, ambient temperature, humidity and other conditions prevailing in India before actual adoption of the said Standard.

- e) The effects of wind, storms, floods, lightening, elevation, temperature extremes, icing, contamination, pollution and earthquakes must be considered in the design and operation of the connected facilities.”
- f) The BESS, therefore, shall be designed keeping in view the ambient temperature and weather conditions prevailing at site i.e. The BESS shall be able to deliver rated performance at the extreme temperature and weather conditions at site where it is deployed. In this regard, the procedure notified by CEA on 8th April 2024 for assessment of the “Design Temperature for RE Plants in compliance to CEA (Technical Standards for Connectivity to the Grid) Regulations” shall be followed. Same is available at: <https://cea.nic.in/whatsnew/?lang=en>

7.3 System Testing and Commissioning

The BESS shall be commissioned as per commissioning criteria and procedures specified by the CEA.

7.4 Identification and Traceability

Cells/Racks/Packs Assembly/Container shall meet seismic requirements for the plant location of the BESS. Labelling of cells/batteries shall include manufacturer’s name, cell type, name-

plate rating, date of manufacture and date of expiry of parts and labour warranty. Contractor shall The contractor shall not use any refurbished cell(s)/batteries in the project.

7.5 Other Sub-systems/Components

Other subsystems/components used in the BESS must also conform to the relevant international/national Standards for Electrical Safety for ensuring Expected Service Life and Weather Resistance.

7.6 Authorized Test Centers

Batteries/ Power Conditioning Units deployed in the power plants must have valid test certificates for their qualification as per above specified IEC/ BIS Standards 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.

7.7 Warranty

Contractor shall procure performance guarantees from the OEM to ensure minimum performance levels for predefined application(s) as per the terms of the contract document. OEM shall provide warranty for performance parameters of minimum dispatchable capacity and RTE to Contractor. The Warranty shall clearly indicate life expectancy given discharge profiles provided for the application. Contractor is responsible for Availability and in case of any product damage.

7.8 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/Beneficiary/APSLDC online and/or through a report on regular basis every month for the entire duration of contract.
- b) The Contractor shall provide access to the Employer/APTRANSCO/DISCOMs/MNRE or their authorized representatives for installing any additional monitoring equipment to facilitate on-line transfer of data.
- c) All data shall be made available as mentioned above for the entire duration of the Contract.
- d) 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 the Andhra Pradesh SLDC/ APTRANSCO / 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.
- e) Web-based monitoring should be made available at Andhra Pradesh SLDC at Vijayawada and Employer Control Room, 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.

7.9 Forecasting, Scheduling and Deviation Settlement

As part of the Forecasting, Scheduling and Deviation Settlement the following shall be carried out:

- a) Scheduling of Charging and Discharging of the system will be under the scope of SLDC/DISCOMs. Employer/State DISCOMs will provide required power for charging BESS considering minimum 'system efficiency' under the contract document.
- b) The contractor shall comply with all the applicable CERC/APERC Regulations including on Forecasting, Scheduling and Deviation Settlement as applicable from time to time.
- c) The scheduling of the power to/from the project as per the applicable Regulations shall be decided by DISCOMs/SLDC. However, any Deviation Settlement Mechanism (DSM) penalties due to violation of the schedule of charging or discharging of the BESS at BESS end shall be to the account of the Employer.
- d) In order to remove potential discrepancies and ambiguities, the Contractor are hereby instructed that, as part of scheduling of power to/from the Project, they will be required to punch-in their respective schedules and subsequent revisions

7.10 Operational window

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

- a) Maximum BESS recovery time as specified in this document
- b) Grid Outages (duly certified to this effect by the Grid Operator)
- c) Planned Maintenance Outage duly informed by the Contractor to the Employer/SLDC / DISCOMs with at least one month's prior notice, subject to total no. of planned outage period being not more than 34 hours in a two-month period.

NOTE: Tentative scheduled annual maintenance plan of BESS shall be submitted as per OEM advice before Commissioning Date for the contractual period. Contractor will have to comply with the Charging and Discharging Schedule as intimated by Employer/SLDC/ DISCOMs. Charging or discharging can be scheduled by Employer/SLDC/DISCOMs in one or more sessions depending on SLDC/DISCOMs requirements. SLDC/DISCOMs shall provide tentative day-ahead schedules, however, real time charging and discharging instructions, if required, will be given. This notice shall consider any cooling time required between charging and discharging as specified in the document.

