



Tender for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and Maintenance of 45.6 MW ISTS Connected Wind Power Project at Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Packge-2: Wind)

SECTION – VII

TABLE OF CONTENTS

Sub Section – A	Scope of Works
Sub Section – B	Technical Specifications – Electrical & Civil
Sub Section – C	General Annexures (GA)
GA – A	Estimated Annual Energy Production
GA – B	Guaranteed Power Curve of the Offered WTG
GA – C	Equipment Inspection Category
GA – D	Mandatory Spares
GA – E	Plant Commissioning and Test Procedure
GA – F	FQP and MQP for Civil Works
GA – G	Quality Assurance & Inspection of Civil Works
Sub Section – D	Specific Annexures (SA)
SA – A	Indicative SLD - Plant Pooling Substation
SA – B	Land Layout (With Micrositing & Other Details)
Sub Section – E	Operation and Maintenance Agreement

DISCLAIMER:

1. Though adequate care has been taken while preparing the Bidding Documents, the Bidders/Applicants shall independently satisfy themselves regarding the completeness, correctness, and adequacy of the contents of the Tender Documents and the Scope of Work. Any ambiguity, discrepancy, inconsistency, or omission noticed by the Bidder shall be brought to the notice of the Employer in writing within the stipulated pre-bid clarification period. If no intimation is received from any Bidder within twenty (20) days from the date of notification of NIT/ Issue of the NIT documents, it shall be considered that the NIT documents are complete in all respects has been received by the Bidder.
2. Solar Energy Corporation of India Limited (SECI), hereinafter referred to as the Employer, reserves the right to amend, modify, supplement, delete, or revise any part of the Bidding Documents, including but not limited to technical specifications, drawings, formats, annexures, scope boundaries, and contractual provisions, at any stage prior to the submission of bids. Such amendments/modifications shall form an integral part of the Tender Documents.
3. While this bidding documents have been prepared in good faith, neither Employer or its authorized representatives nor their employees or advisors make any representation or warranty, express or implied, or accept any responsibility or liability, whatsoever, in respect of any statements or omissions herein, or the accuracy, completeness or reliability of information, and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of this bidding documents, even if any loss or damage is caused by any act or omission on their part.
4. The technical specifications, drawings, layouts, equipment details, ratings, quantities, and system configurations indicated in the present Bidding Documents are indicative and intended to define the minimum functional and performance requirements of the Wind Package. The same may require modification, optimization, augmentation, or detailed engineering refinement by the successful Bidder in accordance with Applicable Indian and International Standards, CEA Regulations, Grid Code requirements, OEM recommendations, Good Utility Practices, Site conditions, Micrositing constraints, and Project performance guarantees.
5. The successful Bidder shall be solely responsible for the complete design, engineering, manufacturing, supply, transportation, erection, testing, commissioning, integration, and comprehensive O&M of the Wind Package including all associated systems and auxiliaries



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- necessary for safe, reliable, and continuous operation of the Wind Power Project, irrespective of whether such items are specifically mentioned in the Tender Documents or not.
6. The Bidder shall carefully examine the site conditions, access roads, transportation constraints, topography, soil conditions, wind conditions, meteorological parameters, grid interfacing requirements, and all other relevant factors before submission of the Bid. Any claim arising subsequently due to lack of such assessment shall not be entertained by the Employer.
 7. Any equipment, material, component, accessory, software, firmware, interface device, communication system, protection system, hardware, civil works item, structural component, or service not specifically mentioned but required for successful completion, grid synchronization, statutory compliance, SCADA integration, performance demonstration, reliability, maintainability, and guaranteed operation of the Wind Power Project shall be deemed to be included within the scope of the Bidder without any additional cost implication to the Employer.
 8. The Bidder shall ensure compatibility and seamless integration of this Wind Package with the Solar + BESS Package {Package-1: Solar (70MW-AC) + BESS (25MW/50MWh)}, Pooling Substation systems, Plant SCADA/CMCS, PPC, EMS, and associated communication infrastructure as defined in the Responsibility Matrix and Scope of Work.
 9. Approval or review of drawings, calculations, documents, procedures, reports, or engineering submissions by the Employer shall not relieve the Contractor of its contractual obligations, design responsibility, performance guarantees, statutory compliances, safety obligations, or warranty liabilities under the Contract.

Place:

Date:

(Signature)

Name and Designation of bidder

SECTION - VII

SUB-SECTION A

Scope of Works



TABLE OF CONTENTS

1	Background	3
2	Project Particulars	3
3	Brief Scope of Work	5
4	Responsibility Matrix	7
5	Design & Engineering	11
6	Micrositing	14
7	Installation, Testing and Commissioning	14
8	Quality Spares & Consumables	19
9	Tools and Tackles	19

1 Background

Solar Energy Corporation of India Limited (SECI) is the foremost Navratna CPSU dedicated to the growth and development of Renewable Energy (RE) capacity in India. To realize India's ambitious RE targets, the Government of India designated SECI as a nodal agency to enable meeting the growing energy demand through RE and reducing the dependence on fossil fuels.

SECI has been spearheading innovation in the RE sector since its inception through various innovative business models that could potentially serve to invigorate the RE sector in the country. SECI is developing a 50 MW Firm and Dispatchable Renewable Energy (FDRE) Project at Ramagiri and Muthukavuntla in Andhra Pradesh for supply of power to the Buying Entity under an already executed Power Purchase Agreement (PPA). The 50 MW Renewable Energy Hybrid Project (on FDRE basis) has been divided into two packages, which shall be awarded through separate tenders. The overall project configuration comprises:

Package-1: 70 MW (AC) / 91 MW (DC) Solar PV Power Project paired with a 25 MW / 50 MWh Battery Energy Storage System (BESS); and

Package-2: 45.6 MW (AC) Wind Power Project (to be awarded under this tender)

Under the present tender, 45.6 MW (+5%) Wind section as defined herein, will be awarded to a Single successful bidder, based on award criteria separately specified elsewhere in the bidding documents.

2 Project Particulars

Particulars	Description
Name of Package	Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and Maintenance of 45.6 MW Grid Connected Wind Power Project at Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Package-2:Wind)
Design and Engineering	
FDRE Project AC Capacity	The 50 MW FDRE Project consists of two packages: (i) Package-1: 70 MW Solar PV Power Plant coupled with 25 MW/50 MWh BESS (to be awarded through a separate tender), and (ii) Package-2: 45.6 MW Wind Power Plant (covered under this tender)
Cumulative WTG Capacity	45.6 MW (+5%)



Tender for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and Maintenance of 45.6 MW ISTS Connected Wind Power Project at Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Packge-2: Wind)

WTG Type	Low voltage, 50 Hz, upwind / downwind, horizontal axis Wind Turbine Generators (WTGs) with minimum rating of 3 MW
Design life of power plant	25 Years
Maintenance Contract period	10 Years
Site Location and Micro-siting Details	
Location	Ramagiri
District	Sri Sathya Sai
State/UT	Andhra Pradesh
Latitude & Longitude	14°19'42.20"N, 77°30'41.62"E
Altitude	535 m
Available Land Area	16 Land Patch (Details as Indicated in SA-C: Land Layout)
Type of Land	Government Land allotted to SECI under Right to Use Agreement
Project Ownership	Solar Energy Corporation of India Limited
Access, Storage & Approach Road	
Nearest Urban Area	Ramagiri
Nearest Highway	Nagasamudram Perur Road (adjacent to location)
Nearest Railway Station	Dharmavaram Junction Railway Station
Nearest Airport	Kempegowda International Airport, Bengaluru
Storage	To be arranged by Contractor, however land will be provided by SECI. (Details as Indicated in SA-B: Land Layout)
Approach Road	Ramagiri-Thallimadugu Feeder Road
Power Evacuation	
Plant End Substation Power Transformer Capacity	60 MVA
Plant End Substation Switching Scheme (220 kV)	Double Bus & Transfer Scheme
Point of Interconnection	33kV Pooling Switchgear Incomer Feeder (There will be three nos. of dedicated feeders for Evacuation) Refer SA-A: Indicative SLD
ROW of the 33kV Reticulation System	ROW is in the scope of SECI Refer SA-B: Land Layout
Metering Point	TVM Meter at the dedicated Incomers of the 33 kV Pooling Switchgear located at the Pooling Sub-Station
Design Parameters	
Measured Average Wind Speed	6.31 m/s (100 m) & 6.09 m/s (80 m)
Wind Site Class (IEC 61400-1)	Class-B
Air Density	1.225 kg/m ³
Icing Condition	None

Design Ambient Temperature	50°C (For all the equipment except WTGs)
Normal Temperature Condition for WTGs	-10°C to +40°C (As per IEC 61400-1)
Extreme Temperature Condition for WTGs	-20°C to +50°C (As per IEC 61400-1)
De-Rated Capacity of WTG to be Considered at Temperature	+40°C (As per CEA)
Seismic Zone (IS 1893-1)	Zone II
Corrosion Class	C3
Functional Guarantee	
Machine Availability	1. 98% during high wind season i.e. 1st May to 31st October 2. 96% during low wind season i.e. 1st November to 30th April

3 Brief Scope of Work

The Scope of Supply covered under this specification shall be but not limited to the following:

- 3.1 Design, engineering, manufacture, in house testing and supply at site of suitable low voltage, 50 Hz, upwind / downwind, horizontal axis Wind Turbine Generators (WTGs) with minimum rating of 3 MW and total capacity 45.6 (+ 5%) MW complete with accessories as may be required for erection, commissioning and successful continuous operation. The WTGs shall be equipped with current limiting devices and capacitors (in case of induction generators) so as to maintain power factor as applicable, to ensure compliance with Grid Code and utility requirements. WTGs shall have the LVRT and HVRT capability including all other functional capabilities as per the requirement under the CEA Regulations for Grid connectivity requirements, as amended from time to time.
- 3.2 Design, engineering, manufacture and supply at site of Towers (including all internals e.g. - fall arrest systems, service lifts, internal cabling, ladders, platforms, and wire ropes), Blades, Hub, Nacelle, Foundation Base and other major & minor components suitable for offered WTGs.
- 3.3 Design, engineering, supply and erection of unit sub-station (USS), Crane pads, Crane pad foundations, power & control cables from bottom converter to USS.

Note: Tower Transportation of WTG till site storage yard, fibre optic cable, suitable site office space with HVAC & power during construction and O&M phase, hiring of cranes and contractors for erection, 33kV overhead transmission lines from WTG transformer to the dedicated incoming feeders of the pooling switchgear, connection and

synchronization, all rights of way.

- 3.4 Design, engineering, manufacture and supply at site of wind farm internal electrical system including the equipment at Unit Substations of each WTG, materials for 33 kV Overhead Transmission lines.
 - 3.5 Design, engineering, manufacture and supply at site of Grid interfacing equipment including transformers, HT lines, panels, kiosks, protection equipment, metering, communication and SCADA interface equipment for evacuation of power from the wind power plant to the interfacing point.
 - 3.6 Design, engineering, manufacture and supply of Local Control System (LCS) for WTGs, including all hardware, software, interface provision and commissioning support necessary for seamless integration between LCS and Central Monitoring & Control System (CMCS).
- Note:** CMCS / Plant SCADA is under the scope of the Solar + BESS Contractor. The Wind Contractor shall provide all necessary interfaces and data points to enable full integration.
- 3.7 Design, engineering, manufacture and supply of any item, component, accessory, software, firmware, documentation, or system not expressly specified but required for safe, reliable, compliant, and continuous operation of the Wind Power Project.
 - 3.8 Provision & stocking of adequate spares at site for operation & maintenance of wind energy project.
 - 3.9 Provision & stocking of all the necessary tools and tackles for carrying out operation and maintenance of WTGs and associated systems.

Note: The Contractor shall submit a detailed list of spares, special tools, and tackles with quantities and technical specifications for Employer's approval.

3.10 Wind Monitoring Mast:

- 3.10.1 The bid should include supply, installation and maintenance of one wind monitoring mast at offered site till the power curve testing is carried out. The height of the wind mast should be close to the hub height of the WTGs installed therein. Numbers and specifications of the equipment and sensors (anemometers, wind vanes, temperature and pressure sensors and dataloggers etc. shall be as per the requirement set under the IEC-61400-12-1:2017 edition that defines the standard for power performance measurement of electricity producing wind turbines. In any case the numbers of anemometers shall not be less than two. The Wind Monitoring Mast shall be dismantled and removed by the Bidder only after successful completion and formal acceptance of the Power Curve Test by the

Employer/Owner and submission of all final validated datasets, reports, and certifications.

- 3.10.2 This shall include all required data loggers, sensors etc. capable of recording data for a minimum of 10-minute average intervals to ensure correct and reliable data collection and its computation for analysis, for verification of generation with reference to the actual wind conditions at Hub height.

N.B.: The bidder must quote this item separately in the price bid.

4 Responsibility Matrix

The following Responsibility Matrix is specified to delineate the Scope of Works of different Contracting parties engaged by the Owner (This document corresponds to the Scope of Work of Wind Package).

S. No.	Activity / Scope Item	Solar + BESS Package	Wind Package	Remarks
1	Design, Supply, Installation, Testing & Commissioning of Wind Turbine Generator (WTGs), Blades, Hub, Nacelle, etc.		✓	
2	Design, Supply & Erection of Tower, Foundation Base, Crane Pad, Crane Pad Foundation etc.		✓	
3	Design, Supply & Installation of Power & Control cables from Hub to Unit Substation (USS)		✓	
4	Design, Supply, Installation, Testing & Commissioning of Unit Sub-Station (WTG transformer, SPSS, etc.).		✓	
5	Design, Supply & Erection Foundation of the Unit Sub-Station		✓	
6	Design, Supply & Installation/Erection of 33kV Over Head Transmission System up to 33 kV Pooling Sub-Station/Panel		✓	

7		Design, Supply & Installation/Erection of Data Acquisition System upto the project SCADA system.	Support	✓	Solar+ BESS Contractor shall ensure adequate nos. of ports, tags, etc. for integration of Wind Plant data with the plant SCADA
8		Statutory Approvals Related to Wind Package	Support	✓	Obtaining all approvals related to WTGs, internal transmission system, CEIG approvals for wind facilities, and provide necessary support documents for overall plant approvals.
8	Solar + BESS	Design, Supply & Installation/ Erection of the DC Side of the BESS : Fully-Equipped BESS Containers, Fire Protection System, Cabling from BESS to PCS (DC Cables), etc.	✓		
9		Design, Supply & Installation/ Erection of the AC Side of the BESS : Power Conditioning System (PCS), Cabling from PCS to BESS Transformer LV, BESS Transformer, etc.	✓		
10		Design, Supply & Erection of Civil Works, Foundations for BESS Containers, PCS & BESS Transformer	✓		
11		Internal Roads, Drains, Water Supply, and Fencing	✓		
12		Design, Supply & Installation/ Erection of Cable Trenches, Trays, Supports, Earthing of Equipment's, Lightning Protection System, Aux Supply System	✓		

13	Design, Supply & Installation of Battery Management System (BMS), Energy Management System (EMS) / SCADA	✓		
14	Testing and Commissioning of BESS (Battery, PCS, EMS)	✓		
15	Fire Alarm System Integration with Plant Level SCADA	✓		
16	Design, Supply & Installation of DC side of the Solar: DC Cabling from Module to SCB, SCB, DC Cable from the SCB to Inverter, DC Side Earthing, Lightning Protection System, etc.	✓		
17	Design, Supply & Installation of AC side of the Solar: Inverter, LT AC Cable from Inverter to IDT, IDT, 33kV Cable from IDT to ICOG, ICOG, 33kV Cable from ICOG to Pooling Switchgear, AC Side Earthing, Lightning Protection System etc.	✓		
18	Design, Supply & Installation/ Erection of Module Mounting Structure, Module, ICR, etc.	✓		
19	Design, Supply & Erection of Civil Works, Foundations for MMS, Inverter, IDT, Aux. Transformer, Cable Trench, etc.	✓		
20	Testing and Commissioning of SCB, Inverter, ICOG, PPC, etc.	✓		
21	Pooling Switchgear for Solar, BESS & Wind (With 3 Nos. Feeder dedicated for Wind), Cabling from Pooling Switchgear to PT LV	✓		
22	Design, Supply & Installation of PPC, SCADA, BMS, EMS & Integration of the same with the Existing Plant Pooling Sub-Station Equipment's.	✓	Support	Wind Package shall connect the Communication & Control cable to the respected terminals in the Pooling Sub-Station.

23	Plant Sub-Station, Transmission & Power Evacuation	Design, Supply & Installation of Power Transformer, Transformer Bay, 220kV Bus-Bar Extension of Existing 300MW-220kV Ramagiri Plant Sub-Station, etc.	✓		
24		Design, Supply & Installation/ Erection of Civil & Foundation work of the Pooling Sub-Station Equipment's: MCR Room, Power Transformer, Bay Equipment's, Gantry Tower.	✓		
25		Design, Supply & Installation/ Erection of Cable Trenches, Trays, Supports, Earthing Pooling Sub-Station, Aux Supply System, Illumination, etc.	✓		
26		220kV Conductor Mounting on 220kV Transmission Tower for 4 KM.	✓		
27		Grid Compliance Study as per CEA requirement	✓	✓ Support	Wind Package shall share all the Relevant data to conduct the study.
28		Design, Supply & Installation of Reactive Power Compensation Equipment, Filter, etc.	✓		
29		Design, Supply & Installation/ Erection of Civil & Foundation work of the SVG & Filter Equipment's.	✓		
30		Grid Synchronization and Final Plant Commissioning	✓ Ownership	✓ Support	Roles to be defined in commissioning protocol
31		Plant Performance Demonstration and Trial Operation	✓ Ownership	✓ Support	Roles to be defined in commissioning protocol
32		Cybersecurity & Remote Communication Compliance for Wind Systems	✓ Ownership	✓ Support	Wind Package Contractor shall ensure OEM systems are compatible with project cybersecurity



				architecture and telemetry requirements.
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5 Design & Engineering

- 5.1 Contractor shall prepare the detailed design basis report (DBR), and master drawing list (MDL). The Contractor shall submit a copy to Employer for review and approval prior to detail engineering.
- 5.2 The design, execution and testing of the interconnection work by the contractor shall comply with the Technical Specifications, code requirements, applicable standards, regulations and applicable Laws.
- 5.3 All documents and drawings (soft copy) shall be submitted to the Employer for review and approval. Every drawing shall also be submitted in '*.dwg' format. In case of design calculations done in spread sheet, editable (working) soft copy of the spread sheet shall also be submitted along with 'pdf' copies during every submission. The Employer shall return the document / drawing to the Contractor with category of approval marked thereon. Two nos. of hard copies of approved documents and drawings shall be submitted to the Employer at SECI HQ Office at Delhi and one copy at the site. The drawings/documents shall be approved in any one of the following categories based on nature of the comments/ type of drawing or document.
- Category-I: Approved
 - Category-II: Approved subject to incorporation of comments
 - Category-III: Not approved. Re-submit for approval after incorporation of comments
 - Category-IV: Kept for record/ reference
 - Category-IVR: Re-submit for record/ reference after incorporation of comments

Note:

- a) Approval of document neither relieves the Vendor/ Contractor of his contractual obligations and responsibilities for correctness of design, drawings, dimensions, quality & specifications of materials, weights, quantities, assembly fits, systems/ performance requirement and conformity of supplies with Technical Specifications, Indian statutory laws as may be applicable, nor does it limit the Employer/ Purchaser's rights under the contract.

- b) Tender Drawings and/or Indicative Schematic drawings provided with Section VII shall supplement the requirements specified in the technical specifications. These drawings are preliminary drawings for bidding purpose only and subject to necessary changes during the detailed engineering. Parameters specified in the tender drawing are the minimum required & any increase in these parameters, if required, to meet the system requirement shall be made by the Contractor without any additional cost implication to Employer.

5.4 Contractor shall utilise, only the WTG co-ordinates specified in **SA-B: Land Layout**. The contractor shall submit basic design data, design documents, drawings and engineering information including GTP and test reports to Employer or its authorized representative for review and approval from time to time as per project schedule. The documents typically include, but not limited to, the following:

- a) Detail Technical Specifications of the WTGs and associated Equipment for the wind farm.
- b) Power Curve and Thrust Curve of the offered WTG model.
- c) General arrangement and assembly drawings of all major equipment.
- d) Schematic diagram for entire electrical system (AC and auxiliary systems).
- e) Test reports of all the equipments (for type, routine and acceptance tests).
- f) Design calculations and sheets (civil, mechanical, structural and electrical designs).
- g) Geo technical investigation data and Topographical survey report including topographical survey data in digital format (Excel file) and Contour plan of the area.
- h) GA Drawings of the entire project including WTG Micrositing, Unit Sub-Station, 33kV reticulation system, roads, storm water drainage, sewage networks, security cabin (if applicable), perimeter fencing, transformer yard fencing etc.
- i) Schematic diagram for entire evacuation system and transmission loss calculations.
- j) GA drawings for overhead lines along with all types of structures, 33kV Unit Sub-Station & Interfacing.
- k) Quality assurance plans for manufacturing (MQP), Standard Operating procedure (SOP) and field activities (FQP)
- l) Copies of WTG type test certificates and certified Power Curve Test certificates,
- m) WTG Design assessment certificates with all annexures, along with test reports
- n) Routine and acceptance tests for major components.
- o) As-built drawings / documents and deviation list from good for construction (GFC).

5.5 Site Suitability assessment report:

- 5.5.1 Bidder shall carry out the site suitability assessment study including the mechanical load assessment for the offered WTG w.r.t. the WTG microsite as given in **SA-B: Land Layout**. Bidder shall submit the detailed site suitability assessment report for the offered WTG along with the bid document. All the assessment under the site suitability assessment study shall genuinely assess the WTG suitability for the given microsite, and the Bidder shall not offer any of the WTG model which are not found suitable for the given microsite and are having any of the site suitability issue which may impact its design life and performance etc.
- 5.5.2 The Bidders shall restrict themselves to the already given microsite only and there shall not be any modification in the microsite. Any such concern related to non-ability to provide any functional or technical guarantee for the offered WTG due to any limitation of the given microsite, shall be communicated to Employer during the Pre-bid itself.
- 5.6 Submission of all the drawings on "as built" basis covering all changes/modifications, if any, due to site conditions in four sets to Employer after commissioning of the project for record purpose.
- a) One soft copy of as-built drawings shall also be submitted.
 - b) O & M Manuals in four sets.
- 5.7 The Contractor shall submit technical connection data, inter alia, generator data for fault studies, dynamic simulation data, details of data & voice communication within one month of signing the LOA. In case, technical data is subjected to change during detailed engineering, the contractor shall furnish the tentative technical data within one month of signing the LOA & shall furnish the final technical data not later than six (6) months from award of work.
- 5.8 As the Grid Compliance Study and connectivity are within the scope of the Solar + BESS Contractor, the Bidder shall submit the unit Wind Turbine Generator (WTG) software models required for conducting the Grid Compliance Study, in accordance with the applicable CEA guidelines and statutory requirements.
- 5.9 The Contractor shall forward to Employer, Schedule of supply within 15 days' time from the date of Award of Contract.