7.11 Other necessary Criteria/Requirements

- i. Central Electricity Authority, Technical Standards for Connectivity to the Grid, (Amendment) Regulations, 2013 and 2019 mention connectivity standards applicable to the wind generating stations, generating stations using inverters, wind - solar photo voltaic hybrid systems and energy storage systems. BESS, being an inverter-based power system element, shall also comply to the requirements specified for other generating stations using inverters.

1. Some of the requirements are indicated below and following shall be added separately in the “Technical and Regulatory Requirements to be followed by Battery Energy Storage System”:
 - a) BESS shall be capable of operating in the frequency range 47.5 to 52 Hz and be able to deliver rated output both in charging and discharging mode in the frequency range of 49.5 Hz to 50.5 Hz.
 - b) **Low/High Voltage Ride Through (LVRT/HVRT)** - BESS shall be capable 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 generation sources (inverter based) may be referred as available in CEA (Technical Standards for Connectivity to the Grid) Regulations shall be applicable to BESS.
 - c) **Dynamic Reactive Power Support / Voltage Control** - BESS shall have the feature to detect and regulate the voltage of interconnection point as per the specified capability i.e. The BESS shall be capable of supplying dynamically varying reactive power support at least up to the limits specified for wind/solar generation sources (inverter based) in the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations. The response time of the BESS shall not exceed the value specified in relevant standards or grid codes.
 - d) **Primary Frequency Control** – The BESS shall have provisions for Primary Frequency Control with a droop which can be set as per system requirement between the range specified for wind/solar generation sources (inverter-based) in the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations.
 - e) BESS shall be capable to receive active power/reactive power set point from load dispatch centers i.e. SLDC/RLDC.
 - f) The BESS shall have the black start and intentional island control capability to extend start-up of a blackout system or to operate independently after formation of an island.
 - g) BESS is required to have the following basic functions:
 1. Monitoring: Monitor operational parameters, equipment status and communication status, alarm and faults of main equipment and BESS system, etc.
 2. Information exchange: Receive and process information with SLDC/RLDC/NLDC including operation parameters, switching information, various alarms and alerts, protective action signals, control information, etc.
 3. Control: Including control mode and parameter setting sharing with SLDC/RLDC/NLDC
 4. 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 SLDC.
 5. BESS shall be able to operate in Automatic Generation Control (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):

- (i) Maximum MW permissible (dynamic or user entry)
 - (ii) Minimum MW permissible (dynamic or user entry)
 - (iii) Ramp rate up permissible (dynamic or user entry)
 - (iv) Ramp rate down permissible (dynamic or user entry)
 - (v) Actual MW
 - (vi) Actual MVAR
 - (vii) Auxiliary Consumption MW
 - (viii) Scheduled MW (dynamic or user entry)
 - (ix) BESS Temperature (for monitoring and correlation)
 - (x) Ambient Temperature (for monitoring and correlation)
 - (xi) Cycle limits (0-100%) per day (user entry)
 - (xii) Circuit breaker status
 - (xiii) Local/Remote status
 - (xiv) AGC Set Point MW from NLDC to BESS
 - (xv) Voltage (kV) at grid level
 - (xvi) Voltage (V) at BESS LV side
6. 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 SLDC/RLDC/NLDC.
7. The design of monitor & control mode shall be finalized during the engineering stage. Suitable and accurate dynamic models in PSS/E and EMT models for simulation in PSCAD, shall be provided to assess reliably the impact of the proposed BESS on the dynamic performance and security and stability of the power system. The required dynamic models and EMT models must operate under RMS and EMT simulation respectively to replicate the performance of the BESS facility. EMT models shall include all parameters required for EMT simulations such as positive, negative and zero sequence impedances for all elements, magnetizing curves, losses and tap changer data for transformers as well as positions of surge arresters and their V/I characteristics. EMT models shall also include all protection and control functions of the plant.
8. In addition to the above, the Project Capacity shall also respond to secondary and Tertiary control signals from the Nodal Agency for providing SRAS-UP, TRAS-UP and SRAS-Down, TRAS-UP services as defined under the Central Electricity Regulatory Commission (Ancillary Services) Regulations, 2021. The performance monitoring and incentives, if any for the SRAS/TRAS shall be in accordance with the extant Regulations for Ancillary Services.
9. BESS will ensure the compliance of requirements mentioned in procedure of First Time Charging (FTC) as applicable for other power system elements. The consolidated FTC procedure including the requirements for BESS is available in public domain at