6 Micrositing

Micrositing of the Wind Farm has been completed by the Employer. The geographical coordinates for the location of the Wind Turbine Generators (WTGs) are provided by the Employer in **SA-B: Land Layout** of this Tender Document. The Bidder shall strictly adhere to the specified coordinates for execution of the Works.

7 Installation, Testing and Commissioning

The Scope of Installation, Testing & Commissioning covered under this specification shall be but not limited to the following:

7.1 Statutory Approvals:

Obtaining statutory approvals / clearances, wherever required, from Government departments but not limited to the following:

- a. State Renewable Energy Development Agency
- b. State Power Utilities
- c. Electrical Inspectorate (CEIG)
- d. State Load Dispatch Centre
- e. Other applicable permissions / clearances relevant for the Project site.

Copy of documents of all such clearances taken should be submitted to the Employer

7.2 Erection, Testing & Commissioning of Wind Farm: The scope of work under this Contract shall include, but not be limited to, the complete erection, installation, testing and commissioning of the Wind Farm, comprising the following activities:

- a. Civil works: Construction of reinforced concrete foundations for WTG towers, including excavation, reinforcement, concreting, curing, backfilling and all associated civil works as per approved drawings and soil conditions.
- b. Transportation & Handling: Transportation, handling, storage and insurance of all WTG components, transformers, electrical equipment, and associated materials from designated delivery points to respective WTG locations.
- c. Erection of WTG Towers: Mechanical erection and alignment of WTG towers on completed foundations, including grouting, bolting, torque tightening, and verification of verticality as per OEM specifications.
- d. Installation of WTG Components: Installation and assembly of nacelle, hub, rotor blades, internal cabling, auxiliary systems, and all associated components on the erected towers in accordance with the WTG OEM's installation manuals and quality procedures.

- e. Grid Interfacing System: Installation, testing and commissioning of all grid interfacing equipment required for power evacuation from the Wind Power Plant to the Pooling Substation, including but not limited to:
- WTG step-up transformers
 - 33 kV overhead transmission lines / underground cables from WTG transformers to pooling switchgear
 - Terminating cables to the dedicated incoming feeders of the pooling switchgear panel at pooling substation
 - Protection, metering and control equipment
 - Kiosks, junction boxes and marshalling panels
 - Earthing and lightning protection system
- f. Testing & Commissioning of WTGs: Pre-commissioning checks, cold commissioning, hot commissioning, synchronization with grid, trial run, performance verification, and all mandatory type/site tests as per applicable standards and OEM procedures.
- g. Local Control Station (LCS): Installation, testing and commissioning of the Local Control Station (LCS). The LCS shall be fully integrated with the WTG control system The LCS shall be responsible for:
- Data acquisition from all WTGs
 - Monitoring of turbine operational parameters
 - Monitoring of grid parameters at plant level
 - Monitoring of grid parameters at plant level
- h. Integration with Centralized Monitoring & Control System (CMCS) / Plant SCADA: The supply, installation and commissioning of the Centralized Monitoring and Control System (CMCS) / Plant SCADA shall be under the complete scope of the Solar + BESS Contractor. However, the WTG EPC Contractor shall be fully responsible for:
- Provision of all necessary hardware and communication interfaces
 - Supply of communication ports and protocol compatibility (IEC 60870-5-104 / IEC 61850 / Modbus TCP or as specified)
 - Mapping and validation of all required data points
 - Software integration support and interoperability
 - Ensuring seamless communication between WTG, LCS and CMCS / Plant SCADA

The WTG EPC Contractor shall ensure that complete data visibility, remote control capability, and grid compliance functionalities are achieved at the CMCS / Plant SCADA level without any functional limitation.

- 7.3 Access Infra-Structure: Contractor shall assess suitability of internal roads w.r.t. requirement and arrange construction/ strengthening as desired and also check suitability of land around each WTG for placement of crane, etc.

N.B.: Internal Roads shall form part of the Plant Facilities. Please refer the Tender Drawing (**SA-B: Land Layout**) for access Roads to individual Wind Turbines.

- 7.4 Operation and Maintenance of the wind farm on comprehensive basis for the 10 (Ten) years. The rates quoted by bidder for Comprehensive O&M of the Plant Facilities on yearly basis for 10 years shall be inclusive of the O&M of Part-02 (Wind Plant).

- 7.4.1 The Contractor shall be responsible for all the required activities for maintenance and successful running of the WTGs for:

- Optimum energy generation as well as maintenance of associated facilities of the wind farm.
- Deputation of Engineering and other supporting personnel.
- Keeping the WTGs in operational mode so as to get optimum energy generation from the Wind Farm. Any Planned annual shutdown period shall be mutually decided with the Employer.
- Monitoring controlling, troubleshooting maintaining of records, registers.
- To maintain proper and adequate inventory of all spares, consumables and fixing / application of the same as per WTGs
- Conducting periodical maintenance check, testing over hauling and taking preventive action for smooth running of wind farm as required.
- General up keeping of all equipment, building, roads etc.
- Submission of daily/periodical reports to Employer on energy generation & operating conditions of the wind farm.
- Continuous monitoring of performance of the WTGs and regular maintenance of the whole system including WTGs, transformers, overhead lines, outdoor kiosks, switchgear, equipment etc. for extracting and maintaining the maximum energy output from the wind farm.
- To maintain at the facility accurate and up-to-date operating logs, records and monthly reports regarding Operation & Maintenance of the facility.

- 7.4.2 The daily and monthly energy output of each WTG shall be recorded. Daily

Generation Reports shall be shared with the Employer. Monthly Performance reports indicating turbine wise energy production, down time, capacity utilization factor, machine availability etc. shall be prepared for each WTG as well as for the wind farm and furnished in soft mode to Employer in the first week of the following month. The Report shall comprise of details like energy generation, grid availability, breakdowns, generation hours, low wind hours, machine availability etc. which shall be sent through e-mail and /or made available to Employer.

- 7.5 Employer shall be given online access to the real time SCADA Data at its head office so as to visualise the plant operation and performance status on real-time basis.
- 7.6 Quarterly and Annual performance Reports covering monthly performance details based on the following parameters shall be prepared and submitted to Employer:
- Estimated annual energy generation submitted along with the bid. Giving all Gross P50, Net P50, P75 and P90 values. Monthly values if available in EYA report shall also be provided in the Annual Performance Report
 - Actual energy generation at LCS panel during the year.
 - Monthly billed energy generation during the year including the breakup of exported and imported energy, reactive power consumption etc.
 - Machine Availability during the year
 - Internal Grid Availability during the year
 - External Grid Availability during the year
 - Details of non-available hours including breakup for at-least following parameters
 - Scheduled Maintenance hours during the year
 - Unscheduled Maintenance hours (Breakdown hours) during the year
 - Any other non- availability due to Operator's fault within the responsibility of O&M Contractor
 - Force Majeure hours which caused unavailability of the wind plant during the year
 - Unavailability Due to Curtailment
 - Unavailability due to Employer's instructions
 - Any Other Non-Operational Hours that is not the responsibility of O&M Contractor
 - Average Wind Speed Recorded for the year. Nacelle anemometer wind speed. Mast data if available.
 - Details of Major breakdown and rectification done

- 7.7 The above report shall be submitted annually.
- 7.8 Employer at its discretion may get the performance checked from an independent technical consultant.
- 7.9 Maintenance: The Contractor shall draw the preventive maintenance schedules for daily, monthly and yearly and attend to the breakdowns keeping in view that the machine availability is always more than 98% during high wind season and 96% during lean wind season. A copy of such Preventive Maintenance Schedule shall be submitted to the Employer. The Contractor shall carry out the periodical/plant maintenance as given in the manufacturer's service manual and perform minimum two certified services per annum. Such programme for all the equipment shall be prepared as per operating manuals of manufacturer's and shall be implemented in letter and sprits.
- 7.10 Regular periodic checks of the WTGs shall be carried out as a part of routine preventive maintenance during low wind period. In order to meet the maintenance requirements stock of consumables are to be maintained as well as various spare as recommended by the manufacturer at least for 2 years to be kept for usage. This shall also include maintenance of other major equipment involved in wind energy farm like overhead line equipment, switchgear, outdoor 33 kV VCB kiosk and metering panel.
- 7.11 Maintenance record is to be maintained to record regular maintenance work carried out as well as any breakdown maintenance along with the date of maintenance, reasons for the breakdowns, steps taken for attending to the breakdown, duration of the breakdown etc. Schedules will be drawn such that some of the jobs other than breakdown, which may require comparatively long stoppage of the WTG's, shall be carried out preferably during the non-windy season.
- 7.12 The Contractor will attend to breakdown jobs immediately for repair/replacement /adjustments and complete at the earliest during the currency of O&M Contract. The Contractor shall immediately report the accidents, if any, to the Engineer In charge & to all the concerned authorities as per prevailing law of the State showing the circumstances under which it happened, and the extent of damage and / or injury caused. O&M Contractor would be solely & fully responsible / liable to pay for any losses/damages/claims, etc. and Employer will be fully indemnified for such losses / claims.
- 7.13 The Contractor shall comply with the provision of all relevant Acts of Central or State and rules made there under from time to time.
- 7.14 The Contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules.

- 7.15 The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his or his Co-Contractor or Employer's Workmen.
- 7.16 If in the event of negligence or mal-operation by the Contractor's operator any failure of equipment take place such equipment should be repaired / replaced by Contractor free of cost within a reasonable period of time.

8 Quality Spares & Consumables

In order to ensure longevity and safety of the core equipment and optimum Performance of the system the Contractor should use only genuine spares of high quality standards as recommended by manufacturers.

9 Tools and Tackles

The Contractor shall arrange for all the necessary tools and tackles for carrying out all the maintenance work.

SECTION - VII

SUB-SECTION B

TECHNICAL

SPECIFICATIONS (TS) –

ELECTRICAL SYSTEM

TABLE OF CONTENTS

A	Equipment Specifications	4
1	Wind Turbine Generators (WTG)	4
2	Tower	7
3	Blades.....	8
4	Transmission or Gearing Mechanism.....	8
5	Soft Start	9
6	Electrical Systems.....	9
7	Power Panel	10
8	MCCB/ACB.....	11
9	Labelling	12
10	Local Control System (LCS).....	12
11	Earthing & Lightning Protection.....	15
12	Cabling.....	16
13	Surge Protection	17
14	Electrical System for Interfacing with the Grid	18
15	Wind Monitoring Mast.....	23
16	Communication with LCS	24
17	Central Monitoring and Control System (CMCS)/SCADA.....	26
18	Floating Stock of Gear Boxes (not applicable for gearless machines)	27
19	Grid Compliance Requirement.....	28
B	Guarantee/Warranty.....	28
C	Inspection and Testing	29
D	Civil Works	30
1	Scope of Work.....	30
2	Design Criteria.....	31
3	Materials & Job Specification.....	31
4	Detailed Contour Survey & Soil Investigation of the Site	31
5	Land Development for site activities	32
6	WTG Tower Foundation.....	32
7	Control Cabin	35
8	Switch yard civil works.....	35



Tender for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and Maintenance of 45.6 MW ISTS Connected Wind Power Project at Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Packge-2: Wind)

E	Safety Requirements for Wind Turbine Generator and associated Equipment...	35
F	Erection and Installation of all items	38
G	Commissioning	38
H	Documentation and Submittals	39
5.	Standards & Statutory Requirements.....	44
6.	Design Improvement	44

A Equipment Specifications

The Scope of Supply covered under this specification shall be but not limited to the following:

1 Wind Turbine Generators (WTG)

1.1 General Requirements

Specification	Detail
Type	Horizontal Axis, 3-Blade, three-phase induction generators (asynchronous/synchronous generators)/doubly fed induction generators/PMG (Permanent Magnet Generator)
Minimum Rated Capacity	3 MW
Rated voltage	3 phase according to the design of the manufacturer
Rated frequency	50 Hz
Degree of protection (IEC)	IP54/55 (induction /DFIG) & IP23 (Synchronous)
Power factor capability	0.95 lagging to 0.95 leading
Efficiency	Min. 90% at rated capacity
Insulation class	'F' or better (IEC 60085), as per type test
Vibration category	As per relevant IS/IEC
Total Harmonic Distortion (THD)	As per Central Electricity Authority (standards for connectivity to the grid) regulation 2007 and subsequent amendments.
DC Injection	
Flicker	
LVRT/ HVRT/ FRT	

- 1.1.1 The WTG shall be fitted with components as specified in the type certificate. The make, type, rating and model of the components of WTG shall be specified by the Contractor.
- 1.1.2 The WTGs shall be complete with all parts and components necessary for normal operation during the lifetime of the WTG.
- 1.1.3 The generators shall be compatible for 50 Hz grid connection and in accordance with Indian/ International standards applicable for design and manufacturing of generators, with following specifications:

1.2 Main Design Criteria

- 1.2.1 WTG shall be suitable for continuous and satisfactory operation at the site for the prevailing wind and climatic conditions and designed to have not less than 20

(twenty) years for continuous operation as per IEC 61400-1 “Wind turbines - Part 1: Design requirements” or any other internationally accepted standard for the wind turbine design. Bidder shall indicate the list of components whose life is less than 20 (twenty) years. In case of life of other major equipment (such as power panel, transformer, VCB yard, insulators, isolators, pitch motors and control panel etc.) shall also be provided along with the bid.

- 1.2.2 The WTGs shall have survival wind speed capable to withstand cyclonic effect in the offered area.
- 1.2.3 The blades should be designed based on a standard specification, which may be indicated by design registration number, date of issue and issuing authority.
- 1.2.4 The WTG shall have adequate yawing, pitching and braking control systems in order to optimise the WTG operations and regulations of the rotor blade movement.

1.3 Braking System

- 1.3.1 The wind turbine shall be equipped with two independent braking systems, one of which shall be of aerodynamic type utilizing tip brake or pitch control mechanisms, as stipulated by IEC 61400-1:2019.

1.3.2 Aerodynamic Braking System

- a) The aerodynamic brake may be hydraulic, mechanical, or electrical type and shall be designed to apply braking force evenly through all blades to minimize vibration and undue stresses on the rotor in accordance with load calculation and fatigue requirements.
- b) The braking system operation shall be foolproof with minimum adverse effects from ingress of dust and water/moisture into moving parts. The brakes shall incorporate automatic and remote-controlled activation and reset capability with response time as per IEC 61400-1:2019 requirements or manufacturer specifications demonstrating equivalent performance.
- c) Where the hydraulic power pack is located in the hub, the unit shall be certified for safe operation at any position with respect to horizontal level and remain unaffected by centrifugal forces experienced during rotor overspeed conditions.
- d) The aerodynamic braking system shall be fail-safe, such that upon loss of control or power, the brakes default to the safe condition (e.g., blades feathered to stop rotation). Redundancy or backup provisions for control power supply should be incorporated where technically feasible.

1.3.3 Mechanical Braking System

- e) A fail-safe, heavy-duty electro-hydraulic or hydraulic brake shall be provided for mechanical braking of the rotor in accordance with IEC 61400-1:2019 and recognized best practices. This brake may be installed on either the high-speed or low-speed shaft but shall not be located on the non-driving end of the generator to prevent fatigue failure of the generator shaft.
- f) The brake shall be adequately rated to safely stop the rotor at full speed during emergency conditions, including sudden power failures. Design calculations and structural assessments (force, temperature, wear) shall follow IEC guidelines or equivalent standards.
- g) Brake shoe lining shall withstand temperature rise during braking operations and have adequate surface area for efficient thermal energy dissipation, maintaining uniform contact to avoid slippage or uneven wear. The brake materials must have stable friction coefficient and sufficient yield strength to prevent failure under worst-case loading conditions.
- h) The brake shoes shall be designed for minimum operating cycle life as per manufacturer specifications meeting industry standards before requiring replacement. The mechanical brake shall operate independently from the aerodynamic system, ensuring stopping capability even if one system fails.

1.3.4 Additional Manual Brake

An additional manually operated brake shall be provided accessible from the nacelle for holding the rotor in any position when main brake(s) are dismantled for inspection and servicing.

1.3.5 Documentation Requirements

The Contractor shall provide detailed explanatory notes on the working principles of both braking systems and indicate the expected life of the braking system components and brake pads. These notes shall explain safety features for situations when wind turbines are kept switched off for extended periods during maintenance and are disconnected from the grid.

1.4 Yaw System

- a) The WTG shall be provided with an active yaw system responding to the signals from wind direction sensor.

- b) The yaw system shall possess a feature for automatic untwisting of cables connected to the Nacelle. The yaw system shall be protected against corrosion, dirt and also fatigue due to gust, storm, freak wind-shift etc.
- 1.5 Generator shall be protected against short circuit, earth fault, overload, over and under-voltage.
- 1.6 The generators shall be provided with temperature sensors installed in the stator windings being part of the generator protection system.
- 1.7 In case separate cooling fan with cooling fins and ducting are provided for the generator, the fan shall be automatically controlled through temperature sensing device.
- 1.8 Generator windings etc. must be provided with corrosion protection to cope with condensation problems caused by the high relative humidity and temperature gradient at the site.
- 1.9 WTGs shall have adequate protection and controls to operate in parallel and synchronized manner with grid.
- 1.10 The WTG manufacturer shall specify the wind speed range at which the turbine can connect/synchronize with the grid and shall clearly define the turbine cut-in and cut-out wind speeds during detailed engineering.
- 1.11 The Contractor shall furnish the following design parameters:
- The withstand capability for maximum 10-minute average wind speed at hub height.
 - The withstand capability, for maximum 2 sec gust wind speed at hub height.
 - The maximum operation wind speed, given as 10 minutes average wind speed.
 - The maximum electrical power output.
 - The maximum rotor revolution speed.
 - The certified power curve.
- 1.12 Details of auxiliary power supply as required for various segment of Electrical and Automations system shall be furnished. Similarly, provision of cooling system for Electrical panels etc. shall be separately brought out.
- 1.13 The WTG model should be listed in the Revised List of Models and Manufacturers (RLMM list) of MNRE as on the date of bid submission.

2 Tower

- 2.1 RCC or lattice, Tubular tower or Hybrid (Tubular plus Lattice) Tower fabricated from

structural grade steel sections or plates shall give a minimum hub height of 100 mts and above the ground level.

- 2.2 All exposed portion of the tower and foundation bolts/anchor plates/stubs etc. shall be galvanized or painted with anti- corrosion paint as per specifications & in accordance with Indian/International standards so that it can withstand environmental impact for at least 25 years. Switchboards shall have two coats of epoxy painting of minimum 120 microns thickness over two coats of primer. Alternatively these can have powder coating having thickness more than 60 microns. The bidder shall submit descriptions of protection methods to be used for all components
- 2.3 The tower shall be designed for the dynamic loading imposed by the normal operation of the WTGs as well as to withstand survival wind speed without any damage. The permissible tolerances in fabrication of towers shall be as per the relevant Indian standards. Complete details of the towers shall be furnished along with bid.
- 2.4 The towers shall be provided with facilities like lift & other convenient climbing devices etc. for safe access to the nacelle and to the aerodynamic brakes. The safety ropes & belts shall be made available by the contractor as and when required during the construction period and O&M period. The necessary foundation bolts should be supplied along with the tubular towers.
- 2.5 If tubular towers are offered and the local control panels and associated electrical equipment are installed inside the tower, lockable door shall be provided at the base of the tower. In case of lattice type or RCC tower, a separate electrical room with adequate protection against weather and unauthorized entry shall be provided.
- 2.6 The towers shall be painted with SECI logo on one side.

3 Blades

- 3.1 Blades shall be sturdy enough to maintain its surface smoothness, and its shape and alignment when kept in stalled or stopped condition at any angle to the vertical and for a long period of time.
- 3.2 Safety system of the blades assembly shall be of failsafe design.
- 3.3 The blades of the rotor shall have in built lightning protection. This will be in addition to lightning protection provided for rest of Nacelle equipment.

4 Transmission or Gearing Mechanism

- 4.1 The gearbox, if provided, shall be of proven and special design suitable for WTG application from an experienced and reputed manufacturer for long and trouble-free operation. Standard components shall be used to give high reliability.

- 4.2 The transmission may be direct or built as composite gearbox with generator through an independent gearbox coupled with the Generator or directly coupled to the generator or without gearbox.
- 4.3 The gearbox, if used, shall be provided with a temperature sensor mounted in the sump for measuring the oil temperature amongst other parameters.
- 4.4 Information about the safety factor and lifetime of all gear wheels, bearing, etc. shall be given in the bid.
- 4.5 The transfer of vibrations from the gearbox to the nacelle shall be minimized. The Contractor shall mention as to how it is achieved.

5 Soft Start

The current drawn by the WTG at the time of grid tie up shall be limited to the full load current of the generator by providing suitable thyristor controls or other means. Provision for inhibiting start from the central monitoring system must be provided. The maximum inrush / starting current shall not exceed the full load current of the generator

6 Electrical Systems

- 6.1 The electrical power and control installations of the WTGs must be designed for unattended, automatic service. The design must ensure
 - a) High reliability (well-proven principles).
 - b) Easy maintenance and services.
 - c) Maximum power production.
- 6.2 All installations must be designed, fabricated and tested in accordance with latest publications from the international organisations of standards, or Indian equivalent.
- 6.3 System Parameters
 - 6.3.1 The WTG system shall be designed to operate continuously and satisfactorily under the following system parameters with variation as per Central Electricity Authority (standards for connectivity to the grid) regulation 2007 with all latest amendments.
 - a) Voltage: nominal value (according to IEC 60038) $\pm 10\%$.
 - b) Frequency: Frequency variation shall be as per stipulations of CEA (technical connectivity to the grid) regulations 2013 along with latest amendments to the same.
 - c) Voltage imbalance: the ratio of the negative-sequence component of voltage not exceeding 2% .
 - d) Current asymmetry: The Wind Turbine Generator (WTG) shall be capable

of continuous operation with negative sequence current not exceeding: 5% of the rated positive sequence current, without derating the active power output.

- e) Auto-reclosing cycles: Auto reclosing norms as per statutory regulations to be followed.
- f) However, the above variations should be acceptable to State EB.
- g) The parameters mentioned in above sub-clauses are indicative in nature. However, the offered WTG model shall operate as per the design conditions suiting the system parameters of State grid. Tolerances exceeding above limits, must not harm/damage the installation in any way.

6.3.2 If the WTGs are to be stopped or tripped beyond limiting values mentioned above, adequate time delay shall be incorporated for cooling of the electrical equipment in accordance with the system design.

6.3.3 Contractor shall furnish the provisions for protection of the system or equipment when boundary conditions are violated.

7 Power Panel

7.1 For each turbine a switchboard is to be installed within the space of tower. The switchboard must include all power distribution for the turbine and the cabin, protection systems, soft start, capacitor control (as applicable) etc.

7.2 General data for the switchboard:

Parameter	Value
Control Voltage	As per requirement
Frequency	50 Hz with +1 Hz / -0.2 Hz variation limit or as per the Grid Codes
Short Circuit Level	As per requirement, defined at incoming terminals (suitable rated excluding contribution from the turbine)
Incoming Cable	PVC insulated & armoured, suitable cross-section
Spare Space (Extensions)	10%
Enclosure Material	Protected against humid environment and vermin proof
Degree of Protection	IP54 for outdoor / IP23 for indoor
Applicable Standards	IEC: 439, IEC-144, IEC-157-1, IEC-158, IEC-292, IEC-255 & IEC-337
Space Heaters	Required, with thermostat

7.3 The power panel and its bought-out components shall be designed and manufactured

in accordance with Indian/IEC standards.

- 7.4 The supply between power panel and transformer shall be protected against short circuit by circuit breaker / MCCB on distribution board. Lightning arrestors must be installed at the control panel end for protecting against voltage transients on the grid. The power panel frame shall be connected to earth at two points.
- 7.5 The switchboard must include outlets of sufficient rating and numbers to feed the yaw motor system, pitch system, hydraulic power system, cooling fans, nacelle & tower lights, heaters, control & communication panels and sockets in the nacelle and in the shelter of the WTGs. Socket outlets and lights must be kept powered or emergency lights shall be provided in the tower area for safe movement, even when the WTG is stopped and all remaining electrical installations are isolated from the grid.
- 7.6 The generator overload protection system must be combined with temperature measurement of the generator windings to ensure maximum production time of the WTGs even at low grid voltage.
- 7.7 A phase relay must cut out the generator, if any of the phases is missing. Relays and computer systems must be fully functional at a voltage variation of $\pm 10\%$.
- 7.8 Voltage variations beyond (+/-) 13% or ambient temperature above 45 degree C must not harm/damage the systems with suitable protection mechanism.
- 7.9 A mushroom type emergency push button must be located on the switchboard front.
- 7.10 A switch for preventing remote control operation must be located in the front of the switchboard.

8 MCCB/ACB

8.1 Incomer:

- a) MCCB/ACB at the power panel of each WTG provided should take care during full load current exceeding the specified limit.
- b) Breaking capacity: Minimum 50kA at 415V.
- c) Adjustable thermal & magnetic trip settings.
- d) Shunt trip & undervoltage release (if required)
- e) Mechanical ON/OFF/TRIP indication.

8.2 Outgoing:

- a) MCCB/ MCB/ MPCB type suitable for motor loads, heater circuit, lighting circuits, control circuits, hydraulic units, yaw motors, cooling systems, etc.
- b) Each feeders shall be provided with proper short circuit & overload protection.

9 Labelling

- 9.1 All components, internal wiring and terminals must be numbered according to the drawings and marked/labelled at locations, which are easily readable.
- 9.2 The switch board panel identification must be indicated on the front in a conspicuous way.
- 9.3 It should be identical with the number of the WTG controlled by the switchboard.

10 Local Control System (LCS)

- 10.1 Each WTG shall have a Local Control System (LCS) and it shall be designed for automatic, unattended operation based on a microprocessor/ PLC-controlled system with adequate power backup. It shall have facility for fibre optic cable/RF based communication with Central SCADA with a facility for remote control and a centralized remote monitoring system for control and monitoring and database system.
- 10.2 The local control system (LCS) together with the power system must fully protect the mechanical and electrical installations of the WTG against break down and at the same time ensure a maximum overall energy production under given wind conditions.
- 10.3 The control panel of LCS shall be installed within the tower or a separate local control room. The microprocessor/ PLC and power control units shall be located at well-ventilated place.
- 10.4 In case of tubular tower, the LCS shall be capable of operating satisfactorily at such temperature that may exist inside the tower without exceeding the permissible temperature rise. The LCS shall be able to display basic operating functions of the WTG along with provision for stopping and restarting the WTG. The system shall as a minimum be able to display:
 - a) Grid condition,
 - b) Brake position,
 - c) Generator rpm.
 - d) Instantaneous power (kW)
 - e) Power Factor
 - f) Energy transmitted to the Grid (kWh)
 - g) Cumulative energy generation (kWh)
 - h) Cumulative energy consumption (kWh)
 - i) Wind speed and direction,
 - j) Instantaneous kVAR consumption,
 - k) Cumulative kVAR consumption

- l) Status of capacitor bank connection,
- m) Temperature of generator, yaw motor, gear box, gear oil etc.
- n) Hydraulic Oil Pressure
- o) Voltage (V), of all the three phases in RMS values.
- p) Current (A) of all the three phases in RMS values.
- q) Frequency (Hz)
- r) Rotor Revolution Speed (Rotor rpm)
- s) Brake Activation
- t) Total run hours of WTG
- u) Status of WTG
- v) Yaw angle

10.5 The LCS shall also initiate shut down, display and give alarm at following conditions:

- a) Low oil level or pressure in gear box (if applicable).
- b) Yaw failure
- c) Cable twist failure
- d) Control system failure
- e) Excessive vibration in nacelle or another major item.
- f) Worn brake-pads
- g) Abnormal temperature in generator, gearbox (if applicable), yaw motor, brake callipers.
- h) Grid failure i.e. frequency error, excess current asymmetry, voltage failure.
- i) Over speed of rotor and generator.
- j) Activation of emergency stop.
- k) Aerodynamic brake operation.
- l) Over temperature in switchboard (Power Panel).
- m) Failure of capacitor banks (if applicable)

LCS shall have display features at LCS level

10.6 This shall also stop the WTG and restart when conditions are acceptable again with display for:

- a) Low wind speed.
- b) Excessive wind speed.
- c) Untwisting of cables.
- d) Activation of stop push-button (Restart when start push-button is

activated).

- e) Abnormal grid condition e.g. over/under voltage, over/under frequency and current asymmetry.

- 10.7 LCS shall have the functionality of stopping the WTG automatically as per the grid requirement and the WTG shall start automatically provided it was released by the SCADA/CMCS. The WTG shall be manually restarted in case of all other shut-down situations.
- 10.8 Any shut down must be reported through the system.
- 10.9 Provide parameters and operational conditions to the Central Monitoring and Control System (CMCS/SCADA) in the Central Control Room. All the display parameters including errors & alarms as per WTG design as displayed on the LCS at WTG controller level, shall be displayed at SCADA/CMCS level also for effective monitoring.
- 10.10 All relay set points at relays or instruments must be adjustable within safety limits of the equipment. These include Voltage and Frequency sensing relays also.
- 10.11 LCS must be capable of reporting any shut down to the Central SCADA, giving enough information to identify the cause of failure. All set points of microprocessor/PLC controller shall be adjustable. The LCS must be interactive with Central SCADA but not completely depend on that. If there is a fault in the Central Control System, the LCS must continue to control the WTGs and keep it in operable condition.
- 10.12 It should be possible from SCADA/CMCS at the master control room to control all the Wind Turbine Generators, give commands, record their various data and take out the printed reports of energy generated and other operational & calculated data on demand, from each WTG or from the whole wind power project, export/import of energy, etc.
- 10.13 Indicative list of digital and analog I/O's for the system being offered is to be furnished by the bidder.
- 10.14 Auxiliary power requirement for contactor/relays/control electronics etc. shall be met through a UPS. Its capacity and backup shall be mentioned. Requirement of important control element are mentioned below: Minimum backup period for UPS shall be half (1/2) hour and accordingly battery capacity shall be provided for UPS.
- a) DC Power Supply shall be SMPS based suitable for wide input supply with power boost facility, shall have reliable starting of loads and proactive alarm signals and selective fuse breaking capability, UL/international certification body (safety related), approved, safety in acc. with EN 60950/VDE 0160.
- b) Signal barriers/Isolators certified as per EMC guideline 89/36AEEC & UL

508 with 3-way galvanic Isolation and spring cage terminals.

- c) Interposing / auxiliary relays shall be modular, pluggable mountable on DIN Rail with LED indication, UL approved.
- d) Transducer/signal converter /multipliers shall preferably be configurable, 3-way galvanically isolated, mountable on DIN Rail and certified as per EMC guideline 89/E.EC, UL approved.
- e) Communication devices shall be industrial grade and shall be certified as per EMC guidelines 89/336/EEC & the interference /immunity shall be as per EN 55 011/EN 61000-6-2.
- f) Wireless Signal Transmission Device (for Analog, Digital & Data Signals), if used, shall be based on Frequency Hopping Spread Spectrum (FHSS) technology, operating the licensed free Band (Frequency shall be 2400-2480 MHz) with Diagnostic Indications like RF link status with relay outputs.
- g) Terminal Blocks shall comply with IEC-947-7-1. All metal parts shall be captive & made of copper alloys. Housing material shall fire retardant type and suitable for vibration level up to 5g.

11 Earthing & Lightning Protection

- 11.1 Earthing (or grounding) of WTGs, transformers, and all related electrical installations shall be under the scope of the Bidder. The design of the grounding system and supply and installation of all required materials shall ensure proper performance of electrical and electronic components and safety of personnel against lightning and ground faults. All electrical frames shall be effectively connected to earth at least at two points. Material required for earth electrode as well as earth current conductor shall be supplied by the Bidder. Combined earth resistance at each WTG shall be less than two Ohm.
- 11.2 The earthing system and the earth resistance requirement of the lightning protection system shall be designed in line with the provisions of IEEE 80 / IS 3043. Suitable earthing system to protect the nacelle, electrical system, and tower against lightning strokes shall be in accordance with IS/IEC 62305.
- 11.3 Earth electrode shall be designed to withstand the maximum possible short circuit current. Lengths of electrodes shall be such that the combined earth resistance shall be less than two Ohms.
- 11.4 Suitable independent earthing system shall be provided for protection of blades, nacelle, and tower against any lightning surge. Effective earth resistance on individual

electrodes shall be less than 3 (three) Ohm and the combined earth resistance shall be less than 2 (two) Ohm. The work shall be executed as per IS:2309 / IS:3043. Bidder should append a drawing showing the earthing arrangement for WTG and transformer.

- 11.5 The Bidder shall carry out soil resistivity tests at site for the design of suitable earth pits. A detailed soil resistivity report along with design calculations shall be submitted to the Owner.
- 11.6 All mechanical metallic parts of the WTG and transformer, including tower, nacelle, and structural supports, shall be bonded and connected to earth.
- 11.7 The cover slab on every earth pit shall be adequately labelled in line with the provisions of IE Rules.
- 11.8 Lightning Arrester shall be of appropriate voltage and impulse current rating to protect all power equipment within WTG system. They shall be readily accessible and easily replaceable. Lightning Arrestor of suitable design as acceptable to the DISCOM shall be provided to meet the operational requirements complying with the requirements of relevant standards.
- 11.9 Lightning protection provided for rotor blades, shall be highlighted indicating the scheme and design details.
- 11.10 In addition to surge protection of control cards, the bidder shall provide lightning arresters and/or varistors within the control panel to protect electrical and electronic equipment against lightning and switching surges expected in the electrical network.
- 11.11 The bidder shall provide suitable lightning protection system at the highest possible point on the WTG.

12 Cabling

12.1 Cable type

- 12.1.1 Two categories of cables shall be provided, one for stationary equipment and the other for movable equipment and components. Irrespective of utilization voltage and current rating, cables shall have copper/aluminium conductor and shall be minimum of 1100 volts grade. The cables shall be adequately insulated for the voltage required and shall be suitably colour coded for the required service. Sufficient margin should be taken into consideration while selecting the current carrying capacity of the cables with due consideration of ageing, derating due to various conditions of short circuit.
- 12.1.2 The Contractor shall furnish the size and rating of cables during detailed engineering.

12.2 Cable end termination

12.2.1 The cable ends shall be terminated with adequate size metallic double compression cable glands/PVC glands and the glands shall be earthed at two locations. Suitable lock type crimping lugs shall be used for cable end terminations. Where cables are raising from ground, suitable PVC pipe guarding shall be provided for cable raising with sealing of the guarding PVC pipe including a suitable clamp.

13 Surge Protection

13.1 Surge protection devices shall be provided at the following points with minimum requirements as given in the table below

Location	SPD Type / Class	Ratings	Features	Standard
Input side of Main Distribution Cabinet (690 VAC / 415 VAC)	Stage I / Class B, single spark gap	Rated voltage: 440 VAC (690 VAC) / 310 VAC (415 VAC) or above Surge capacity: 50 kA, 10/350 μ s waveform (L–N) Protection level: 2.5 kV (690 VAC) / 0.9 kV (415 VAC)	–	IEC 61643
Input side of AC Drive Cabinet (690 / 415 / 230 VAC), UPS, PLC Cabinets, Control Panels	Stage II / Class C	Rated voltage: 600 VAC (690 VAC) / 310 VAC (415 VAC) or above Surge capacity: 10 kA, 8/20 μ s waveform	Pluggable, testable, diagnostic functions (overload indication, potential-free outputs)	IEC 61643
Input Power Supply line of 24 / 48 / 60 V AC/DC	Stage III / Class D	–	Pluggable, testable, diagnostic functions (overload indication, potential-free outputs)	IEC 61643-21
Bus Systems (Profibus, Modbus, etc.) / Serial Ports (RS-232 / RS-485)	Data line SPD	Surge capacity: 10 kA (Core–Core), 10 kA (Core–Ground)	Pluggable, on-site testable	IEC 61643-21

Ethernet Networks	Network SPD	Protection for all 8 signal paths Surge capacity: 350 A (Core–Core), 2.5 kA (Core–Ground), 8/20 μ s waveform	–	IEC 61643-21
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14 Electrical System for Interfacing with the Grid

- 14.1 Each WTG will be connected to grid through unit transformer of suitable capacity and voltage ratio, unit sub-station & 33 kV overhead line upto the dedicated incoming feeders of the pooling switchgear located in the pooling sub-station. The design of the electrical system shall be in accordance with the Indian Electricity (IE) Rules, Chief Electrical Inspector General (CEIG) requirements, Standard Practices of DISCOMS, Code of Practices issued by Bureau of Indian Standards (BIS), APERC Regulations and Orders, CEA Regulations on Grid Connectivity etc.
- 14.2 The Contractor shall furnish a single line diagram of the electrical system for connecting the WTGs with the pooling sub-station/ grid.
- 14.3 It is open to the Contractor to group the WTGs of the Owner in one or more groups and connect them to the pooling sub-station/ grid through dedicated feeder(s) for the Owner.
- 14.4 The Contractor's scope of work shall include providing all necessary technical, engineering and documentation support to the Solar + BESS Contractor for obtaining requisite approvals from the concerned State Transmission Utility (STU)/ Central Transmission Utility (CTU), and/or any other identified statutory authority having jurisdiction over the Project. Such support shall include, but not be limited to, the following:
- Preparation, review and validation of technical documents, drawings and calculations related to the detailed grid tie-up and power evacuation scheme.
 - Coordination for submission of applications, technical data sheets, protection schemes, SLDs, load flow studies, short circuit studies and any other documents as required by the approving authority.
 - Participation in technical discussions, review meetings and clarification sessions with the concerned authority.
 - Incorporation of comments/observations issued by STU/CTU/identified authority and revision of documents accordingly.

e) Assistance in compliance with applicable Grid Code, CEA regulations and connectivity conditions relevant to the Project.

14.5 The Wind Turbine Generator (WTG) and the associated Step-Up Transformer shall be interconnected through power cables of adequate voltage grade, current carrying capacity and insulation level, suitable for the rated output and operating conditions of the WTG. The selected cable shall be designed to:

- Safely carry the full-load current corresponding to the rated output of the WTG under site conditions.
- Withstand short-circuit levels as per the applicable system fault level and relevant standards.
- Limit voltage drop within permissible limits as per applicable standards and grid code requirements.
- Be suitable for the installation conditions (buried/ducted/trenched/inside tower) including ambient temperature, soil thermal resistivity and derating factors.

14.6 WTG Step-Up Transformer shall be designed, manufactured, tested, and supplied in strict compliance with the applicable IEC/IS standards and shall fully conform to the technical requirements specified by the respective WTG OEM.:

Parameter	Technical Requirement
Applicable Standards	Transformer shall comply with latest editions of IEC standards including: • IEC 60076 – Power Transformers • IEC 60076-11 – Dry-Type Transformers (where applicable) • IEC 60076-3 – Insulation Levels and Dielectric Tests • IEC 60076-5 – Short-Circuit Withstand Capability • IEC 60296 – Mineral Insulating Oil (for oil-filled units)
Type	(a) Oil Immersed, Naturally Air Cooled (ONAN), Outdoor Type, OR (b) Dry Type, Air Natural (AN), suitable for WTG installation (nacelle/tower/USS)
Application	Step-up transformer for interconnection between WTG generator voltage and MV collection system (typically 33 kV or as specified).
Cooling	Oil Filled: ONAN Dry Type: AN (Air Natural)
Installation Location	Suitable for nacelle-mounted, tower-mounted, or ground-mounted on engineered plinth/elevated platform.
Rated Capacity	Shall match or exceed rated output of respective WTG under site conditions and continuous full-load operation.
Voltage Ratio	As per WTG LV output and MV system voltage (e.g., LV/33 kV or as specified in project SLD).

Tapping Range	Off-Circuit Tap Changer (OCTC) with $\pm 2.5\%$ tapping per step, covering overall $\pm 5\%$ voltage variation on HV side (unless otherwise specified).
Frequency	50 Hz (or as specified in project requirements).
Insulation Level (BIL)	As per system voltage and IEC 60076-3 requirements.
Short Circuit Withstand	Transformer shall withstand thermal and dynamic effects of short circuit as per IEC 60076-5.
Temperature Rise	Shall comply with IEC limits for ONAN or AN cooling. Designed for continuous rated operation under site ambient conditions.
Type Tests	Transformer shall be type tested as per IEC 60076 / IEC 60076-11. Valid type test certificates from accredited laboratory shall be furnished.
Routine & Special Tests	All routine, type and special tests as per applicable IEC standards shall be conducted. Test reports shall be submitted for approval.
Oil (for Oil-Filled Units)	Mineral insulating oil conforming to IEC 60296. Oil level indicator and necessary accessories shall be provided.
Environmental Suitability	Suitable for outdoor installation with protection against dust, humidity, temperature variation and wind loading.
Impedance	Percentage impedance shall be suitable for system fault level and protection coordination (to be specified/approved).
Sound Level	Sound level shall be within limits specified in IEC 60076.
Protection & Accessories	Standard accessories including temperature indicators, conservator (if applicable), PRD, breather, earthing terminals, marshalling box (if applicable), etc., shall be provided as per IEC and OEM standard practice.
Documentation	GA drawings, SLD, datasheets, loss data, impedance details, test certificates and calculations shall be submitted for Employer's review and approval.

14.7 Transformer Protection Scheme: Each WTG step-up transformer shall be provided with a comprehensive protection and switching arrangement in accordance with applicable IEC standards. The protection scheme shall include:

- A 33kV (or other approved voltage level) Vacuum Circuit Breaker (VCB) housed in an outdoor/indoor kiosk conforming to IEC 62271, with suitable protection relays and interlocking arrangements.
- Horn Gap Fuse, if specifically recommended by the Transformer/WTG OEM and compliant with relevant IEC standards.
- Lightning Arresters (metal-oxide type, gapless) mounted on a suitable galvanized steel support structure, rated for the system voltage and insulation level.

The protection coordination, insulation level (BIL), short-circuit withstand capability and relay settings shall be designed to ensure selectivity with upstream and downstream protection devices. The Contractor shall submit detailed protection coordination studies for approval.

14.8 Unit Substation (USS) and Compact Substation: For the Unit Substation (USS) of each WTG, a compact substation (CSS) arrangement shall be acceptable, provided it complies with IEC 62271-202 (High-Voltage/Low-Voltage Prefabricated Substations).

In case of a compact substation:

- a) Horn Gap Fuse and Lightning Arresters shall be provided as per OEM recommendations and applicable IEC standards.
- b) Dry-type transformers conforming to IEC 60076-11 shall be acceptable for installation at the USS, within the WTG nacelle, or inside the tower, subject to design approval and statutory compliance.

14.9 Transformer Mounting and Structural Requirements: The transformer shall be installed in one of the following configurations, as per OEM design and project requirements:

- a) Nacelle-mounted
- b) Tower-mounted
- c) Ground-mounted on a suitably engineered plinth or elevated platform

The mounting structure shall be designed in compliance with relevant structural standards and wind loading criteria. For nacelle or tower-mounted transformers, structural adequacy and dynamic loading considerations shall be validated by detailed design calculations. Where ground-mounted, the plinth/elevated platform shall:

- a) Be designed for static and dynamic loads.
- b) Ensure adequate oil containment (for oil-filled transformers) as per environmental norms.
- c) Provide safe access for operation and maintenance.

14.10 Fencing, Safety and Statutory Compliance: The transformer area for each WTG shall be provided with a secure fencing arrangement in accordance with:

- a) Requirements of the Chief Electrical Inspector to Government (CEIG)
- b) Applicable provisions of the Central Electricity Authority (CEA) Regulations
- c) Relevant STU/CTU connectivity and safety requirements
- d) Applicable IEC safety standards, including IEC 61936-1 (Power Installations Exceeding 1 kV AC).