7.12 Safe Disposal of unit Batteries from the BESS

The Contractor will comply with the requirements under Hazardous & other Waste (Management and Trans boundary Movement) Rules, 2016, as amended from time to time, as applicable. The Contractor shall ensure that all Unit Battery modules from the plant after their ‘end of life’ (when they become defective/ non-operational/ non-repairable) are disposed in accordance with the “e-waste (Management and Handling) Rules, 2016” notified by the Government and as revised and amended from time to time and Battery Waste Management Rules, as and when notified by the Government of India.

After the expiry/termination of the contract, the entire land area allocated to the contractor shall be returned to Employer in the same condition as it was allocated within 180 days of expiry/termination of the Contract. If the Contractor does not vacate the allocated land area and/or does not uninstall the entire Project equipment from the designated land area upon expiry/termination of the Contract, Employer shall charge the applicable market price/circle rate for the respective land parcels, as fixed by the concerned Revenue Authorities of the Government, as part of penalty on the Contractor till they hand over the land in same condition as it was allocated. Furthermore, Employer shall have the right of first refusal with respect to the infrastructure developed by Contractor at project location.

7.13 Battery Management System

The project shall comply with a battery management system, which regulates and monitors the operation of a battery during charge and discharge. In addition, it shall be responsible for connecting with other electronic units and exchanging the necessary data about battery parameters. The voltage, capacity, temperature, power consumption, state of charge and health, charging cycle, and other characteristics of the battery are controlled and monitored by the battery management system.

7.14 Auxiliary System

Employer shall draw power from interconnection point/separate feeder for the Auxiliary Power load of BESS. For this purpose, separate meter would be arranged by Contractor to measure Auxiliary consumption and that would be billed by DISCOMs as per prevailing tariff; applicable electricity bill shall be paid by Employer to DISCOM during O&M period. However, during construction phase, the Contractor shall make their own arrangements or may avail power supply from DISCOMs on chargeable basis as per applicable rules/procedure. Contractor shall provide necessary transformer, HT Cable and other associated switchgear equipment required for utilizing this supply for BESS. Contractor shall design & construct facilities for auxiliary supply with N-1 level contingency at 33 kV transformer for full load with provision of dual power supply for PCS transformer, battery container, PCS, lighting transformer etc. for ensuring reliability, availability, redundancy and continuous performance of BESS as required in this specification. 2 Nos. of auxiliary power feeder at LT level shall also be sourced from BESS AC Distribution Board. Auxiliary supply arrangement shall be finalized during detailed engineering as per the contractor’s design.

7.14.1 Liquidated Damages (LD) Calculation w.r.t. Excess Auxiliary Consumption

The actual Auxiliary Consumption of BESS during Charging/Discharging operation and idle state shall be measured during performance guarantee stage (trial run), and if the actual consumption is found to be more than that allowed consumption then the applicable LD amount (one time) shall be calculated with following formula:

1. LD for higher Auxiliary consumption (in ₹) during charging/discharging = {Actual Loss (in kW) – 1.8% of BESS Power Capacity (in kW)} x INR 2,01,279/-
2. LD for higher Auxiliary consumption (in ₹) during idle state = {Actual Loss (in kW) – 0.2% of BESS Power Capacity (kW)} x INR 3,53,599/-

7.15 Quality Assurance & Testing

Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT) of the BESS shall be as per relevant parts of IEC 62933 or similar IEC/IS standards. The procedure for FAT & SAT shall be finalized during detailed engineering.

7.15.1 Third Party Verification

The Contractor shall be further required to provide entry to the site of the Project free of all encumbrances at all times during the construction as well as during operation & maintenance period to APTRANSCO/ DISCOMs /SLDC /CEA /MoP /MNRE (or its authorized representatives) and a third Party nominated by any Indian Governmental Instrumentality for inspection and verification of the works being carried out by the contractor at the site of the Project.