The fencing shall:

- a) Prevent unauthorized access to energized equipment.
- b) Maintain minimum statutory safety clearances.
- c) Include lockable gates and appropriate danger signage in accordance with IEC and statutory requirements.

The Contractor shall also ensure compliance with any security directives or guidelines issued by Government authorities from time to time. All safety provisions shall be incorporated in the detailed engineering and shall be subject to approval by the Employer and statutory authorities.

14.11 The Wind Turbine Generators (WTGs) shall be interconnected through a 33 kV overhead line network for evacuation of generated power to the incoming feeders of the 33 kV Pooling Substation (PSS) switchgear panel. The interconnecting system shall be designed considering technical losses, voltage regulation, short-circuit levels, system reliability, and applicable statutory regulations.

14.12 The grid interconnection arrangement for each individual WTG or for grouped WTGs shall comprise, but not be limited to, the following:

- a) Outdoor / Indoor High Voltage Vacuum Circuit Breaker (VCB) of suitable rating
- b) Double Pole (DP) structure with complete metering arrangement
- c) Time-of-Day (TOD) compliant energy meter
- d) CTs/PTs of required accuracy class
- e) Isolators, Lightning Arresters, and associated protection equipment

All equipment shall conform to relevant IS/IEC standards and the requirements of the concerned State Transmission Utility (STU) / DISCOM / Grid Code. Metering and protection schemes shall be strictly as per prevailing State Policy and utility regulations.

14.13 The Contractor shall submit a comprehensive Power Evacuation Scheme for review and approval by the Employer. The submission shall include, but not be limited to:

- a) Single Line Diagram (SLD)
- b) Load flow and short-circuit calculations
- c) Protection coordination study
- d) Conductor sizing calculations
- e) Voltage drop and loss calculations
- f) Details of grid interconnection point

g) Compliance with grid connectivity and metering regulations

14.14 Any equipment, material, accessory, protection device, control component, or installation activity not explicitly mentioned in this specification but deemed essential for the safe, reliable, and statutory-compliant operation of the complete electrical system shall be included in the Contractor's scope of work. No additional cost shall be payable for such items, and the system shall be handed over in a fully functional and grid-compliant condition.

14.15 Metering: Each Wind Turbine Generator (WTG) shall be provided with an independent three-phase, four-wire, bi-directional energy meter of accuracy class 1.0 or better, conforming to applicable IS/IEC standards and utility regulations. The meter shall be installed on the high-voltage side of the Unit Transformer. The energy meter shall:

- a) Record active energy (kWh) export and import separately
- b) Provide real-time measurement and data logging capability
- c) Be capable of Time-of-Day (TOD) recording, if required
- d) Support communication interface compatible with the Plant SCADA system

Energy export and import values recorded in the Local Control Station (LCS) shall be continuously logged and integrated into the Plant SCADA system for monitoring, reporting, and reconciliation purposes.

Note:

- a) Metering arrangement at the incoming feeders of the 33 kV Pooling Switchgear Panel, including supply, installation, testing, commissioning, calibration, communication integration, statutory approvals, and compliance with applicable CEA / CERC / SERC / STU / DISCOM requirements, shall be entirely in the scope of the Solar + BESS Contractor.
- b) The Wind EPC Contractor's scope shall exclude the above metering system at the pooling switchgear incomer feeders, except for necessary coordination to ensure seamless integration with the overall plant SCADA and grid compliance requirements.

15 Wind Monitoring Mast

15.1 The bid should include supply, installation and maintenance of one wind monitoring mast at offered site.

15.2 The height of the wind mast should be close to the hub height of the WTGs installed therein with all the equipment and sensors (anemometers, wind vanes, temperature

and pressure sensors and data loggers etc.) required as per the IEC-61400-12-1: 2017 for the performance of the Power Curve Verification Test. This shall include all required data loggers, sensors etc. capable of recording data for a minimum of 10minute intervals to ensure correct and reliable data collection and its computation for analysis, for verification of generation with reference to the actual wind conditions at Hub height.

N.B.: The bidder must quote this item separately in the price bid.

16 Communication with LCS

16.1 General: The Central Monitoring and Control System (CMCS) / Plant SCADA shall be under the scope of the Solar + BESS Contractor.

However, provision of all necessary hardware, software interfaces, communication ports, data points, and integration support required to establish seamless connectivity between the Wind Turbine Generator (WTG), Local Control Station (LCS) and the CMCS / Plant SCADA shall be entirely under the scope of the WTG EPC Contractor.

Clear demarcation of scope and interface responsibilities shall be maintained to ensure successful integration without any functional limitation.

16.2 Data Acquisition and Monitoring: The Local Control Station (LCS) shall be responsible for data acquisition, monitoring, and control of all Wind Turbine Generators (WTGs) and associated grid parameters within the project scope. All operational, electrical, status, alarm, event, and performance data measured at each WTG shall be made fully accessible to the Central Monitoring and Control System (CMCS) / Plant SCADA without restriction.

In addition to WTG parameters, the LCS shall measure and make available the following grid parameters at the interconnection point:

- a) Three-phase voltage
- b) Grid frequency
- c) Active and reactive power
- d) Current and other relevant electrical parameters

The WTG Contractor shall ensure that:

- a) All required data points are mapped and documented in a Data Point List (DPL).
- b) Communication ports and protocol configuration are provided at the LCS end.
- c) The system is fully compatible with the CMCS / SCADA architecture being implemented by the Solar + BESS Contractor.

16.3 Communication Architecture: Data exchange between the LCS (Wind Scope) and the CMCS / Plant SCADA (Solar + BESS Scope) shall be through standard industrial communication interfaces such as:

- a) Serial Interface
- b) RS-232 / RS-485
- c) Ethernet-based communication
- d) Fiber Optic interface
- e) Or other industry-standard protocol (e.g., Modbus TCP/IP, IEC 60870-5-104, IEC 61850, IEC 61400-25 or equivalent)

The WTG EPC Contractor shall clearly define the proposed communication protocol, interface hardware, data refresh rate, redundancy philosophy, cybersecurity provisions, etc. in the bid.

All necessary interface equipment, converters, protocol gateways, media converters, switches, patch panels, termination accessories, and configuration required at the LCS end for successful data transmission to the CMCS shall be included in the WTG EPC Contractor's scope.

16.4 Fiber Optic / Wireless Communication: Where Fiber Optic or Wireless communication is proposed between WTG LCS and the interface point, the WTG EPC Contractor shall provide all required communication equipment in compliance with relevant IS/IEC standards as applicable. The communication system shall ensure:

- a) Adequate bandwidth and low latency
- b) High reliability and availability
- c) Immunity to electromagnetic interference
- d) Suitability for site environmental conditions

16.5 Scope Boundary Clarification:

- a) CMCS / Plant SCADA system: **Under Solar + BESS Contractor Scope**
- b) LCS and WTG internal communication: **Under WTG EPC Contractor Scope**
- c) Interface provision and successful integration between LCS and CMCS: **Under WTG EPC Contractor Scope**, including coordination and commissioning support

The WTG EPC Contractor shall extend full cooperation during integration, testing, commissioning, and performance validation of the complete monitoring and control system.

17 Central Monitoring and Control System (CMCS)/SCADA

17.1 The Central Monitoring and Control System (CMCS) / Plant SCADA system for the project shall be under the complete scope of the Solar + BESS Contractor.

The CMCS shall provide centralized monitoring, supervisory control, data acquisition, reporting, alarm management, and performance analytics for the entire Renewable Energy Plant comprising Solar PV System, Battery Energy Storage System (BESS), Wind Turbine Generators (WTGs) through LCS interface, Pooling Substation (PSS) equipment & Grid interconnection systems. The system shall be designed for continuous, reliable, and secure plant-wide operation.

The CMCS / SCADA system shall, as a minimum, provide the following functionalities:

Monitoring:

- a) Real-time monitoring of electrical and operational parameters of Solar, BESS, Wind (via LCS), and PSS systems
- b) Monitoring of grid parameters (voltage, frequency, power factor, active/reactive power)
- c) Breaker/isolator status, protection signals, and alarms

Data Acquisition & Logging:

- a) Continuous data acquisition from all plant subsystems
- b) Time-stamped event and alarm recording
- c) Historical data storage with configurable resolution
- d) Minimum data retention period as per statutory and Employer requirements

Control Functions:

- a) Supervisory control of plant equipment as permitted under Grid Code and protection philosophy
- b) Remote set-point control (if applicable)
- c) Curtailment control, reactive power control, and grid support functions.
- d) SCADA/ CMCS shall be possible to carry out start the WTGs, stop the WTGs, reset of alarms, modification of configurable alarm limits (where permissible), etc. **through the LCS & PPC interface.**

17.2 Integration with WTG Local Control Station (LCS): The CMCS shall interface with the Wind Turbine Generator Local Control Station (LCS) for acquisition of all relevant wind turbine and grid data. The Solar + BESS Contractor shall:

- a) Provide necessary SCADA servers, workstations, networking infrastructure, and database systems
- b) Ensure compatibility with the communication protocol proposed by the WTG EPC Contractor
- c) Integrate data received from LCS into the unified plant SCADA platform

The WTG EPC Contractor shall provide communication interface and data at the designated LCS output port, as defined elsewhere in this specification. **Final integration testing, signal verification, and commissioning of the communication link between CMCS and LCS shall be carried out jointly by both contractors.**

17.3 Telemetry to RLDC: In compliance with CERC Order No. 1/14/2015-Reg.Aff. (FSDS-Proceed.)/CERC dated 03.03.2017 and subsequent amendments:

- a) The WTG EPC Contractor shall provide necessary WTG-level data at the plant interface point.
- b) The Solar + BESS Contractor shall integrate and transmit required telemetry data to the concerned RLDC/SLDC through the CMCS/SCADA system.

The complete telemetry solution shall comply with prevailing Grid Regulations, including hardware, software, communication links, and protocol requirements.

17.4 Supply of power plant controllers (PPC) and development of entire energy plant (Solar + BESS + Wind) model in PSS/E & PSCAD software as per CTU/STU (as applicable) are in the scope of the Solar + BESS Contractor. Detail control logic in the PPC shall be finalized during detail engineering and same shall be in line with the above regulation requirements. CMCS/ SCADA and PPC network shall be suitably designed, so that PPC shall directly and independently able to control the individual WTG for active and reactive control.

17.5 After certain faults as per LCS settings, the WTGs are restarted automatically. To avoid excess voltage drops, the CMCS/SCADA shall inhibit start of more than one WTG at a time. The time between start of WTGs must be adjustable in the range 0 to 60 sec.

18 Floating Stock of Gear Boxes (not applicable for gearless machines)

18.1 To avoid linger down time due to gearbox failure in the WTG, the contractor should have a floating stock of gearboxes at their closest service centre/factory. Whenever the gearbox requires any repair, the contractor shall send one from their stock for temporary replacement to keep the machine running even during the period or repair of the gearbox at no extra cost.

19 Grid Compliance Requirement

19.1 Regulatory Compliance: The individual WTGs shall comply with the applicable Grid Connectivity Regulations, 2007 and all subsequent amendments, including but not limited to:

- a) Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2019 (as amended)
- b) Applicable CERC / SERC Regulations
- c) CTU / STU connectivity requirements
- d) Relevant provisions of the Indian Electricity Grid Code (IEGC)

All equipment, protection systems, control systems, PPC, and SCADA integration shall be designed to meet the above regulatory requirements.

19.2 Power Factor and Reactive Power Compliance: The overall plant-level compliance with power factor and reactive power requirements at the Point of Interconnection (POI) shall be under the scope of the Solar + BESS Contractor. The Solar + BESS Contractor shall ensure that:

- a) The power factor at the Point of Interconnection (POI) is maintained at ≥ 0.95 (or as specified by applicable Grid Code / PPA).
- b) Reactive power consumption does not exceed 3% of the annual active energy exported, or as per prevailing regulatory requirements.
- c) Any additional reactive power compensation equipment (e.g., capacitor banks, STATCOM, SVG, or equivalent systems) required to meet grid compliance shall be provided within their scope.

The WTG EPC Contractor shall ensure that individual WTGs are capable of operating within their declared reactive power capability curve and support plant-level reactive power control through PPC integration.

B Guarantee/Warranty

1.1 Any material, equipment and/or accessories which prove defective or which fail to meet the design guarantee or Performance Guarantee during the defect's liability period (As mentioned under GCC) the Contractor shall replace / rectify at his own cost such material, equipment and/or accessories.

1.2 The Contractor shall guarantee the wind farm and installation work for a period of the defects liability period as mentioned under GCC. Any damage or defect that may arise or lie undiscovered at the time of issue of completion certificate, connected in any way with the equipment or materials supplied by him or in the workmanship, shall be

- rectified or replaced by the Contractor at his own expenses as deemed necessary by
- 1.3 the Engineer-in-Charge or in default, the Engineer-in-Charge may cause the same to be made good by other workman and deduct expenses (for which the certificate of Engineer-in-charge shall be final) from any sums that may be then or at any time thereafter, become due to the Contractor or from his Performance Bank Guarantee.
- 1.4 Serial Defect Liability Period shall be as per the GCC clause 27.2. Serial Defect shall mean occurrence of the similar faults in at-least 10% of the WTGs in a given time interval. Under this Serial Defect Liability, the Bidder will be required to rectify or replace all such serial defects in all the WTGs of the Project.

C Inspection and Testing

- 1.1 All major/critical items (towers, rotor blades, nacelle assembly, generators, transformers, and control panels) shall be inspected and tested through third party inspection agency during manufacture and in assembled condition prior to dispatch in accordance with the standard practice/ QAP of the manufacturer and applicable standards at no cost to Employer. Copies of test certificates for such inspections in triplicate shall be supplied before dispatch of the equipment.
- 1.2 After the award of work, the successful bidder shall furnish a complete list and details of all tests to be conducted on all major equipment.
- 1.3 The bidder shall also furnish a schedule of inspection / testing so that Employer may associate is representative to witness the tests. The Contractor shall also furnish copies of all test/inspection reports for records and reference of Employer.
- 1.4 SECI reserves the right to witness the tests on mutually agreed items / stages at manufacturing units. The final test certificates for the major critical equipment shall be submitted to Owner for records. However, such inspections shall not absolve the Contractor from the responsibility to provide performance guarantee/warranty.
- 1.5 Contractor shall arrange and extend necessary cooperation for effectively carrying out inspection / testing.
- 1.6 Inspection shall be carried out (through sampling method) on major items: towers, rotor blades, nacelle assembly, generators, transformers and control panels. For HT/EHT Circuit Breakers manufacturers test certificate shall be submitted. All other items like cables, conductors, relays and associated equipment/components shall confirm to relevant international/national standards.
- 1.7 All the standard tests in accordance with the Standards adopted shall be carried out at the manufacturer's works on all the major equipment and accessories so as to ensure

efficient operation and satisfactory performance of all the components.

1.8 Factory Tests:

1.8.1 Factory tests include testing, adjusting and calibration of all components and systems.

1.8.2 The testing of major critical equipment & the inspection thereof shall be carried out as per the manufacturer's Quality Assurance Plan for such equipment, a copy of which shall be submitted to Owner for review during detailed engineering. The test program shall include at least:

- a) Balancing of blades & shafts (as applicable)
- b) Mechanical brake system
- c) Power system including generator, transformer, cables, primary & secondary power evacuation system components (CB, Isolator, LA, CT, PT etc) according to IEC/IS and factory standard test.
- d) Switch board, CRP, Control Panels including capacitor banks, according to IEC/IS and factory standard tests.
- e) Safety systems
- f) Control functions
- g) Alarm functions
- h) Display functions
- i) Automatic data collections
- j) NDT (UT/MPI/LPT) on Tower / Mast, casted hub, casted nacelle / main frame, generator cantilever

1.8.3 SECI's involvement in testing of major items viz. tower, blades, hub, nacelle assembly, generators, control panels, transformers, switchgear (indoor & outdoor), switchyard equipment (CT, PT, LA, Isolator, poles, conductor, etc.) shall be discussed & mutually agreed.

1.9 Functional Guarantee Test Procedure for Provisional/Operational Acceptance of the Pant Facilities shall be performed as per the detailed procedure laid out in Annexure II of SS-F: Operation & Maintenance Agreement.

D Civil Works

1 Scope of Work

The scope of work under civil work shall include:

- 1.1 The land should be handed over to Owner on foot print basis with boundary marked by stone pillars of approx. 1 ft. (H) x 6" (W) x 6" (Th) above the ground.
- 1.2 Conducting contour survey and soil testing/ Geotechnical investigation
- 1.3 Foundations of WTGs.

- 1.4 Foundations for step-up transformers & HT switchgear kiosk etc.
- 1.5 Room for housing WTG local control panels (applicable for WTGs with lattice type tower).
- 1.6 Motorable approach & internal roads suitable to bear the load of heaviest equipment of WTG shall be constructed as per prudent practices generally followed at wind farm sites. The internal /approach roads on sharing basis shall be acceptable.
- 1.7 Basic amenities for staff in office.

2 Design Criteria

- 2.1 All civil, structural and architectural work shall be designed, supplied and constructed as per latest editions of Indian Codes and Standards with addendums and supplements issued by BIS or relevant International Standards. In case of ambiguity between codes, specifications and drawings, the more stringent of them shall govern.
- 2.2 The Contractor shall conduct geo-technical investigation and decide on various design parameters he proposes to adopt for foundation design. Based on ground water and sub-soil chemical environment, the requisite measures for protection of foundation/sub-structure shall be taken as per IS:456. No commercial implications for any variations in this regard during execution shall be entertained.
- 2.3 All structures and portions thereof shall be analyzed and designed to sustain various loads and combinations thereof, conforming to the latest revision of applicable Indian Standards, specifications, engineering practice and other technical requirements. All structures shall be designed to sustain worst combination of dead loads plus assigned live loads, equipment, wind, seismic, temperature or other loads it is being subjected to.
- 2.4 Minimum factors of safety against overturning, sliding and hydrostatic up lift adopted for design shall be as per relevant Standards and Codes.
- 2.5 Stability of structures shall be investigated for loading conditions during construction. However, factors of safety given in relevant Standards and codes shall also be taken care of.

3 Materials & Job Specification

- 3.1 All construction materials and practices shall be finalized by the Contractor, considering the design life of the plant.

4 Detailed Contour Survey & Soil Investigation of the Site

- 4.1 A detailed contour survey with 5m contour interval shall be carried out and drawings

prepared by the Contractor. Boundary stones of approx. 1 ft. (H) x 6"(W) x6"(Th), shall be fixed for identification of land. The Contractor shall also be responsible for detailed soil investigation at all WTG locations for the purpose of finalization of foundation system. The Contractor should conduct soil test on their-own and design structures accordingly.

5 Land Development for site activities

- 5.1 The Contractor shall be responsible for making the site ready by clearing of bushes, felling of trees (if required), leveling of ground (wherever required) etc. for commencing the project.

6 WTG Tower Foundation

6.1 General

- 6.1.1 The work shall comprise of design and construction of WTG foundations as per locations indicated on the final layout drawings prepared after micro-siting.
- 6.1.2 The foundations shall be designed to take adequate care of the possible soil condition and adverse seismic effects on the basis of soil conditions of the site. For this purpose, the Contractor is required to carry out the soil investigation at each WTG location prior to the foundation work.
- 6.1.3 The foundation design shall suit the local soil conditions and the materials used viz. cement, reinforcement steel etc. shall conform to IS:456 or relevant standards.
- 6.1.4 The soil conditions, survival wind speed, load on tower and foundation, together with such other parameters required for a safe design of tower and its foundation shall be considered by the Contractor
- 6.1.5 The foundation system design and drawing including available bearing capacity, shall be vetted by reputed engineering institutes like IIT / NIT /SERC (CSIR-Structural Engineering Research Centre) and a certificate for the same to be submitted by the Contractor during detailed engineering along with other documents for the approval of the employer.
- 6.1.6 The drawing for WTG foundation as per bidder's standard practice shall be submitted indicating the general arrangement & cross-sectional details besides the reinforcement details of foundation.

6.2 Excavation, back filling and erosion control measures.

- 6.2.1 The Contractor shall carry out all excavation works in accordance with the dimensions and levels indicated on the drawings.
- 6.2.2 The excavated material under above categories shall be kept separately, so that

good quality material can be used, as required.

- 6.2.3 Excavation shall be carried out in accordance with the guidelines given in IS:3764.
- 6.2.4 Blasting, if required, shall be carried out strictly in accordance with IS:4081 "Safety code for blasting and related drilling operations" and the latest State laws, regulations and rules. Blasting, if done, shall at all times be carried out under the supervision of fully qualified, experienced and licensed supervisors.
- 6.2.5 If any damage of any kind occurs, the Contractor shall be solely responsible for such damages or any claims that may arise there from, and shall, at his own expense, carryout repairs or restoration as required.
- 6.2.6 Back filling of foundation shall be carried wherever required with suitable materials. Filling materials shall be spread, levelled and thoroughly compacted. Each layer shall be separately compacted to achieve the required state of compaction.
- 6.2.7 For erosion control, stone pitching/soil filled geocell with vegetative cover may be adopted. For stone pitching, the area to be pitched shall be trimmed and any loose material re-compacted. Pitching shall be laid on a bed of approved granular material. For soil filled geocell with vegetative cover following technical specification may be followed.
- 6.2.8 Technical Specifications for Geocells
 - a) Material composition: High density polyethylene (HDPE) with a density of minimum 0.92 glee (tested as per ASTM D 1505).
 - b) Carbon black content: 1.50-2 % by weight (tested as per ASTM D 1603).
 - c) Cells with nominal opening of 450 cm² to 1250 m².
 - d) The polyethylene strip shall be perforated with horizontal rows of maximum 10 mm diameter holes. Cell perforations area shall not exceed 12% of cell surface area.
 - e) Creep rupture strength (ASTM D2990): Creep rupture load at 10000 hours shall be IKN minimum obtained from the 95% prediction interval at 10000 hrs considering a logarithmic time/creep rupture model.
 - f) Cell depth (+/-3%): 75 mm.
 - g) Cell weight: min 0.4 kg/m² for 75 mm cell depth (calculated as section weight without packaging divided by the expanded section area as per suppliers' specifications).
 - h) Sheet wall thickness: min 1.3 mm (tested as per ASTM D 5199)
 - i) Seam peel strength: min 400 N per 75 mm joint (tested as per EN ISO

13426 Method-B)

- j) Environmental stress - Cracking Resistance (ESCR): min 4000 hrs (tested as per ASTM D 1693 for any standard style)
- k) Seam hang strength: min 7 days (tested as per ASTM D 751 for any standard style).
- l) Filling Material: Geo cell shall be filled with locally available soil. Vegetation shall be grown over it to make the erosion control more effective.

6.3 Reinforced Concrete & Plain Cement Concrete Works

- 6.3.1 The works shall consist of making and placing on Crete for reinforced concrete works in conformity with the drawings.
- 6.3.2 All materials, work man ship and testing shall comply with the latest revisions of the relevant Indian Standards Codes of Practices.
- 6.3.3 Plain and Reinforced cement concrete works shall be as per IS: 456.

6.4 Shuttering

- 6.4.1 The works shall consist of supply, fabricating, placing and removing all temporary forms for shaping of concrete, together with all temporary construction required to support such forms.
- 6.4.2 The Contractor shall be responsible for the correct dimensions, alignment, leveling, cleaning and oiling. Shuttering shall not be removed before the concrete is sufficiently set and hardened.

6.5 Steel Reinforcement

- 6.5.1 The work shall consist of supplying, cutting, bending, placing and fixation of reinforcement bars of the grade type and size specified on the drawings.
- 6.5.2 Reinforcement shall be of high strength deformed bars grade Fe-500D conforming to IS: 1786.

6.6 Anchor Plates/Anchor Bolts/ Stubs/ Circular Embedment

- 6.6.1 Anchor plates/Anchor Bolts/Stubs/Circular Embedment along with necessary templates will be provided by the wind electric generator supplier. The Contractor shall be responsible for correct placing and fixation in accordance with dimensions, levels and specifications within the tolerances given on the drawings.

6.7 Soil Investigation

- 6.7.1 Records of all soil investigations shall be kept as a part of final project data.

7 Control Cabin

- 7.1 In case of lattice type towers for the WTGs, it is essential to provide control cabin for housing the switch board and local control panels. Cabin shall provide adequate protection against weather and unauthorized entry. The foundation shall be designed to suit the soil conditions. The size of the cabin shall be adequate to house the equipment with required clearances and operating space. Cabin shall be constructed by using good quality stones/bricks. Roof slab shall be of RCC.
- 7.2 Door, Window, Ventilators shall be of metal construction and painted with 2 coats of paint over two coats of suitable primer. Cable trench as required shall be provided. The Contractor shall furnish the plan and construction details of the control cabin, in the bid, in case the bid is for WTGs with Lattice Towers.

8 Switch yard civil works

- 8.1 Switch yard civil work includes step up transformer plinth, HT Switchgear kiosk plinth, two pole/4 pole structure foundation, earth pits, metal spreading curb wall in and around switchyard and fencing. The transformer/ HT switchgear kiosk plinth shall be made of concrete or dressed stones masonry conforming to relevant standards. The height of transformer/HT Switchgear kiosk plinth shall be decided based on the requirement of ground clearance as per voltage of unit sub-station.
- 8.2 Earth pit construction shall be of brick masonry with pre cast RCC (1:2:4) cover. The fencing of the switchyard shall be with GI chain link of 1800mm height with MS Angle posts. The gate shall be made of steel of the same height as that of the fencing.

E Safety Requirements for Wind Turbine Generator and associated Equipment

- 1.1 The Contractor shall ensure incorporation of all necessary systems/ arrangements for safe working of the wind farm as a whole. Following safety aspects shall be incorporated during design of the wind turbine generator and its associated equipments/ systems
- 1.2 Wind Turbine Tower shall have either of the following provision for climbing to the nacelle of WTG.
- 1.2.1 Provision for lift: The adequate capacity lift (at least two-person capacity) shall be provided for the units having tower height of 80 MT and above. The lift shall be approved & certified by statutory authority/ lift inspector. During O&M phase the statutory testing & certification of the lift shall be in bidder's scope. Lift shall be

equipped with the emergency safety facilities such as over speed arrester.

- 1.2.2 Automatic dragging rope/climbing puller arrangement: An automatic dragging rope/climbing puller shall be provided, the equipment shall be provided with Nylon rope, which shall be suitably designed to share at least 30% of the weight of the person climbing the rung ladder. This is to facilitate the effortless climbing by a person while using the rung ladder. The operating instructions for safe use of climb puller shall be attached at the base of tower.
- 1.3 Provision for vertical fall arrester:
 - 1.3.1 The rung ladder, if provided shall be equipped with fall arrester and instruction sheet shall be provided near the rung ladder for procedure to use the fall arrester. Full body harness use shall be made compulsory while climbing the tower with rung ladder with or without climb puller
- 1.4 All the safety devices used including Lift/Puller arrangement shall have been certified for use in offered WTG by the competent lab/authority.
- 1.5 Contractor shall be responsible for renewal of License/Certificates of safety devices used in the WTG if validity of such License/Certificates is due for renewal on or before the six months from the end date of O&M or DLP of the project under the scope of contractor.
- 1.6 Platform: Platforms made up of chequered plates shall be provided at approximately each 20 m height with hatches and non-slippery floor. The hatches should be lockable.
- 1.7 Rescue plans: Rescue plans showing the way to emergency exit (highlighted by emergency lighting) should be provided at following locations
 - i) In the nacelle assembly
 - ii) Near entrance of platform at each level
 - iii) At the entrance at Tower bottom.
- 1.8 Power cable terminations: All Electrical power cable terminations including the cables from generator to the bottom of the tower must be terminated and insulated properly with heat shrinkable insulation kit.
- 1.9 Emergency exits: Emergency exits shall be provided at required levels to facilitate the evacuation in case of any emergency while the persons are inside the wind turbine generator.
- 1.10 Fire extinguishers: Dry chemical type Fire extinguishers of suitable capacity as necessary shall be provided at following locations
 - i) Nacelle Assembly

- ii) Base of the tower
- iii) 33 kV Substation.
- iv) Inside the lift (as applicable)

1.11 First aid box: First aid box with all first aid kit shall be provided at following locations

- i) Nacelle Assembly
- ii) Base of the tower

1.12 Electric wrench /Hoist for Material lifting:

1.12.1 Electrical wrench/hoist of suitable load handling capacity based on the wind turbine design shall be provided at nacelle assembly for the material handling during maintenance of the WTG unit. Hoist capacity shall be suitable for handling the maintenance tools/tackles/equipment and also the spare parts which are replaceable at the nacelle at tower top itself to reduce the downtime during maintenance, bidder to confirm the same while selecting the hoist capacity. The reach of the hoist shall be up to the Tower base.

1.12.2 The opening in the nacelle base for unloading through wrench/hoist shall be provided with manual lockable door. The material of the door shall be strong enough to sustain the loads expected in the nacelles during manpower movement and equipment maintenance.

1.13 Protection against cable terminals, bus bars near ladder Protection against open cable terminals, cable trays, bus bars near ladder area shall be provided to avoid electrical accidents during climbing inside tower.

1.14 Proper Ventilation, Heating and Cooling Arrangement

1.14.1 Proper Ventilation, Heating and Cooling Arrangement shall be provided in the nacelle assembly for maintaining proper working conditions for workmen during the maintenance.

1.15 Lighting arrangement

1.15.1 Adequate lighting arrangement shall be provided at basement of the tower, near ladder, critical maintenance areas inside tower, nacelle assembly.

1.16 Lightning arrester

1.16.1 Lightning arrester arrangement shall be provided in the blades of the wind turbine generator to take care of lightning striking at wind turbine. Lightning arrester shall also be provided in the nacelle to protect the wind turbine generator against lightning.

- 1.17 Apart from the above specified guidelines for safety system, bidder shall on their own review and provide the safety systems for the entire plant to ensure safe working and operating conditions during erection, commissioning, operation, testing and maintenance of the WTG plant and Electrical system.

F Erection and Installation of all items

- 1.1 All the above items, including other items, which is required for successful commissioning and operation of wind farm shall be erected as per relevant standards and to ensure satisfactory functioning of wind firm.
- 1.2 Items/Information not specified but required/ essential
- 1.2.1 Contractor shall supply any additional equipment and materials, which are not specifically mentioned in the contract but are required to complete the system, offered by him in every respect, and for safe and efficient operation and guaranteed performance. It shall be the responsibility of Contractor to furnish such materials and equipment and provide the services specified accordingly.
- 1.3 A list of tools & tackles shall be submitted along with the bid for reference purposes.
- 1.4 However, such tools & tackles shall not be required to be supplied to Owner but shall be made available as & when required for erection activities of this project.

G Commissioning

- 1.1 NIWE certified final AEP will be required to be submitted with the actual / as built micro-siting at site.
- 1.2 The commissioning certificate as issued by State Nodal Agency or SECI shall be considered as Commissioning Certificate for all purposes. However, the Contractor may note that Owner will issue Completion Certificate after completing the trouble-free operation of WTGs continuously for 96 hrs. **(Ref: GA-E: Plant Commissioning Test Procedure)** post stabilization period.
- 1.3 The verification of actual generation by the test WTG shall be verified during power curve testing, to be conducted as per the given procedure in GA-E: Plant Commissioning Test Procedure. The commissioning as per OEM's standard practices followed in the industry & as acceptable to the State Nodal Agency or SECI shall be applicable.
- 1.4 Commissioning shall be done strictly as per OEM's instructions manual, international/ Indian Standards and IE Rules. History cards shall be provided for each WTG.

H Documentation and Submittals

1. General Requirements:

- 1.1 The Contractor shall furnish complete and comprehensive documentation necessary for verification of contractual compliance, statutory approvals, commissioning, operation and long-term maintenance of the Wind Farm.
- 1.2 All documentation shall be submitted in the English language and shall be sufficiently detailed, clear, and instructional to enable operation, maintenance, troubleshooting, repair, and modification of the plant without reliance on the manufacturer's technical support. Manuals and miscellaneous documentation shall be provided in properly bound volumes as well as in editable soft copy format.
- 1.3 Review, comments, or acceptance of drawings and documents by the Employer and/or Consultant shall not relieve the Contractor of responsibility for correctness, completeness, adequacy, safety, or compliance of the design and works.
- 1.4 All documents shall bear clear titles indicating the project name, Employer, facility location, document number, revision number, and document function.

2. Requirement of Single WTG unit Simulation model & Benchmarking report: The Bidder/OEM shall submit a validated simulation model and benchmarking report for a single Wind Turbine Generator (WTG) unit in compliance with applicable CEA Connectivity Regulations and associated guidelines.

- a) Single SoC (Statement of Conformity) and Evaluation Report for Type Test certification as per CEA Technical Standards for Connectivity to the Grid, clearly indicating all hardware, software and firmware versions of the WTG and controller.
- b) Voltage–current characteristics of the WTG during fault conditions, including contribution during symmetrical and asymmetrical faults.
- c) Provision for capture and recording of current and voltage waveforms at WTG output terminals during LVRT and HVRT events. The recorded data shall be accessible to NGEL through PPC/SCADA.
- d) WTG time synchronization facility with PPC and SCADA using GPS/NTP or equivalent industry-accepted protocol.
- e) WTG controller settings shall be compliant with CEA Grid Connectivity Regulations and submitted as part of the documentation.
- f) Validated single WTG simulation models shall be provided in RMS (PSS®E) and EMT (PSCAD) platforms. The models shall be benchmarked against lab/factory/field test measurements used during certification.

The benchmarking report shall include model validation against all clauses specified in B1 and B2 of CEA Technical Standards for Connectivity to the Grid (Amendment) Regulations, 2019.

The Bidder shall refer to the “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 its subsequent amendments/clarifications for detailed benchmarking requirements.

- g) Provision shall be available to modify WTG control settings to suit site-specific operating conditions, subject to compliance with CEA regulations and approval by NGEL.

Following shall be minimum part of the submission:

- a) Comparison of field test measurement with simulation results numerical values & as well as graphical values for following points.
- Power Quality (only in EMT).
 - Active power set change (RMS & EMT)
 - Reactive power control- V control, pf & Q control (RMS & EMT)
 - WTG capability demonstration (RMS & EMT)
 - LVRT (RMS & EMT)
 - HVRT (RMS & EMT)
 - Frequency response (RMS & EMT)
- b) Final Model Parameters: Complete model parameters including generator model, electrical control model, drive-train model, converter model, protection model, etc. for both RMS and EMT simulations.
- c) Firmware version of the WTG controller corresponding to the certified WTG model shall be clearly mentioned.
- d) Field Test References: All field test and certification documents used for benchmarking shall be referenced in the report.
- e) Consistency of Settings: WTG settings used during field testing and the actual WTG installed at site shall be identical. Any deviation shall be justified with technical reasoning and approval from NGEL.
- f) RMS Model Flat-Run Test: Flat-run simulation for 100 seconds with a simulation time-step of 1 ms. Electrical parameters (P, Q, V, f) and rotor speed shall be recorded and included in the report.

- g) EMT Model Flat-Run Test: Flat-run simulation for 100 seconds with a simulation time-step of 10 μ s or better. Electrical parameters (P, Q, V, f) and speed shall be recorded. The EMT model shall initialize within 3 seconds and shall support snapshot functionality.
- h) Model compatibility:
- EMT model shall be compatible with PSCAD v4.6 and above with Intel Visual Fortran v15 or higher.
 - RMS model shall be compatible with PSS®E v34.4 and above.
 - EMT models compatible with PSCAD v5 (latest version) using GNU Fortran and Intel Fortran compilers shall be provided.
 - If models compiled with one compiler are not compatible with the other, both compiled versions shall be submitted.
- i) Controller & Model Parameter Table: A consolidated table of WTG controller settings and RMS/EMT model parameters for all control functions shall be included.
- j) Model File Submission:
- PSS®E: .sav, .dyr, .py, .idv, .sld, .out files
 - PSCAD: .pscx files and all supporting library/dependency files.
- k) The conclusion section shall include a summary table listing all benchmarked models and their compliance status. The deviation between simulation results and actual field measurements shall be minimized and shall not exceed $\pm 5\%$.
3. **Engineering Submittals:** Necessary submittals shall be finalized during the detailed engineering stage as per the mutually agreed & finalized MDL. as per the The Contractor shall provide three copies of the following information, drawings and documents, within four weeks of the placement of order:
- a) Technical particulars and general data of WTGs, Generator, Rotor, Tower, Yawing system, Brake system, Gear system (in case of geared machines), Hub, Nacelle, Main shaft, Main bearing, Coupling, Power panel, Control system, Power factor compensation (if required), AC-DC-AC convertor (if required).
 - b) Technical particulars, guaranteed technical parameters, drawings, and valid Type Test Reports for the WTG step-up transformer and all equipment forming part of the Unit Sub-Station (USS), including but not limited to circuit breakers, isolators, earthing switches, current transformers (CTs), potential/voltage transformers (PTs/VTs), surge arresters, cables, busbars, protection relays, metering equipment, marshalling kiosks, and auxiliary power supply systems.

Note: All equipment shall comply with the latest applicable Indian Standards (IS), IEC standards, and CEA Technical Standards for Electrical Plants and Electric Lines, as applicable. Type Test Reports shall be issued by NABL-accredited or internationally recognized independent laboratories and shall be valid for the offered rating and design. In case of design deviations from standard tested configurations, the Bidder shall submit detailed justification along with additional test certificates, if required.

- c) Technical particulars, design calculations, drawings, and valid Type Test Reports for the entire 33 kV overhead transmission system connecting the Unit Sub-Station (USS) of each WTG to the dedicated incoming feeder of the Pooling Switchgear at the pooling substation.

The scope shall include, but not be limited to, line conductors, poles/towers, insulators, cross-arms, line hardware fittings, stay sets, foundations, earthing systems, anti-climbing devices, danger plates, vibration dampers, spacers (if applicable), overhead earth wire (if provided), optical ground wire (if applicable), jumpers, and all associated accessories required for complete and safe installation.

- d) Route alignment drawings, longitudinal profile, tower/pole spotting schedule, crossing details (roads, canals, railways, rivers, HT/LT lines), statutory clearances, right-of-way details, and compliance with safety clearances as per CEA regulations.
- e) The Bidder/OEM shall submit detailed General Arrangement (GA) drawings and layout drawings of all machinery and equipment associated with the WTG and Unit Sub-Station (USS), including complete electrical equipment layouts. The drawings shall clearly indicate equipment placement, clearances, access pathways, maintenance space requirements, cable routing, earthing arrangement, fire safety provisions, and interfaces.
- f) Detailed specifications and procedures for anti-corrosion protection of all exposed and buried metallic components of the WTG, USS, 33 kV overhead line structures, foundations, and associated hardware. The specification shall include surface preparation methods, coating systems (galvanization/epoxy/polyurethane/painting systems), minimum coating thickness, expected service life, corrosion category as per ISO/IS standards, inspection and testing methods, repair procedures, and warranty period.
- g) The Bidder/OEM shall submit the complete protection philosophy and scheme for the WTG and Unit Sub-Station, including protection functions, relay settings philosophy, coordination studies, interlocking logic, redundancy philosophy, fail-safe features, and interface with pooling substation protection. Detailed protection single-line diagrams,

logic diagrams, setting calculation methodology, and protection coordination studies shall be provided for review and approval by SECI, as applicable.

- h) The Bidder shall submit the Final Annual Energy Production (AEP) report duly certified by NIWE for the offered wind farm configuration.
 - i) Micrositing plan of WTGs.
 - j) Comprehensive wind farm layout drawings shall be submitted showing the locations of WTGs, internal roads, crane pads, overhead/underground electrical lines, Unit Sub-Stations, pooling substation, control rooms, buildings, drainage, boundary fencing, and access routes. The layout shall indicate statutory clearances, right-of-way, land parcel boundaries, and interfaces with external infrastructure. All layouts shall be coordinated with civil, electrical, and environmental designs and shall be submitted in editable and PDF formats.
 - k) Detailed project planning network diagram (PERT/CPM) to be submitted within **one month from Contract signing**, including key engineering, procurement, construction, testing & commissioning milestones.
 - l) Foundation Drawings & Design Calculations of the WTG towers & 33 kV Unit Sub-Station Equipments considering the soil bearing capacity in the design.
 - m) SLD covering WTGs to 33 kV pooling switchgear incoming feeders, Internal collection system, 33 kV switchgear arrangement (incoming feeders only), Protection scheme and metering philosophy (as applicable to scope), etc.
 - n) Complete O&M manuals for WTGs and Unit Sub-Station equipment within scope, including Local Control System (LCS), SCADA interconnection with the Local Control System (LCS) & Central Monitoring & Control Station (CMCS), control philosophy, interlocks, alarms, and protections, & Operating procedures and emergency handling.
 - o) Detailed QAP (Quality Assurance Program) for all equipment and works within scope, mutually agreed during detailed engineering stage.
 - p) Progress Reports: Fortnightly and monthly progress reports (soft & hard copies) including physical & financial progress, slippages and recovery / catch-up plans, Key risks and mitigation measures, etc. Project review meetings to be held at predefined periodicity with Employer and Consultant.
4. Final Handover / As-Built Document Set: To be submitted within **four (4) weeks from completion / commissioning**. The Contractor shall submit **three (3) hard copies and two (2) soft copies** of the following:
- a) Approved Technical Documents: All drawings, specifications, and technical documents as per which the works were executed.

- b) As-Built Drawings: As-built drawings shall reflect all site modifications and final installed configuration.
- Four (4) sets of hard copies
 - Two (2) sets of soft copies (USB/drive)
- c) Test Certificates: Copies of type test, routine test, and acceptance test certificates for major equipment within scope (WTGs, transformers, switchgear, cables, protection panels, etc.).
- d) Soil test reports indicating Safe Bearing Capacity for WTGs and pooling substation foundations.
- e) All statutory permissions and approvals applicable to the project scope (environmental, electrical, local authority, forest/revenue land permissions, etc.).
- f) Complete erection, testing, and commissioning records and certificates issued by the Electrical Board / DISCOM / competent authority for all facilities within scope.
- g) O&M Technical Dossiers: Complete set of: datasheets, design documents, control & protection schematics, loop diagrams, interlocking schemes, preventive maintenance schedules (daily/weekly/monthly/quarterly/half-yearly/yearly) to enable Owner to independently undertake O&M in case of termination or non-renewal of O&M contract.
- h) Any additional documents required for statutory compliance, safe operation, future maintenance, or regulatory audits related to the scope.

5. Standards & Statutory Requirements

- 5.1.1. The WTGs and other equipment should conform to the relevant International / Indian Standards and shall meet all the CEA/CEIG and local statutory requirements. The Bidder shall furnish the standards adopted by them.

6. Design Improvement

- 6.1.1. The bidder may suggest for improvement in specifications, if any, of equipment which could yield in better performance of machines. Such suggestions could be discussed based on merits and modifications in the specifications could be considered, if found appropriate.
- 6.1.2. If any of the agreed change is such that it affects completion schedule, the parties may agree for revised completion schedule before the bidder proceeds with the change.



Tender for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and Maintenance of 45.6 MW ISTS Connected Wind Power Project at Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Packge-2: Wind)

SUB-SECTION C

GENERAL ANNEXURE A

Estimated Annual Energy Production from Wind Plant

Work Sheet for Estimated Annual Energy Production from Wind Plant (For Each Model Separately)

(To be furnished by the bidder)

Bidder shall furnish an Independent Energy Yield Assessment Report prepared by National Institute of Wind Energy (NIWE) for estimated Annual Energy Production (AEP) of the wind farm for the site for the offered WTG model by the bidder.

Bidder shall reach to NIWE with all its input documents required for carrying out an independent energy yield assessment, giving the reference to this specific Project Bid. NIWE will follow the standard procedure for carrying out the energy yield assessment using WAsP software model. The Wind Resource Data available with NIWE, as provided by SECI will be used for the assessment of EYA for all such Bidders independently by NIWE. NIWE will ensure that the same data is used for EYA of all the bidders. Bidders will not be allowed to receive the raw wind data used by NIWE, however they may be allowed to verify the same with NIWE as per the NIWE policy of interacting with the client for any such independent energy yield assessment.

The Report submitted by the Bidder as prepared by NIWE shall contain all the information such as the information on WTG model used, WTG model power and thrust curve, micro siting of the WPP, micro siting of external WTGs along with the details of the external WTG models (WTG model name, rating, hub height and rotor diameter, power curve) used for EYA, contour, Wind frequency distribution used, site specific air density considered, turbulence intensity, details of losses considered, uncertainty considered, estimated annual AEP at 1 year, 10 year and 25 year average, WTG location wise Gross AEP and Net AEP, any limitation of the study, etc. along with all the information that NIWE provides as a part of its independent energy yield assessment report.