The contractor shall provide full support to APTRANSCO/ DISCOMs/ SLDC/ CEA/ MoP/ MNRE and/ or their third party designated by in this regard. APTRANSCO / DISCOMs / SLDC /CEA /MoP/MNRE and/or their designated third party may verify the construction works/operation of the Project being carried out by the contractor and if it is found that the construction works/operation of the Project is not as per the Prudent Utility Practices, POWERGRID may seek clarifications from contractor or require the works to be stopped or to comply with the instructions of such third party.

7.16 Commissioning

The Commissioning of the Project shall be carried out by the contractor in line with the procedure finalize during design & engineering. The Contractor shall commission the Project in line with provisions of the APERC (Andhra Pradesh Electricity Grid Code) Regulations, 2014/CERC (Indian Electricity Grid Code) Regulations, 2023/ CEA regulations, as amended from time to time. In line with this regulation, the contractor proposing the Project, or its part, for commissioning, shall give to Employer/SLDC/APTRANSCO, at least sixty (60) days' advanced preliminary written notice and at least thirty (30) days' advanced final written notice of the date on which it intends to synchronize the project to the grid system.

Availability of data communication from EMS/SCADA till RLDC is to be ensured by Contractor before commissioning.

Employer shall authorize any individual or committee or organization to witness construction/development of the Storage project and validate the commissioning procedure on site. The contractor shall obtain necessary safety clearances from the Central Electricity Authority/CEIG/STU/State Utility prior to commissioning of the Project. Prior to commissioning of the Project, contractor shall submit the following documents:

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1. Intimation regarding the timeline for CoD of the Project.
2. Approval of Metering arrangement/scheme from STU/CTU/GRID INDIA/ any other concerned authority as applicable
3. CEI/CEIG (as applicable) report containing approval for all the components, including modules, inverters, transformers and protection system, along with all annexures/attachments. It would be the responsibility of the Contractor to obtain the certificate.
4. Documents to establish the compliance of technical requirement as per TS
5. Any other document as deemed necessary by Employer for the purpose of commissioning.

7.16.1 Part-commissioning of the Project

Part commissioning of the project without imposition of any liquidated damages, on part which is not commissioned, shall be accepted by Employer subject to the condition that the minimum part commissioning capacity for the 1st part will be 50% of MWh capacity at the project. The total number of instalments in which a Project can be commissioned will not be more than 3, i.e., 1st initial instalment of 50% of MWh capacity at the project and 2 subsequent instalments.

However, the Schedule Date of Commissioning will not get altered due to part commissioning, Irrespective of dates of part commissioning or full commissioning.

7.16.2 Synchronization & 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, Contractor should successfully demonstrate all the control function of Power Plant Controller (PPC)/EMS/SCADA of BESS. 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, Capacity (MWh), Power Rating, Auxiliary Power Consumption etc. values shall be calculated and shall be checked with declared values by Contractor for validity/acceptance.

At least 30 days prior to trial run of the Project, the contractor shall submit requisite documents as per APERC's latest Grid Connectivity and Intra-state Open Access Regulations and amendments thereto,

- I. Intimation regarding the timeline for commencement of supply of power from the Project.
- II. Copy of Connectivity Details Installation report duly signed by the POWERGRID.
- III. The BESSD is advised to take due care in furnishing such Installation Report.
- IV. CEI/CEIG/State Electrical Inspectorate (as applicable) report containing approval for all the components, including Batteries, inverters, transformers, transmission system and protection system, along with all annexures/attachments. It would be the responsibility of the contractor to obtain the certificate.
- V. Approval of metering arrangement/scheme from DISCOMs/APTRANSCO or any other concerned authority as applicable.

- VI. Plant Layout, Plant (AC & DC) SLD.
- VII. Affidavit certifying that the Contractor has obtained all the necessary approvals for commencement of power supply from the Project, and indemnifying POWERGRID, APTRANSCO and DISCOMs against any discrepancies in the above details.
- VIII. Documents to establish the compliance of technical and regulatory requirement as per technical specifications.
- IX. Invoices against purchase of the Batteries, Inverters/PCUs, SCADA, EMS and BMS along with the summary sheet containing the list of all the invoices, inverters including details and number of items. Lorry Receipts for delivery of Project components at site along with certified summary sheet by the authorized signatory.