A summary Table shall be provided in the report for following parameters

Parameter	Value
Capacity of WTG :	
Hub Height :	
Mast Location Air Density at Mast Height:	

Mast Location Air Density at WTG Hub Height	
Mast Location:	
Average mast location wind speed at mast height	
Average mast location wind speed at WTG hub height	
Power Law Index :	
Turbulence Intensity	
Average Air Density at WTG Hub Height	

The Losses assumptions to be considered for the Energy Yield Assessment shall be as per the following Table

Standard Loss Category		Sub-category	Loss value (%)
1. Availability	a	Turbine	95.00%
	b	Balance of plant	99.00%
	c	Grid Availability	99.00%
2. Wake effects	a	Internal wake effects	As determined by NIWE through Modelling
	b	External wake effects	As determined by NIWE through Modelling
	c	Future wake effects	99%
3. Turbine performance	a	Site Specific Power curve adjustments	99.00%
	b	High wind hysteresis / Sub Optimal Performance	As determined by NIWE
4. Electrical	a	Electrical Efficiency	97.00%
	b	Facility Parasitic Consumption	99.50%
5. Environmental	a	Lightning	99.80%
	b	Rotor Blade Degradation	99.50%
	c	Environmental Loss	100.00%
6. Curtailment	a	Load Curtailment	100.00%
	b	Grid Curtailment	98.00%
	c	Environmental/Permit Curtailment	100.00%
	d	Operational Strategies	Any Loss Factor due to any sectoral management required.

7. Other Factor	a	Any Other Factor as deemed Appropriate by NIWE based on the assessment	
Aggregate Losses			

The Uncertainties shall be as assessed by NIWE and shall contain at-least following level of uncertainties assessment.

Sl. No.	Uncertainty Components	Energy Uncertainty (%)		
		1 Yr.	10 Yr.	25 Yr.
1	Wind Measurement	6.61	6.61	6.61
a.	Calibration of Anemometer	3.53	3.53	3.53
b.	Operational characteristics of Anemometer	3.53	3.53	3.53
a.	Flow distortion	2.65	2.65	2.65
b.	Dataset Measurement Continuity	3.43	3.43	3.43
2	Wind Variability	7.41	5.06	4.87
a.	Inter Annual Variability	5.70	1.80	1.14
b.	Wind in the past (MCP)	4.39	4.39	4.39
c.	Long-Term Stability of Windiness	1.77	1.77	1.77
3	Wind Flow Modelling	5.42	6.71	8.17
a.	Vertical	0.74	0.74	0.74
b.	Horizontal	3.06	3.06	3.06
c.	Wind Resource Similarity	2.65	2.65	2.65
d.	Topographical Input Dataset	3.53	5.30	7.06
4	Wind Turbine Power Curve	5.30	5.30	5.30
5	Loss	0.57	0.57	0.57
a.	Wake	0.30	0.30	0.30
b.	Availability	0.23	0.23	0.23
c.	Power Curve	0.25	0.25	0.25
d.	Electrical	0.25	0.25	0.25
e.	Environmental	0.25	0.25	0.25
f.	Curtailement	-	-	-
Overall Uncertainty (%):		12.51	11.95	12.75

N.B.: The estimated long-term average annual CUF (P90 value) for 20 years based on the Power and Thrust Curve of the proposed WTG Model, as assessed by NIWE, shall not be less than the parentage (%) as specified under the Bid Evaluation Criteria.

Although the Annual Energy Yield from NIWE Report as submitted by the Bidder will be considered final for Evaluation, SECI may if required during the evaluation, get the energy yield assessment done from any third-party

consultant or NIWE itself for all the Bidders, if SECI feel that so necessary. Bidders shall submit all the desired (WTG Power and Thrust Curve, Hub Height and Rotor Diameter information, temperature de-rating curves, and any other information that may be deemed necessary during the evaluation) to SECI as is required for carrying out the Independent Energy Yield Assessment Report for their offered WTG model.

SUB-SECTION C

GENERAL ANNEXURE B

Guaranteed Power Curve of offered WTG

Guaranteed Power Curve of WTG offered

(To be furnished by the bidder)

Standard Power Curve

A	Power (kW)	Thrust Coefficient (C_t)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

Air Density 1.225 kg/m³

Reference of Certified Power Curve be given and a copy thereof furnished. Site Specific Air Density Corrected Power Curve:

Wind Speed (m/s)	Power (kW)	Thrust Coefficient (C_t)
1		
2		
3		
4		
5		
6		

7		
8		
9		
10		
11		
12		
13		
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24		
25		

Site Specific Air Density considered for correction is to be mentioned by the Bidder. Site Specific Air Density Considered is 1.225 kg/m³

SUB-SECTION C

GENERAL ANNEXURE C

Equipment Inspection Category

All equipment is classified into three categories namely, Category – A, Category – B and Category – C on the basis of pre-dispatch inspection requirement by SECI and EPC Contractor.

Category	Stake holder	Pre-dispatch inspection
Category – A	SECI	Yes
	EPC Contractor	Yes
Category – B	SECI	No
	EPC Contractor	Yes
Category – C	SECI	No
	EPC Contractor	No

However, SECI reserves the right to conduct pre-dispatch inspection for Category-B and Category-C equipment also.

S. No.	Equipment Code	Equipment Description
Category-A		
1	WTG	Wind Turbine Generator (Nacelle, Rotor, Hub, Generator, Gearbox)
2	TCU	Turbine Control Unit / Main Controller
3	CU	Converter Units
4	GTR	Generator Step-Up Transformer (WTG Transformer)
5	HTP	HT Switchgear Panel (33 kV RMU / GIS / AIS)
6	PTR	Power Transformer (Pooling Substation)
7	SCADA	SCADA System (Servers, RTU, Networking Equipment)
8	NIFPS	Nitrogen Injection Fire Protection System (Transformer Fire Protection)
9	SWO	Unit Substation (USS) Equipment – CT, PT, Circuit Breaker, Isolator, LA
Category-B		
1	ATR	Auxiliary Transformer (Station / WTG Auxiliary)
2	LTC	LT Cable (WTG Power, Control, Auxiliary, etc.)
3	TLC	Transmission Line Conductor / Cable
4	LDC	LT Distribution Cable (Substation Aux / Yard Lighting)
5	CPC	Control & Power Cables
6	UPS	Uninterruptible Power Supply System
7	LTP	LT Panels (ACDB, DCDB, MCC)
8	TEA	Telemetry Equipment & Accessories (SLDC/ RLDC Communication)
Category-C		

1	WMS	Weather Monitoring Station/ Metereological Mast (Wind Speed, Density, Temp, Humidity, etc.)
2	CCTV	CCTV Cameras & Surveillance System
3	FAS	Fire Alarm System
4	TI	Testing Instruments (Insulation Tester, Relay Test Kit, etc.)
5	CTK	Cable Termination Kits
6	CMC	Communication Cable (Fiber / Ethernet)
7	LPS	Lightning Protection System (WTG + Substation)
8	EES	Earthing Electrode System & Accessories
9	LED	Plant Illumination Equipment & Accessories
10	TLT	Transmission Line Tower / Pole & Accessories
11	FST	Fasteners, Clamps, Supports
12	OTR	Equipment Pre-approved by DISCOM / TRANSCO

* Material inspection to be done prior to manufacturing

Proto-type inspection to be done prior to manufacturing

1. Category – A

The Contractor shall give inspection call to SECI for pre-dispatch inspection of Category – A equipment at Manufacturer's/Supplier's factory. The inspection call shall be given only after the approval of equipment documents under Category – I as per Drawing and Document Control Index and be attached with internal routine test reports performed by the Manufacturer/Supplier as per the approved Quality Assurance Plan. Inspection call should be given at least 7 working days before the scheduled start date of pre-dispatch inspection for a location within India and 15 working days in case of a foreign country. Based on the inspection report and compliance report (if any), Material Dispatch Clearance Certificate (MDCC) will issued by SECI.

2. Category – B

For Category – B equipment, the Contractor shall intimate SECI about the proposed inspection at least 3 working days before the scheduled start date of pre-dispatch inspection. Such intimation shall be given only after the approval of equipment documents under Category – I as per Drawing and Document Control Index and be attached with internal

routine test reports performed by the Manufacturer/Supplier as per the approved Quality Assurance Plan. SECI will participate in the pre-dispatch inspection, if required.

If SECI participates in the pre-dispatch inspection, based on the inspection report and compliance report (if any), Material Dispatch Clearance Certificate (MDCC) will issued by SECI. In case SECI does not participate in the pre-dispatch inspection, the Contractor shall submit the Inspection Report signed by Contactor and Manufacturer/Supplier Representatives to SECI for issuance of Material Dispatch Clearance Certificate (MDCC).

3. Category – C

For Category – C equipment, the Contractor shall submit internal routine test reports performed by the Manufacturer/Supplier as per the approved Quality Assurance Plan. For all equipment inspected by the DISCOM, Inspection Report/Test Report signed by DISCOM shall be submitted to SECI for information.

The methodology proposed for conduct inspection and issuance of MDCC is as under:

Category	Inspection done by	MDCC issued by	
A	SECI and / or Customer	SECI	Inspector will submit the inspection report to SECI along with his observations, if any. In case of any observation reported by Inspector, then Contractor shall submit compliance report for the same to SECI. SECI shall review the inspection report, along with the compliance report submitted by Contractor, in line with the approved QAP and Drawings / Documents and if found satisfactory, shall recommend issue of MDCC. MDCC shall be issued by SECI/Owner.
B	EPC contractor (SECI optional)	SECI	Contractor shall submit all the test report / material certificates to SECI. SECI shall review these documents and if found satisfactory, shall recommend issue of MDCC. MDCC shall be issued by SECI.
C	COC by Manufacture / Supplier	SECI	EPC contractor will verify the CoC and issue the MDCC.

SUB-SECTION C

GENERAL ANNEXURE D

Mandatory Spares

1. **Scope:** The EPC Contractor shall supply mandatory spares for the Wind Turbine Generators (WTGs), Balance of Plant (BoP), Pooling Substation (PSS), and Transmission System as specified herein.

The spares shall be sufficient to ensure:

- Trouble-free operation during the Defect Liability Period (DLP)
- Minimization of turbine downtime
- Compliance with guaranteed availability
- Smooth transition to O&M phase

All spares shall be new, unused, of latest revision, and identical to the equipment supplied.

2. **General Requirement:**

- All mandatory spares shall be supplied along with main equipment.
- Spares shall be packed, labelled, and stored suitably for minimum 5 years shelf life.
- Part numbers, drawings, and catalogues shall be provided.
- Shelf-life sensitive items shall include manufacturing & expiry date.
- Recommended storage conditions shall be clearly indicated.

3. **Mandatory Spares Item & Quantity:**

Sl. No	Description	Minimum Quantity Requirement
Electrical & Control Spares (WTG)		
1	Main Controller Module	2 Nos.
2	I/O Modules	10% of installed qty
3	Power Supply Modules	2 Nos.
4	Converter Control Cards	1 No.
5	Pitch Control Card	2 Nos.
6	Anemometer	2 Nos.
7	Wind Vane	2 Nos.
8	Temperature Sensors	2 Nos.
9	Proximity Sensors	2 Nos.
10	Brake Rectifier	2 Nos.
Mechanical Spares (WTG)		
1	Hydraulic Pump	1 No.
2	Hydraulic Accumulator	2 Nos.
3	Hydraulic Valve Set	1 No.
4	Yaw Brake Pads	2 Nos.
5	Pitch Motor	1 No.
6	Cooling Fans	2 Nos.
7	Gearbox Oil Pump	1 No.
8	Grease Pump	1 per project
Unit Sub-Station (USS)		
1.	VCB	2 Nos.

2.	Protection Numerical Relay	1 per type
3.	CT	1 per ratio
4.	PT	1 per ratio
5.	Trip Coil	2 per breaker type
6.	Spring Charge Motor	2 Nos.
33kV Transmission Line		
1.	Insulator	2% of the installed qty.
2.	Hardware fittings	2% of the installed Qty.
3.	Conductor	2% of the Total Length (Each Type).

SUB-SECTION C

GENERAL ANNEXURE E

Plant Documentation, Commissioning and Test Procedure

TABLE OF CONTENTS

1	Introduction	3
2	Codes & Standards.....	3
3	Commissioning	3
3.1	Scope of Commissioning:	3
3.2	Pre-Commissioning:.....	4
3.3	Grid Synchronization:	4
3.4	Trial Operation:	5
3.5	Performance Guarantee Tests (PGT):	5
3.6	Reliability Run:	5
3.7	Performance Guarantee Tests for Wind Plant	6
	LD for Power Curve Warrantee Failure	10

1 Introduction

This document lays down the procedures, requirements and templates for conducting commissioning tests and inspection of the Plant Facilities after installation and for subsequent re-inspection, maintenance or modifications in accordance with the Tender Specifications. This document shall serve as the template for the Commissioning and Performance Guarantee (PG) Tests to be conducted by the Contractors.

2 Codes & Standards

The Testing and Commissioning Procedures shall, in general, comply with the following standards:

1. IEC 61400 standard
2. IEC 60364-6:2016 - Low voltage electrical installations - Part 6: Verification.
3. IEC 62305-3– Protection against lightning - Part 3: Physical damage to structures and life hazard
4. IS/IEC 61557: Part 2: 2007 - Electrical safety in low voltage distribution systems up to 1000 V ac and 1500 V dc - Equipment for testing, measuring or monitoring of protective measures: Part 2 insulation resistance

3 Commissioning

3.1 Scope of Commissioning: The Contractor shall be responsible for complete commissioning of the Wind Turbine Generator (WTG) package including but not limited to mechanical completion, electrical completion, grid synchronization, SCADA integration, trial operation, performance testing, reliability run & taking-over.

Note:

- a) Since the evacuation point for the WTG Package is the dedicated incoming feeders at the pooling switchgear of the Pooling Substation under the Solar + BESS Contract, the achievement of Grid Synchronization, SCADA integration, Trial Operation, Performance Guarantee Tests and Reliability Run shall be dependent on the readiness and commissioning of the Pooling Substation by the Solar + BESS Contractor.
- b) In case of delay in readiness of the Pooling Substation, the associated commissioning-linked payment milestones of the WTG EPC Contractor shall stand deferred without prejudice to the WTG EPC Contractor's entitlement to payments already due for Mechanical Completion and Electrical Completion, provided the WTG EPC Contractor is otherwise ready for grid

integration.

3.2 Pre-Commissioning: The Contractor shall carry out complete pre-commissioning of each WTG prior to Grid Synchronization to demonstrate that the equipment has been installed in accordance with the Contract, is safe for energization, and is technically ready for commissioning and performance testing. Pre-commissioning activities shall include, but not be limited to, the following:

- a) Mechanical checks should include verification of erection completion, torquing of all structural and mechanical fasteners, alignment checks, lubrication and fluid filling, functional checks of yaw system, pitch system, brakes, auxiliary systems etc.
- b) Electrical checks should include insulation resistance (IR), continuity tests, verification and testing of protection relays and protection settings, functional testing of switchgear, converters and auxiliary power systems, earthing, lightning protection continuity checks, etc.
- c) Communication and SCADA interface checks should include verification of signal mapping and communication links, compliance with applicable safety standards and OEM requirements, verification of access systems, lock-out/tag-out provisions and fall protection systems etc.
- d) Verification of safety systems and interlocks.
- e) Certification that the WTG is technically ready for Grid Synchronization, subject to availability of grid evacuation facilities **under the relevant interface scope**.

3.3 Grid Synchronization: shall form part of the Commissioning Milestones and shall be carried out by the Contractor in accordance with applicable Grid Code, statutory regulations, and Employer's technical requirements. The Contractor shall:

- a) Statutory & Grid Operator Approvals: Coordinate and support all technical approvals, clearances and permissions required from the Grid Operator for synchronization of the WTGs, including submission of test reports, protection settings, and compliance documentation.
- b) Readiness for Synchronization: Complete all Mechanical Completion and Electrical Completion activities and certify that each WTG is technically ready for grid synchronization, including protection systems, communication interfaces and safety interlocks.
- c) Successful Synchronization: Demonstrate successful first synchronization of each WTG with the grid, followed by demonstration of the compliance of each WTG with applicable Grid

Code requirements.

- d) SCADA & Communication Integration with LCS: Demonstrate successful integration of WTGs with the Employer's CMCS/ SCADA system and stable real-time data exchange, alarms and control functions from the Employer's control room.

Note:

Interface Dependency: Grid Synchronization shall be subject to the readiness and availability of the evacuation facilities, pooling switchgear and pooling substation under the scope of the Solar + BESS Contractor. Any delay solely attributable to non-readiness of such interface facilities shall be treated as an interface dependency, provided the Contractor has otherwise achieved Mechanical Completion and Electrical Completion and is ready for synchronization.

- 3.4 Trial Operation:** Each WTG shall undergo continuous trial operation for minimum 240 hours without major failure. Successful trial operation is defined as:

- a) Continuous operation at variable wind speeds
- b) No major component failure
- c) Compliance with vibration, temperature and operational limits

- 3.5 Performance Guarantee Tests (PGT):** Following successful completion of Trial Operation and Grid Synchronization, the Contractor shall carry out Performance Guarantee Tests (PGT) for each WTG in accordance with the applicable provisions of IEC 61400 series and other relevant international standards, OEM manuals, and Employer's technical requirements.

- a) Power curve guarantee test.
- B) Short term performance test

- 3.6 Reliability Run:** Each WTG shall complete a minimum 30-day Reliability Run demonstrating:

- a) Minimum Technical Availability: **As specified in Annexure-2 of Sub-Section F.**
- b) No repeat failure of critical components
- c) Compliance with alarm limits

3.7 Performance Guarantee Tests for Wind Plant

3.7.1 Power Curve Guarantee Test Procedure

The Power Curve Guarantee Test shall be conducted for the Performance Guarantee Verification of the Wind Power Plant. The Test shall be conducted during first high wind season after completion of stabilization period of 60 days from the commissioning.

Test can be conducted by a mutually agreed and appointed MEASNET accredited Consultant for the Power Curve Verification of the Wind Turbines.

a) Location of Test site

One representative WTG among all the WTGs of the Project will be selected for the test. The turbine on which test is to be conducted shall be decided upon mutual consent between the Contractor, Owner and the third-party consultant. A Joint survey may be conducted by the Owner, the Contractor and the appointed Consultant for the identification of suitable WTGs of the Project for conducting the PCGT in accordance with the applicable standard and agreed procedure. The final recommendation on the selection of the turbine among the suitable turbines for PCGT must be given by the Owner.

In general, the Test site shall be free from flow distortion affected by other WTGs or obstacles in predominant wind direction. The measurement sector shall be selected as per the conditions prescribed in IEC 61400-12-1: 2017.

b) Location of Meteorological Mast

Contractor shall install a wind mast at a distance between 2D-4D (D is rotor diameter of Test WTG) from the designated turbine in consultation with Owner and the Consultant. This mast shall record wind data for the test and shall be maintained at site for the period required for successful power curve testing. Erection of wind mast and onsite facilities/support for testing and monitoring shall be the responsibility of the Contractor.

All the sensors to be used shall have valid calibration certificate from a MEASNET accredited organization. Any sensor, though having validity period, if it is already used for any other prior test, such a sensor needs to be re-calibrated before using it for said test.

c) Test Equipment

All the test equipment and Instruments such as Wind mast with all measurement sensors, CT, PT, metering arrangement etc. shall be installed as per Annexure-A Part III of IEC-61400-12-1: 2017.

Metering arrangement CTs duly calibrated shall be provided at LCS.

Calibration certificate for the CTs, PTs and energy meter to be used for the testing should be provided in advance before conducting the test.

- Accuracy class of all the measuring equipment shall be 0.5 or better. Contractor shall furnish calibration certificates only from the accredited test house (accreditation certificate should be enclosed) for all measuring instruments before their installation at site.
- Calibration certificates of measuring equipment from the State Electricity Board/DISCOM will be acceptable.

The Contractor shall submit a detailed report on the Test Wind Mast Installation as well as the other equipments and instruments installed for the PCGT purpose along with all the drawings for reference and verification.

d) Test Period and Duration

The Test shall be conducted during first high wind season after completion of stabilization period of 60 days from the commissioning. The duration of the data measurement period shall be minimum 3 months and shall be continued till the time the desired completeness of the datasets as stipulated in the IEC standard is achieved.

e) Data Collection and Analysis

The data recorded at the test wind mast and the power output data recorded at the metering system installed at LCS shall be collected on daily/weekly basis and analysed for its appropriateness, any error, adequacy and the data completeness to derive the measured power curve as per the IEC standard. Database shall be considered complete when it has met following criteria

- Atleast 3 datasets (10-minute average, i.e. 30-minute data) for each wind speed bins shall be achieved as well as the peak wind speed conditions shall be achieved.
- Total duration of the measurement period (database) includes at-least a minimum of 180 hour of sampled data.
- Selected datasets shall cover at-least IEC wind speed bin ranges.
- The grid frequency, RPM, Blade pitch angles, nacelle wind speed and yaw angles shall have been recorded for all useful datasets.
- The datasets shall be received by the Owner from the Contractor and shall be verified by the Owner or the designated Power Curve Verification Consultant

f) Measured Power Curve Calculation



The Measured Power Curve shall be calculated as per the procedure given in the IEC-61400-12-1 based on the reference measured wind speed distribution from the test mast and the site-specific air density calculated based on the measured data at the site during the test period.

The measured Power Curve shall be adjusted to the reference site air density in order to make it comparable to the contracted (warranted) power curve as per the air density correction methodology given in the standard.

All the uncertainties of calculation shall be based on the IEC-61400-12-1.

g) Verified Power Curve Performance Calculation

The Validation of the Power Curve Performance shall be based on the Estimated AEP from the measured Power Curve of the test WTG as per above given procedure and the Estimated AEP from the Warranted Power Curve, both at the reference site air density.

The AEP from both the measured Power Curve and the Warranted Power Curve at reference site air density shall be calculated based on a reference nominal wind speed distribution at the site. This could be the wind data from the reference wind mast installed by SECI at the Project site before start of the Project or any other mutually agreed wind speed distribution dataset.

The Theoretical annual energy production (AEP) based on the Measured Power Curve of the Wind Turbine and the nominal wind distribution is called as the Measured Power Output (MPO)

The Theoretical annual energy production (AEP) based on the Warranted Power Curve of the Wind Turbine and the nominal wind distribution is called as the Warranted Power Output (WPO)

Following formula shall be used for the calculation of Verified Power Curve Performance (VPC) of the WTG:

$$VPC = \left(\frac{MPO}{WPO} \right) \times 100\%$$

If VPC is greater than or equal to 98% then the Power Curve Guarantee Test is considered to be passed.

3.7.2 Short Term Performance Test (STPT) Procedure for WTG

- a) The Short-Term Performance Test shall be conducted for each WTG of the Project within 60 days upon commissioning of the respective WTG. Before commencement of the test the Contractor shall inform to the Owner of its intention to conduct the test and the proposed start date for the test. Owner or its representative will have the right to witness the test.
- b) On start of the test all the initial readings shall be recorded.
- c) Test shall be conducted for 96 hours. The procedure for calculating machine availability for individual WTG is specified in Annexure-2 of Sub-Section F i.e:

$$MA = \frac{[D - (GF + FM + S + U)] \times 100}{D - (GF + FM)}$$

Where:

D = Total number of hours in the applicable period

GF = Grid Failure hours

FM = Force Majeure hours

S = Scheduled Maintenance hours

U = Unscheduled / Forced Maintenance hours

- d) During the test the Wind Turbine shall achieve Machine Availability should be minimum 98%.
- e) If any turbine has not achieved the required Machine Availability as mentioned above during the test period, then the test can be re-conducted for that specific wind turbine.
- f) During the test period the Contractor shall ensure that all alarms are functioning properly.
- g) During the test the reiterated turbines alarms of 3 times only can be allowed for remote restart. After that local reset has to be done with proper inspection and failure rectification.
- h) If during the test the stoppage duration is more than 2 hours due to external causes like Grid drop, Force Majeure Conditions of Extreme Weather Conditions, the down hours which is above 2 hours will be extended from 96 hours test duration.
- i) If stoppage duration is more than 24 hours due to causes mentioned above, then the test shall be repeated.
- j) Upon passing of the Test for a WTG, the Owner may issue a Certificate on STPT Completion for that respective WTG within 3 business days.

k) If the Owner or its representative fails to either:

- I. Issue the Certificate on STPT Completion for a WTG; or
- II. Issue a notice advising that the relevant WTG and associated equipment have not passed STPT in accordance with the test condition within 3 business days after receipt of Contractor's Notice of completion of the tests along with all results, the STPT on that WTG will be deemed to have been achieved within 5 days of Contractor's notice.

3.7.3 Liquidated Damages for Performance Shortfall in Wind Plant

LD for Power Curve Warranty Failure

If the PCGT fails pursuant to procedure described above, the Contractor shall Pay compensation to Owner as per following:

In the event upon completion of the first Power Curve Guarantee test, if it is found that WTG is not meeting the Power Curve Guarantee, Contractor may opt to re-conduct the test at its own cost after resolving the defect in the test WTG and such solution will be replicated on all the WTGs in the Project. If Contractor chooses to repeat PCGT in the next wind season at its own cost, then Contractor will compensate Owner for the shortfall in performance during the first year of operation @ Rs. 4.5/kWh for the estimated generation loss units due to such shortfall in the Power Curve Performance. If the 2nd PCGT also fails then the Contractor shall compensate to the Owner as per following:

- (a) Compensation to Owner of an amount equal to the estimated loss for the Project life. This shall be calculated as the NPV of annual loss for 25 years. Annual loss of revenue will be estimated based on the actual electricity sale tariff for the power generated from the Project and estimated annual generation loss due to shortfall in power curve performance. For more clarification the formula to be used for estimated annual revenue loss from the Wind Power Plant is Estimated Annual Revenue Loss due to shortfall in:

$$PCW = (\%S_{PCW}) \times P_{cap} \times CUF_{est} \times T_{PPA} \times 8760$$

PCW: Power Curve Warranty compensation

S_{PCW}: Shortfall in Power Curve Warranty (%)

P_{cap}: Project Capacity (kW)

CUF_{est}: Estimated Annual Capacity Utilization Factor (As per the CUF value calculated from the AEP value submitted by the bidder for bid evaluation)

T_{ppa}: Rs. 4.5/kWh

(b) If the repeated PCGT is below 93% then Contractor will provide technical plan to improve the Power Curve. Contractor shall hire an internationally reputable third-party agency in consultation with Owner for the purpose of analyzing and reporting the reasons for not achieving the PCW and Contractor shall follow the advice of such agency to improve the Power Curve and such advice to be implemented at the Contractor's cost to ensure that the power curve performance is not less than 98 % of warranted. After that the PCGT shall be conducted again. If still the PCGT fails and is below 93% then the Owner will have the right to reject the WTG and obtain a refund. In case of rejection the Contractor will be required to refund entire amount paid by the Owner to the Contractor with respect to the wind plant including supply and services as per the breakup given in the contract. Contractor will refund all amounts paid by Owner for the wind plant along with interest cost (@13% (thirteen percent) per annum) from the date of payments made for WTG including Advance Payment. Further Owner will pay to Contractor, an amount equivalent to 50% of the amounts received from DISCOM or as any other benefit against generation from the rejected WTG(s).

LD for Short Term Performance Test Failure

If the Contractor fails to satisfy the STPT of a WTG within 60 (sixty) days from the Commissioning Date of the relevant WTG even after repeated tests, then Owner will have the right to reject the WTG and obtain a refund. Contractor will refund all amounts paid by Owner for that WTG along with interest cost (@13% (thirteen percent) per annum) from the date of payments made for WTG including Advance Payment. Said rejected WTG shall not be considered for Availability calculations.

SUB-SECTION C

GENERAL ANNEXURE F

FQP & MQP for Civil Works

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr.No.	Activity & Operation	Instruments	Class of Check	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vender in QA documentation)	Cheking Agency			Remarks
2								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
3	1	General Requirements											
4	a	Availability of requisite test set-up and equipment in good working condition with valid calibration at site well before commencement of concerned activity	As required/ agreed	Critical	Physical	Once prior to start of work & Monthly there after	Tech. Specs, Construction Drawings	SR	√		x	x	Min. list of equipment - CTM, Set of Seives for CA & FA, Elcometer (digital), Micrometer, Multimeter, Meggar, Torque Wrench, Moulds for casting of concrete/ mortar test samples, Curing tank of adequate size, SS measuring tape - 50m, Theodolite, leveling staff and associated equipment etc. for day to day work with proper storage racks. The equipment shall be in adequate no. matching the site progress requirements. Functioning of laboratory equipment in proper working condition to be verified on monthly basis
5	b	Submission of QA & QC manpower deployment schedule based on agreed L-2 network	As required/ agreed	Critical	Verification	Before start of work	Tech. Specs, Construction Drawings	SR	√		x	x	
6	c	Availability of QA & QC manpower deployment based on agreed deployment schedule, Periodic review for augmentation as per actual progress	As required/ agreed	Critical	Physical	Once prior to start of work & Monthly there after	Tech. Specs, Construction Drawings	SR	√		x	x	
7	d	Submission of schedule/ programme of tests and inspection of civil works (survey, excavation, concreting, backfilling, brickwork, finishing works, roads, drains etc.) to be done monthly and quarterly based on agreed schedule	As required/ agreed	Critical	Physical	Once prior to start of work & Monthly/ Quarterly there after	Tech. Specs, Construction Drawings	SR	√	x	x	x	
8	e	Submission of actual work programme min. 3 days (72 hours) in advance to facilitate planning for quality checks as per approved QP	As required/ agreed	Critical	Physical	48 hours before start of actual work	Master programme/ schedule	SR	√	x	x	x	
9	f	Stacking and storage of construction materials and components at site	IS: 4062	Critical	Physical	Random	Tech. Specs, Construction Drawings & IS: 4062	SR	√	x	x	x	
11	2	Surveying (Execution phase)											
12	a	Availability of Calibrated Instruments, qualified & experieced staff at site	As required/ agreed	Critical	Physical	100%	Tech. Specs, Construction Drawings, Agreed deployment schedule	Calibration Report	√	x	x	x	
13	b	Ensure correct Boundary Layout and Latitude-Longitude Coordinates, True North	construction Drawings	Critical	Measurement	100%	Tech. Specs, Construction Drawings	SR	√	x	x	x	
14	c	GL (ground level), FGL (finished ground level) and Plinth Level, Check PBM(permanent bench mark) with Total Station/ Theodolite and after conformation carryout Peg marking	As required/ agreed	Critical	Measurement	100%	Construction Drawings	SR	√	x	x	x	
16	3	Materials											
17	A	Cement											
18	i	Fineness	As per IS: 4031	Critical	Review of MTC/ Physical	One test at Lab to corelate with MTC	IS:456,IS:269,IS:8112, IS:12269,IS:1489, Tech. Specs	Manufacturers Test Certificate (MTC's) and Laboratory Test results	√	x	x	x	Each consignment/ lot of cement shall be duly correlated with MTC If cement stored is more than 60 days in godown the same shall be re-tested for conformation with MTC
19	ii	Compressive Strength											
20	iii	Initial & final setting time											
21	iv	Chemical composition of Cement											
22	B	Coarse Aggregates (CA)											

	A	B	C	D	E	F	G	H	I	J	K	L	M							
1	Sr.No.	Activity & Operation	Instruments	Class of Check	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be issentially included by EPC vender in QA documentation)	Cheking Agency			Remarks							
2								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner								
23	i	Determiration of Particle size (Sieve Analysis), Flakiness index, Elongation index	As per IS: 2386	Major	Visual	Once per 100 cum or part thereof (During monsoon moisture content to be checked every day)	IS:383,IS:2386, Tech. Specs	Lab Test results	√	x	x	x	Water content of concrete to be corrected as per results of moisture content							
24	ii	Moisture content																		
25	iii	Crushing Value, Impact value, Abrasion value		Critical		One test at Lab for each source/ on every change of source										These tests shall be carried out while establishing design mix. In case of change of source the design mix shall be re-validated for new source				
26	iv	Specific Gravity, water absorption																		
27	v	Bulk Density																		
28	vi	Soundness																		
29	vii	Presence of deleterious materials																		
30	C	<i>Fine Aggregate (FA)</i>																		
31	i	Gradation/Determination of Particle size (Sieve Analysis)	Balance, Oven etc. As per IS: 2386, 383	Major	Visual	Gradation - Once per 1000 cum or part there of Moisture content - Every day	IS:383,IS:2386,IS:456 , Tech. Specs	Lab Test results	√	x	x	x	Water content of concrete to be corrected as per results of moisture content							
		Moisture Content																		
32	ii	Specific Gravity and density (for design mix concretes only)	As per IS: 2386, 383	Major	Visual	One test at Lab for each source/ on every change of source														
33	iii	Water absorption (for design mix concretes only)																		
34	iv	Presence of deleterious materials																		
35																				
36	D	<i>Concrete Admixture</i>																		
37	i	Type of admixture			Review of MTC		IS: 9103, Approved design mix		√	x	x	x	Admixture shall be of brand and type as per approved design mix. Each lot/ batch of admixurture shall accompany the Manufacturer's Brochure and shall be correlated with MTC							
38	ii	Physical & Chemical properties			Review of MTC		IS: 9103, Manufacturer's Brochure													
39	iii	Suitability																		
40	E	<i>Bricks</i>																		
41	i	Dimensional Tolerance, shape			Measurement/ Physical	As per relevant IS code/ one sample for 30,000 nos. or part there of	IS: 1077, IS: 13757, IS: 12894, Tech. Specs, Construction Drawings	Lab Test results	√	x	x	x	Efflorescence shall be checked at each source							
42	ii	Compressive Strength																		
43	iii	Water Absorption																		
44	iv	Efflorescence												Visual						
45	E	<i>Water</i>																		
46	i	Cleanliness - Test for ascertaining limit of solids		Major		One per 3 months for each source	IS:456,IS:3025 (part 18), Tech. Specs, Construction Drawings specification	Lab Test reports	√	x	x	x	Water to be used for concrete shall be of potable quality and shall meet requirements specified in IS: 456							
	ii	Chemical Tests to ascertain the suitability for construction purposes - pH Value, Sulphate & Chloride content					IS:456,IS:3025 (part 22, 23), Tech. Specs, Construction Drawings	Lab Test reports	√	x	x	x								
47																				
48	F	<i>Reinforcement Steel</i>																		
49	i	Identification & Size		Major	Visual	Each batch of delivery	IS:432,IS:1786,IS:1852, Tech Specs	SR	√	x	x	x	Reinforcement steel shall be stored properly at site to avoid rusting							
50	ii	Freedom from cracks, surface flaws, lamination				Random in each shift			√	x	x	x								
51	iii	Tensile Test		Critical	Review of MTC	Each batch of delivery	IS:432,IS:1566,IS:1786, Tech Specs	Manufacturers Test Certificate (MTC's)	√	x	x	x								
52	iv	Yield stress/proof stress							√	x	x	x								
53	v	Percentage Elongation							√	x	x	x								
54	vi	Bend/Rebend Test							√	x	x	x								
55	vii	Reverse Bend Test for HDS wire								IS:432, Tec. Specs	√	x	x	x						
57	3	Structural Steel Work {Example: Chequered plate cover, Panel supports, Rungs, Cat ladder, Inserts, Fencing gate (MS) etc.}																		
58	i	Strutural Steel (Raw material)-Chemical Properties, Ultimate Tensile Strength(UTS), Yield Strength (YS), Percentage Elongation, Bend test		Critical	Review of MTC	For each batch of each section	IS: 2062, IS: 8500, Tech. Specs, Construction Drawings	Manufacturers Test Certificate (MTC's)	√	x	x	x	MTC to be correlated							
59	ii	Dimensional Check - Secition dimensions, thickness		Critical	Measurement	10% of total quanity at Random			√	x	x	x	For Fencing gate - dimensional check 100%							

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1								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
2													
60	iii	Visual checks for damages, rusting, pitting, scaling etc.		Major	Visual	100%	IS: 822, Tech. Specs, Construction Drawings, MTC, relevant BIS standards for painting	Manufacturers Test Certificate (MTC's)/ SR	√	x	x	x	
61	iv	Visual checks for welding defects, painting (surface preparation, primer coat, and Finishing coat - make and shade of paint, DFT) as applicable.		Major	Visual/ Measurement/ Review of MTC	10% of total quanity at Random			√	x	x	x	MTC to be correlated
62	v	Acceptance ofStructural steel works		Major	Physical/ Acceptance	Random	Tech. Specs, Construction Drawings	SR	√	x	x	x	
64	4	Foundation System											

	A	B	C	D	E	F	G	H	I	J	K	L	M
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2								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
80	B	Cable Trench/ Building & Equipment Foundations											
81	a	Before Excavation											
82	i	Ensuring correctness of layout		Critical	Physical	100%	Tech. Specs, Construction Drawings	SR	√	x	x	x	
83	ii	Checking of trench marking & alignment		Major	Visual		Tech Specs, Construction Drawings						
84	b	Excavation											
85	i	Dimensional conformity including diagonal check		Critical	Visual / Measurement	100%	IS:3764, Tech Specs, Construction Drawings	SR	√	x	x	x	
86	ii	Excavated earth kept away from edges		Minor	Visual	Random		SR	√	x	x	x	
87	c	Acceptance of Trench/ Foundation casting - Shape, reinforcement, shuttering, concreting, etc.		Minor	Physical	100%	Tech. Specs, Construction Drawings	SR	√	x	x	x	
89	5	Foundation Bolts / Inserts/ Concrete embedments											
90	i	Visual check of mechanical damage and galvanising painting if applicable on inserts			Visual / Measurement	100%	As per Tech Specs, Construction Drawings	SR	√	x	x	x	
91	ii	Bolt and assecories, inserts - Dimensions (total & threaded length & dia of bolt, size & thk of embedment and lugs etc.), Nos											
92	iii	Verticality, alignment, levels, pitch distance, embeded and projected length of bolt											
93	iii	Use of template for Alignment and Level checking											
94	iv	Acceptance of foundation bolt assembly / inserts in postion											
96	6	Formwork											
97	i	Materials & Accessories	As agreed/ required	Major	Visual	Once before start of work	IS :456 , Other relevant BIS Standard, Tech. Specs, Construction Drawings	SR	√	x	x	x	
98	ii	Soundness of staging, shuttering and scaffolding including application of mould oil/ release agent	As agreed/ required	Major	Visual	Once before start of work	Manufacturer's specs, IS :3096, IS:4014, IS: 4990, Tech. Specs, Construction Drawings	SR	√	x	x	x	
99	iii	Dimensional Check, alignment & levels as per drawing and tolerences		Major	Visual/ Measurement	100%	Tech. Specs, Construction Drawings	SR	√	x	x	x	
100	iv	Proper sealing of joints, Acceptance of formwork before concreting		Major	Physical/ Visual	Before start of concreting	As per provisions, tolerences, Tech. Specs, Construction drawings		√	x	x	x	
102	7	Placement of Reienforcement Steel											
103	i	Check whether Bar bending schedule (BBS) with necessary lap, spacers & chairs is available before start of cutting & bending of bars	As agreed/ required	Major	Visual/ physical	Random in each shift at each work site	Tech. Specs, Construction Drawings, IS: 2502	SR	√	x	x	x	
104	ii	Check whether cutting and bending of bars is as per BBS and placement conforms construction drawings			Visual/ measurement								
105	iii	Check whether all joints and crossing of bars are tied properly with right gauge and annealed wire			Visual								

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106	iv	Check for proper cover,spacing of bars, spacers & chairs after the reinforcement cage has been put inside the foundation			Visual								
107	v	Check whether lapping of bars are tied properly with right gauge and annealed wire			Visual								
109	8	Concrete											
110	i	Availability of approved Design Mix (for all specified grades)		Critical	Physical	For each specified grade of concrete	IS :456, Tech Specs, Construction Drawings	Approved mix design	√		x	x	The concrete shall be as per approved design mix and the materials (cement, coarse and fine aggregate shall be from the same source considered during mix trials. The mix design shall be verified and approved in case of change of source of any of the matearials
111	ii	Minimum cement content (as applicable in foundation/ below ground works)		Critical	Physical	For piling and foundation works	IS: 456, Tech. specs, Construction drawings	SR	√		x	x	The minimum cement content shall correspond to exposure conditions and/ or, suplhate contents in ground water/ soil
112	iii	Trial mixes to ascertain the workability and cube strength	As per recommended mix design from specialist agency	Critical	Physical/ Testing	One for each mix proportion	Tech. Specs, IS: 456	Lab Test Reports	√	x	x	x	Necessary correction for moisture content and water absoption according to mix design recommendations may be carried out during trial mix
113	iv	Mixing of concrete- check for quanities of cement, CA, FA and water used, Concrete shall be homogenous	Mixing shall be done in a approved mixer/ batching plant (conforming to IS: 4926/ 4925)	Major	Physical	Mixer/ Batchter to be calibrated at the time of starting and subsequently once in tree months	IS: 4925, IS: 4926	Calibration Report/ Certificate	√	x	x	x	Review of calibration chart/ Certificate as per IS: 4926 Qty. of materials including cement consumptionshall be available through on line printer
114	v	Handling & trasportation	As required	Major	Physical	100%	As per approved/ agreed construction methodology	SR		x	x	x	Concrete shall be placed within 30 minutes of its removal from mixer
115	vi	Placement of concrete	As required	Major	Visual/ Physical	100%			√	x	x	x	
116	vii	Compacting	As required	Major	Physical	At Random			√	x	x	x	
117	viii	Curing	As required	major	Physical	At Random				x	x	x	
119	9	Concrete Testing & Acceptance											
120	i	Workability - Slump Test		Critical	Physical	At the time of concrete pouring at site every 2 hrs	IS:456, IS:516,IS:1199, Tech Specs, Construction Drawings	Test Results / SR	√	x	x	x	
121	ii	Crushing strength - (Works test cubes)		Critical	Physical	Testing	IS:456, IS:516,IS:1199, Tech Specs, Construction Drawings	Test Results/ SR	√	x	x	x	Building work and Equipment/ Misc foundations etc. - 6 cubes (3 for 7 day test & 3 for 28 day strength) per sample for each 25 cum or part there off
122	iii	Acceptance of concrete work - Dimensional check (dimensions, levels etc), placement of bolts, inserts, pockets, pitch distance for bolts etc.	As required & dimensional tolerences	Major	Visual/ Measurement	100%		Joint Protocol between Civil Conractor, EPC Vendor and SECI/ Owner where applicable/ SR	√	x	x	x	
124	10	Acceptance of Hardened Concrete											
125	i	Dimensional check (dimensions, levels etc), workmanship, finishing after removal of shuttering	As required & dimensional tolerences	Major	Visual/ Measurement	At Random			√	x	x	x	