After successful completion of trial run and acceptance by Employer, 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 Indian Electricity Grid Code-2023, SLDC/RLDC, MNRE, CEA, STU/CTU requirements.

7.16.3 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.

7.17 Transportation and Storage at Site

The Contractor shall be responsible to survey, select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. The dimension of the equipment shall be such that when packed for transportation, it will comply with the requirements of loading and clearance restrictions for the selected route. It shall be the responsibility of the contractor to coordinate the arrangement for transportation of the BESS for all the stages from the manufacturer’s work to site.

The Contractor shall dispatch the battery system in such way to avoid any accident either due to road conditions, environmental conditions and any other conditions which may be arise during transportation.

Contractor shall follow all the rules, regulations and guidelines applicable for transportation of batteries in India as well as in country of origin. Contractor shall be responsible for proper handling and storage of these materials from the time of receipt upto the time of Taking Over of the Facilities by the Employer.

7.18 Operation & Maintenance

The contractor shall carryout Operation and comprehensive maintenance of complete BESS part under its scope from date of commissioning of full project capacity. Operation & Maintenance shall start from date of full commissioning. Additionally, bidder to refer commercial portion of bidding document for details regarding O&M of part capacity commissioned. During O&M period, Employer personnel / Employer’s authorize representative shall have unrestricted entry to the BESS plant

and Control Room any time. Employer 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 Employer on demand. These records are to be handed over to Employer after the O&M period of contract.

The Contractor 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 Comprehensive 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 contractor in the O&M manual to be submitted to Employer for approval.

- Ensuring successful operation of BESS Plant for optimum Charging/discharging operation/duty/Availability.
- Charging/Discharging & Operation of the system as per the requirement of SLDC/DISCOM/Employer of the system
- 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 thereto 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.
- Deployment of Plant in Charge, adequate number of technical support staff and other supporting personnel during the O&M period
- Contractor 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/Central govt regulations/circulars.
- At the time handing over of the plant by the contractor to Employer, the contractor shall handover equipment and spares in healthy condition.
- Contractor must take Comprehensive Annual Maintenance Contract (AMC) from Original Equipment Manufacturer (OEM) **or OEM authorized service provider** for the following components:
 - Battery and BMS System
 - PCS System
 - EMS/SCADA
 - Any other equipment as deemed necessary
- 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 contractor'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.

7.19 Other Requirements

The contractor shall be fully responsible for:

- a. Ensuring that the BESS is integrated with the existing power system network to have trouble-free operation of complete A.C. network.
- b. Ensuring strength of all parts, material and equipment to withstand all stresses including electrical, mechanical, seismic and other forces which may be normally experienced or expected during long term station operations as well as those stresses caused by faults, switching operations and abnormal A.C system conditions.

- c. Ensuring correct application, satisfactory and proper performance of all material, equipment, structures, systems and auxiliary station services under all specified operating conditions without signs of undue strain and without breakdown, damage or deterioration of any of the equipment due to faulty or unsuitable material, equipment, workmanship, design, erection, construction, installation, and commissioning.
- d. Transportation of all temporary and permanent materials, equipment and apparatus from the places of manufacture to the Site.
- e. Supply of complete documentation including drawings, simulation models, study reports, operating and maintenance procedures and manuals for all works.

8.0 QUALIFYING REQUIREMENT OF SUB-CONTRACTOR OR SUPPLIER

a. Battery Manufacturer for BESS Battery System (Qualifying Requirement for bidder qualifying through Route 1)

The battery manufacturer must have manufactured and supplied at least 50 MWh of batteries (of the technology which has been offered in the bid) cumulatively during last three (3) years in stationary grid applications as on issuance of NoA.

b. System Integrator (Qualifying Requirement for bidder qualifying through Route 1 (ii) or (iii) or Route 2)

The System Integrator must have installed/supervised installation, commissioned/supervised commissioning of grid interactive BESS for at least a single BESS of 1 MWh capacity.

c. Energy Management System (Qualifying Requirement for bidder qualifying through Route 1 (i/ii/iii) or Route 2)

The Application Software of the Energy Management System (EMS) of the BESS shall be developed indigenously within India. (as per F.No. 48-15/7/2025-NRE Section; dtd. 04th August 2025, Amendment in Operational Guidelines for viability Gap Funding Scheme for development of Battery Energy Storage System supported through Power System Development Fund (PSDF)-reg.)

9.0 Statutory Compliance, Grid Connectivity And Power Evacuation

The Contractor shall be responsible for facilitating statutory compliance for their part when applying for overall compliance upto Point of Interconnection (POI). Contractor shall comply all provisions and it's amendment(s)/Clarification(s) thereof of the following:

- a. Central Electricity Regulatory Commission (Connectivity and General Network Access to the inter-State Transmission System) Regulations, 2022.
- b. 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".
- c. 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).

- d. 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).
- e. CEA (Technical Standards for Connectivity to Grid) Regulation,2007.
- f. CEA (Technical Standards for construction of Electrical Plants and Electrical Lines) Regulation,2010.
- g. CEA (Grid Standard) Regulation,2010.
- h. CEA (safety requirements for construction, operation and maintenance of Electrical Plants and Electrical Lines) Regulations,2011.
- i. CEA (Measures relating to Safety and Electrical Supply) Regulations,2010.
- j. CEA (Installation and Operation of Meters) Regulations 2006.
- k. Indian Electricity Grid Code Regulation,2023.
- l. CEA (Technical standards for communication system in Power system operations) Regulation 2020
- m. CERC (Communication System for Inter State Transmission of Electricity) Regulations 2017
- n. 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.
- o. CEA (Cyber Security in Power Sector) Guidelines, 2021.
- p. 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.
- q. MNRE/CEA/MOP guidelines/OM/Advisory/Clarifications.
- r. And any other applicable standards/regulations/Guidelines /clarifications /Oms /Advisories.
- s. Indian Electricity Grid Code (IEGC) 2023.
- t. Any other specific guidelines/Regulation/Advisory issued for BESS.
- u. Contractor have to submit all the technical data/information/undertaking as required in Formats of Technical Data for Connectivity Agreement (Attached as Annexure-IV)

Contractor shall facilitate Employer by arranging required documents for submission of connectivity application (connectivity applications shall be submitted by Employer) as per CERC/SERC guidelines. Employer shall bear the statutory charges to be paid for connectivity application (if applicable).

10.0 GRID COMPLIANCE REQUIREMENTS

- i) 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/EMS shall directly and independently be able to control/communicate the individual PCS (dual or multi master) at IEC 60870-5-104 and redundant Power Quality Meters (IEC 61000-4-30 class A) at suitable location/final outgoing portion of plant/As per the directions of RLDC/SLDC. It shall also be able for two way communication with RLDC/SLDC on IEC 60870-5-104 protocol for its various mode of control. Bidder shall install the PQM at ISTS end/As per

the directions of SLDC/employer and integrate with PPC at BESS end. PPC healthiness shall be monitored by SCADA.

- ii) 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/SLDC 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 by Bidder.
- iii) Bidder shall submit preliminary CEA grid compliance study as per timeline mentioned for CON4 submission to CTU/RLDC/SLDC 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/EMS shall be ensured by Bidder during selection of respective Manufacturer.
- iv) 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 are in Bidder scope, and Bidder shall provide IBR model of inverter.

- i) Dynamic model as per the connectivity
- ii) Updated dynamic model at least three months ahead of the proposed date of first-time charging.
- iii) Following Reports also to be included along with the dynamic model:
 - a. 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.
 - b. Simulation Report of plant model confirming CEA compliance for Dynamic reactive support /LVRT/ HVRT/Frequency control.
 - c. Simulation Report of Reactive Capability Curve of Plant measured at POI to /Intra State / 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.
- iv) Harmonic study (Voltage and current harmonics) flicker study at Inverter level, Pooling Switchgear Level and POI. Impedance vs Frequency plot of the plant.

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- v) The Bidder shall ensure that all queries pertaining to the submitted reports and models are satisfactorily resolved in accordance with the expectations of the concerned authorities.
- vi) Bidder should submit Dynamic model of Grid studies including IBR (Inverter Based Resources) for approval of POWERGRID prior to submission to RLDC/SLDC. Bidder shall submit above documents within 3 months from LoA. However, the final requirement or any other requirement shall be as per RLDC/SLDC. The simulation study has to be carried out as per POI data (like SCR, X/R etc.) by bidder based on data shared by POWERGRID/RLDC/SLDC/CTU.
- vii) 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.
- viii) 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/SLDC/POWERGRID 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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