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								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
126	ii	Water tightness test for liquid retaining structures/ tanks	As required	Critical	Physical/ Testing	100%	IS: 3370 (Pt.4), Tech Specs, Construction Drawings	SR/ Test Records	√	x	x	x	Water tightness test shall be performed for Under ground (UG) water tank, Septic tank
128	11	Excavation & filling in foundations, trenches, plinth & grading works											
129		Excavation											
130		Nature, Type of soil/ rock before and during excavation		Major	Visual	Random in each shift	Tech. Specs., Construction Drawings	SR		x	x	x	
131		Initial GL before start of excavation		Major	Measurement	100%		SR	√	x	x	x	
132		Final shape/ size & dimensions of excavation		Major	Measurement	100%		SR	√	x	x	x	
133		Final excavation levels		Major	Measurement	100%		SR	√	x	x	x	
134		Side slope of final excavation		Major	Measurement	Random in each shift		SR		x	x	x	
135	12	Fill / Backfill											
136	i	Suitability of borrowed earth for filling (if applicable) - Grain size analysis, Atterberg limits, Free swell index, Organic matter		Major	Physical	One in every 2000 cum or part there of for each type and source of fill material subject to min. 2 samples	IS: 2720 (Pt. IV), IS: 2720 (Pt. XI), Tech Specs, Construction Drawings	Lab Test Results/ SR	√	x	x	x	The parameter should not be worse than the parameter of the existing soil in plant area
137	ii	Optimum moisture content (OMC), Max. dry density (MDD) before fill		Critical	Visual	At Random	IS: 2720 (Pt. I), IS: 2720 (Pt.VII), Tech Specs, Construction Drawings	Lab Test Results/ SR	√	x	x	x	
138	iii	Layer thickness, Compaction procedure		Major	Visual	At Random	Approved Methodology, Tech. Specs, Construction Drawings	SR	√	x	x	x	The layer thickness, Type & Capacity of roller, No. of passes shall be as per approved methodology, Construction Drawing, Tech. Specs
139	iv	Degree of compaction - 1. Dry density by proctor needle penetration 2. Earth filling - In-situ Dry density (core cutter or sand replacement method) or Sand Filling - In-situ Relative density (Density Index)		Critical	Physical	(i) For foundation fill/ backfill - One for every 10 foundations at Random for each compacted layer (ii) For area grading/ filling - one every 1000 sqm area for each compacted layer	IS: 2720 (Pt. XXIX), IS: 2720 (Pt. XXVIII), IS: 2720 (Pt. XIV), Tech Specs, Construction Drawings	Test Results/ SR	√	x	x	x	
141	13	Brick masonry work											
142	i	Soaking of Bricks before use		Major	Physical	100%	IS: 2250	SR		x	x	x	
143	ii	Grading of sand, Mortar mix / proportion, Compressive strength, Consistency		Major	Physical/ Test	At Random	IS: 2250, IS: 2116, Tech Specs, Construction Drawings / As per Design Specification	Lab Test Results/ SR		x	x	x	The sand grading shall conform to IS: 2116
144	iii	Workmanship, Verticality (Plumb) / Alignment		Major	Physical/ Measurement	100%	IS: 2212, IS: 1905, Tech Specs, Construction Drawings	SR	√	x	x	x	
145	iv	Check for Bond/closers, joints		Major	Visual	At Random	IS: 2250	SR		x	x	x	
146	v	Curing		Major	Visual	100%	IS: 2250 / As perTech. Specification	SR		x	x	x	
148	12	Cement Plaster											

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1										M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
2								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)					
149	i	Quality & Grading of sand, Check for mix proportion, wetting the surface etc		Major	Physical	At Random	IS: 2116, IS: 2386 (Pt. I & II), IS: 1542, Tech Specs	Lab Test Results/ SR		x	x	x	Sand to be used shall be free from deleteriousmaterials, Grading shall conform to Table-I of IS: 2116
150	ii	Plaster & grooves - Thickness, Evenness & Finishing, Trueness os palstering system		Major	Visual/ Measurement	At Random in each shift	Tech Specifications, Construction Drawings	SR	√	x	x	x	Trueness - Deviation not more than 4mm when checked with straight edge of 2m length
151	iii	Hacking, Raking of joints, Cleaning the surface, Removing all loose particles, Wetting the surface etc		Major	Visual	At Random in each shift	IS 1661, Tech Specs	SR		x	x	x	
152	iv	Curing		Minor	Physical	100%	IS 1661, Tech Specs	SR		x	x	x	
154	14	Painting System - Plastered Masonry & Concrete surface											
155	i	Materials & accessories - Approval for Paint, Color shade and Brand- Dry distemper, Oil Bound Distemper, Acrylic Emulsion, Chemical resistant, Oil resistant Paint, Weather proof acrylic exterior paint, water proof cement paint etc.	As approved by SECI/ Owner	Critical	Review of MTC	Each batch of delivery	Tech Specs, Construction Drawings	MTC/ SR	√	x	x	x	MTC shall be correlated with the material received
156	ii	Surface preparation	As required	Minor	Physical	Random in each shift	IS: 2935 (Pt.1), Tech Specs, Construction Drawings	SR	x	x	x	x	
157	iii	Number of coats	As required	Major	Physical	Random in each shift	Tech Specs, Construction Drawings	SR	x	x	x	x	
158	iv	Application and Acceptance of painted surface	As required	Major	Physical	Each surface at Random							
160	15	Floor finishes & Allied works											
161	i	Preperation of Sub-grade			Physical	At Random for each building	Tech. Specs, Construction Drawings	SR	√	x	x	x	
162	ii	Plinth filling in layers (stone aggregates/ rubble with interstices filled with sand), ramming & compaction			Physical	At Random for each building	IS: 2720, Tech. Specs, Construction Drawings		√	x	x	x	Quality Checks as aplicable to Fill/ Back fill
163	iii	Check providing shuttering, reinforcement (if applicable)			Physical	At Random for each building	Tech. Specs, Construcion Drawings			x	x	x	Quality Checks as aplicable to Shuttering/ Reinforcement placement
164	iv	Checking the Panel size (as applicable)			Physical	At Random for each building	IS: 5491, Tech. Specs, Construcion Drawings			x	x	x	The concrete shall be cast in alternate panels in chess board fashion, panel size as specified in Construction Drawing or 25 sqm
165	v	Availability of Design mix (if applicable)			Visual	At Random for each building	Tech. Specs, Construcion Drawings	Mix Design Report/ SR		x	x	x	
166	vi	Clearance for concreting (as applicable)			Physical	100%	Tech. Specs, Construction Drawings	Joint Protocol between Civil Contractor, Eqpt. Supplier/ EPC Vendor & SECI/ Owner SR		x	x	x	
167	viii	Performing concreting ensuring Grade/Mix Proportions, Compaction, Thickness and Finish			Physical	At Random per shift	IS; 456, Tech. Specs, Construction Drawings	SR	√	x	x	x	Quality Checks as aplicabel to Concrete Work
168	viii	Curing			Visual	100%	IS: 456, Tech. Specs	SR		x	x	x	Minimum up to 10 days from date of casting
169	ix	Testing of Concrete Cubes for Flooring			Physical	One sample for every 20 Cum of concreting or part thereof for each days concreting (one sample consists of min 3 test cubes for 28 days strength)	IS:456, IS:516,IS:1199 and Design specification	Lab Test Reports					
170	x	Tiled flooring/ dado											

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1													
2								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
171	a	Material - Glazed ceramic Tiles, Vitrified Ceramic Tiles, Mosaic Tiles, Acid alkali Tiles, Heavy duty cement concrete tiles	As agreed/ required	Critical	Review of MTC & Test Reports	Each lot of material received	IS:13755, IS:1237, IS:8042, Tech Specs, Construction Drawings	MTC/ SR	√	x	x	x	MTC shall be correlated for all the parameters specified in Tech. Specs, BIS Standard
172	b	Finishing & Acceptance		Major	Physical	100%	IS: 1443, Tech Specs, Construction Drawings						
173	xi	IPS with or without IRONITE (as applicable)		Major	Physical	At Random per shift	IS: 5491, Tech. Specs, Construction Drawings	SR	√	x	x	x	
174	xi	Fixing of Panel Dividers for finishing course (3 mm Thk Glass/ 2mm Thk Aluminium strip) (if applicable)		Major	Physical	At Random per shift	Tech Specs, Construction Drawings	SR	√	x	x	x	
175	xii	Anti abrasion/ anti wearing epoxy coating (if applicable)											
176	a	Material	As agreed/ required	Critical	Approved Make and Type	Each lot of material received	Tech Specs, Construction Drawings, Manufacturer's Brochure/ Recommendations	manufacturer's Brochure/ SR	√	x	x	x	Material specifications to be correlated with Manufacturer's Brochure
177	b	Finishing & Acceptance		Major	Physical	100%	Tech Specs, Construction Drawings	SR	√	x	x	x	
178	xiv	Kota stone flooring and skirting (as applicable)											
179	a	Material	Quality, Texture, Thickness, Colour fro approved source	Major	Physical	Each batch of delivery	Tech Specs, Construction Drawings	SR	√	x	x	x	
180	b	Finishing & Acceptance		Major	Physical	100%	Tech Specs, Cosntruction Drawings	SR	√	x	x	x	
181	xv	Acid/ Alkali resistant tile flooring/ dado											
182	a	Material -Tiles, Mortar, Sealing, Fillers etc.	Thickness, Quality,	Critical	Approved source, Review of MTC/ Test Report	Each batch of delivery	Tech Specs, Construction Drawings	SR	√	x	x	x	The acid alkali resistant tile flooring nd dado shall be provided in battery room as per approved Arch finishing details
183	b	Finishing & Acceptance	Workmanship	Major	Physical	100%	Tech Specs, Construction Drawings	SR	√	x	x	x	
184	xvi	Interlocking Blocks											
185	a	Materials	Size/ Shape, colour shade, Grade of Concrete	Critical	Approved source, Review of MTC/ Test Report	Each batch of delivery	BS: 6717, Tech Specs, Construction Drawings	SR	√	x	x	x	
186	b	Final finishing & Acceptance	As agreed/ required	Major	Physical	100%	BS: 7533 (Pt.3), Tech Specs, Construction Drawings	SR	√	x	x	x	
188	16	Damp Proof Course											
189	i	Material - Hot bitumen & water proofing materials etc.	As agreed/ required	Critical	Review of MTC	Each batch of delivery	IS: 702, Tech. Specs, Cosntruction Drawings	SR	√	x	x	x	
190	ii	Acceptance of Damp Proof Course - Thickness, Grade of PCC, Application of Bitumen layer etc.	As agreed/ required	Major		100%	Tech Specs, Construction Drawings	SR	√	x	x	x	
192	17	Grouting of pockets/ underside of base plate											
193	i	Material	As required/ Agreed	Critical	Review of MTC/ Physical	Each batch of delivery	Tech. specs, Construction Drawings, Manufacturerr's catalogue	SR	√	x	x	x	In case of ready mixed grout MTC to be correlated with Manufacturerr's catalogue
194	ii	Type of Mix	Anti shrink cement grout/ Ready mixed - Fluid mix, stiff mix as required	Major	Physical	At Random prr shift of grout application	Tech. specs, Construction Drawings	SR	√	x	x	x	In case of cement grout anti shrink compound shall be added as per provisions of relevant IS/ Cosntruction Drawing
195	iii	Mixing, placement, application	As required	Major	Visual	At Random prr shift of grout application	Tech. Specs, Construction Drawings	SR	√	x	x	x	
196	iv	Crushing Strength - Test cubes	As required	Major	Physical/ Testing	3 cubes for entire grouting work	IS: 4031 (Pt.6), Tech Specs, Construction Drawings	SR/ Lab Test Report	√	x	x	x	

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197	v	Acceptance of Grouting	Thickness, Finished level etc.	Major	Physical	100% of 20 % of grout work at Random	Tech. Specs, Construction Drawings	SR	√	x	x	x	
199	18	Precast Concrete											
200	a	Bought Out Units (Precast boundary wall units - Slab Panels, Column etc., Trench Covers , Manhole Covers, Paver Blocks etc.)											
201	i	Crushing strength	As required	Critical	Review of MTC/ Test Reports	100% for Each batch of delivery	IS: 456, IS:516, IS: 1199, Tech Specs, Construction Drawings	MTC	√	x	x	x	Sampling as per IS: 456, Vendor record review
202	ii	Workmanship, dimentions, R/F	As require/ agreed	Major	Review of MTC/ Physical	Each batch of delivery at Random	Tech Specs, Construction Drawings	MTC/ SR	√	x	x	x	Vendor record review, Physical check at Random
203	b	Cast at site (if applicable)											
204	i	Crushing strength - Test Cubes	As required	Critical	Testing		IS: 456, IS:516, IS: 1199, Tech Specs, Construction Drawings	SR	√	x	x	x	1 sample of 6 cubes (3 for 7 days strength, 3 for 28 days strength) for each 5 cum of concrete with minimum 1 sample per shift of concrete work
205	ii	Workmanship, dimentions, R/F	As required/ agreed	Major	Physical	At Random	Tech Specs, Construction Drawings	SR		x	x	x	
206	c	Acceptance of pre-cast concrete units											
207	i	Bought Out Units - Check for any breakage, damage during handing & trasport, erection at site (levels) etc.	As required/ Agreed	Major	Visual	At Random	Tech Specs, Construction Drawings	SR	√	x	x	x	
208	ii	Cast at site (if applicable) - Check for curing, damage during handling, erection at site (level) etc.	As required/ Agreed	Major	Visual	100% of 10% at Random	Tech Specs, Construction Drawings	SR	√	x	x	x	
210	19	Joints In concrete											
211	i	Joint Material - Bitumen inpregnataed fiber board, PVC water stop, Sealing compound - Bitumastic/ polysulphide, Hydrophilic strip, Expanded polysterene (thermocol) board etc.	As per manufacturer's standards	Critical	Review of MTC	Each batch of delivery	Tech. Specs, Construction Drawings, IS: 1838, IS:1834, IS:2200	MTC	√	x	x	x	
212	ii	Acceptance of installation	As agreed/ required	Major	Physical	Each installation at Random	Tech. Specs and Construction Drawings	SR	√	x	x	x	
214	20	Underdeck Insulation Works											
215	i	Insulation material - Mineral/ Glass wool, galvanized wire neting, Aluminium foil, fasteners etc.	As agreed/ required	Critical	Review of MTC/ Test Reports	Each lot received at site	Tech. Specs and Construction Drawings	MTC/ Test Reports/ SR	√	x	x	x	All tests as per Tech. Specifications
216	ii	Acceptance of installation	As agreed/ required	Major	Physical	Each installation	Tech. Specs and Construction Drawings	SR	√	x	x	x	
218	21	False Ceiling											
219	i	Materials - Gypsum board/ Tiles, Particle board tiles, Al tiles/ Strips, GI hangers, AL/ GI Tee support, AL/ GI Edge angle, Fasteners etc.	As agreed/ required	Critical	Visual/ Physical, Review of MTC	Each lot received at site	IS:2095, IS:8183, Tech. Specs and Construction Drawings	MTC/ SR	√	x	x	x	Compare MTC with Tech. Specifications and requirements
220	ii	Acceptance of Installation	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR		x	x	x	
222	22	Doors, Windows, Ventilators, Glass/ Glazing and Grill											

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1								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M*fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
2													
223	i	Door Frame (Hollow steel metal, Aluminium, Wooden etc. including fittings such as hold fasts etc.)	As agreed/ required	Critical	Visual, Physical, Review of MTC/ Test Reports	Each lot received at site	Tech. Specs and Construction Drawings	MTC/ Lab Test Reports/ SR	√	x	x	x	
224	a	Steel Doors											
225	i	Materials (MS sheet & Stiffeners, fasteners, hinges, jambs, lock strike plate, hydraulic door closer, fittings and fixtures etc)	As agreed/ required	Critical	Visual/ Physical/ Review of MTC, Test Report	Each lot received at site	IS:2062, Tech. Specs and Construction Drawings	MTC/ Lab Test Report/ SR	√	x	x	x	Review of MTC/ Test Report
226	ii	Finishing & Acceptance - Surface preperation for painting, primer & finishing coat, DFT	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR	√	x	x	x	
227	b	Flush Doors											
228	i	Shutters, Teak beading	As agreed/ required	Critical	Review of MTC/ Test Report	Each lot received at site	IS:2202, Tech. Specs and Cosntruction Drawings	MTC/ Lab Test Report/ SR	√	x	x	x	
229	ii	Acceptance	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR		x	x	x	
230	c	Aluminium doors and Partition works											
231	i	Materials- Aluminium sections (average thickness, alkali resistant, anodisation, power coating and colour shade etc.), fittings and fixtures. floor spring, hydraulic door closer, hinges, etc.	As agreed/ required	Critical	Visual/ Physical/ Review of Test Report	Each lot received at site	IS:1948, IS:1949, IS:733, IS:1285, IS:1868, IS:11857, Tech. Specs and Construction Drawings	SR/ Lab Test Reports	√	x	x	x	Review of Test Report For anodization check as per Tech. Specs and Construction Drawings Power coating, colour shade as applicable as per Tech. Specs and Construction Drawings
232	ii	Finishing & Acceptance - fabrication & erection, fitting etc..	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR		x	x	x	
233	d	Grill											
234	i	Materials - Aluminium, MS, Anodization in case of aluminium	As agreed/ required	Critical	Visual/Physical/ Review of Test Report	Each lot received at site	Tech. Specs and Construction Drawings	SR/ Lab Test Reports	√	x	x	x	Review of Test Reports
235	ii	Finishing & Acceptance - erection, fitting, painting in case of MS grill etc.	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR		x	x	x	
236	e	Rolling Shutters											
237	i	Surface finish, Thickness of plate, mechanically operated	As agreed/ required	Critical	Visual/ Physical/ review of MTC	Random for each lot of delivery	IS:8248, Tech. Specs & Construction Drawings	SR	√	x	x	x	
238	ii	Finishing and Acceptance -Painting , DFT	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR		x	x	x	
239	f	Glass and Glazing											
240	i	Material - Clear float glass, wired glass, tinted glass, ground glass, figured glass, thickness	As agreed/ required	Major	Review of MTC/ test reports	For each lot received at site	IS: 14900, IS:1081, IS: 3548, IS:5437 Tech Specs and Construction Drawings	SR	√	x	x	x	
241	ii	Installation, finishing and acceptance	As agreed/ required	Major	Visual/ Physical	Random	Tech Specs and Construction Drawings	SR	√	x	x	x	
243	23	Precast Concrete Boundary Wall											
244		Acceptance of boundary wall- Finising, Alignment Dimensions etc.	As agreed/ required	Major	Physical		Tech Specs and Construction Drawings	SR		x	x	x	For inspection of precast concrte units -refer S.No. 18
246	24	Roof Water Proofing											
247	i	Methodology for the application of water proofing system	As required	Critical	Review	for each type of treatment	Tech Specs and Const. Drawings						
248	a	Materials											

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249	i	Polyurethane based coating, polyester scrim cloth, extruded HD dimpled polyurethane	As agreed / required	Critical	Review of MTC/ test reports	For each lot received at site	ASTM C-836, ASTM C898 and Tech Specs /Const. Drawings	MTC/ SR	√				
250	b	Roof											
251	i	Graded under bed - Slope/ Level	As agreed / required	Major	Physical	100%	Tech Specs and Construction Drawings	SR		x	x	x	
252	ii	Elastomeric coatings -Primer coat, Finishing coat	As agreed / required	Major	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Construction Drawings	MTC/ Test Reports/ SR	√	x	x	x	
253	iii	Wearing Course - PCC-Grade, chicken wire mesh, elastomeric sealant	As agreed / required	Major	Visual/ Review of MTC	Each lot of delivery of material/ Review of Test Report	Tech Specs and Construction Drawings	MTC/ Test Reports SR	√	x	x	x	2 samples of 3 no. of test cube each shall be taken for PPC work for testing of crushing strength of concrete mix, Review of MTC for Chicken wire mesh, waterproof sealant
254	c	Acceptance of Water proofing treatment	As agreed/ required	Major	Visual/ Physical	100%	Tech Specs and Construction Drawings	SR		x	x	x	
256	25	Water Supply and Sanitary Installations											
257	a	Water Supply Fittings and Fixtures											
258	i	Materials - GI/ MS/ C-PVC/ uPVC/PPR/HDPE pipes and fittings	As agreed / required	Critical	Review of MTC/ test reports	Each lot of delivery as per Specifications	IS:1239, IS:4736, IS:4985, IS:6745, IS: 4984, IS:2633, IS:2629, IS:15778, IS:15801, Tech Specs and Construction Drawings	MTC/ SR	√	x	x	x	
259	ii	Disinfection - Before use	As agreed / required	Major	Physical	Each installation	IS:2065, Tech specs and construction Drawings	SR		x	x	x	
260	iii	Hydraulic test - Before use/ Leakage	As agreed / required	Critical	Physical	Each installation	Tech Specs and Construction Drawings	SR		x	x	x	
261	iv	Acceptance & Working	As agreed / required	Major	Physical	Random	Tech Specs and Construction Drawings	SR		x	x	x	
262	b	Sand Cast Iron/ Cast iron Pipes											
263	i	Material - SCI / CI pipes and fittings / joints	As agreed / required	Critical	Review of MTC/ test reports	Each lot of delivery (as applicable)	IS: 1729, IS:1536, IS:1538, Tech Specs and Construction Drawings	MTC/ SR	√	x	x	x	
264	ii	Acceptance and leakage	As agreed / required	Major	Physical	Random	Tech Specs and Construction Drawings	SR		x	x	x	
265	c	HDPE Pipes for Sewerage											
266	i	Material- HDPE pipes and fittings/ joints	As agreed/ required	Critical	Review of MTC/ test reports	Each lot of delivery (as applicable)	IS:14333, Tech. Specs	MTC/SR	√	x	x	x	
267	ii	Acceptance & leakage	As agreed / required	Major	Physical	Random	Tech Specs and Const. Drawings	SR		x	x	x	
268	d	HDPE Pipes for Rain water Downcommer											
269	i	HDPE pipes and fittings/ joints	As agreed/ required	Critical	Review of MTC/ test reports		IS:4984, Tech. Specs	MTC/SR	√	x	x	x	
270	ii	Acceptance & leakage	As agreed / required	Major	Physical	Random	Tech Specs and Const. Drawings	SR		x	x	x	
271	e	Sanitary fitting and fixtures											
272	i	Sanitary items and fixtures i.e. water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap containers, geyser, water cooler, etc, water supply / sanitation pipes, manhole cover and frames etc	As agreed / required	Major	Review of MTC/ Test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	MTC/Test Reports/ SR	√	x	x	x	

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273	ii	Acceptance of installations of all sanitary items and fixtures	As agreed / required	Major	Acceptance	100%	Tech Specs and Const. Drawings	SR		x	x	x	
274	f	RCC Pipes											
275	i	Material - RCC pipes	As agreed / required	Major	Review of MTC/ test reports	Each lot of delivery as per Specifications	IS: 458, Tech Specs and Const. Drawings	MTC/Test Reports/ SR	√	x	x	x	
276	ii	Acceptance and leakage	As agreed / required	Major	Physical	Random	Tech Specs and Const. Drawings	SR		x	x	x	
277	g	Water Storage Tank											
278	i	Over head / loft type	As agreed / required	Critical	Physical, review of MTC/ test reports	Each lot of delivery as per Specifications	IS:12701, Tech Specs and Const. Drawings	MTC/Test Reports/ SR	√	x	x	x	
279	ii	Aceptance and leakage	As agreed / required	Major	Acceptance	Random	IS:12701, Tech Specs and Const. Drawings	SR		x	x	x	
280													
281	26	Special Items (Switch Yard)											
282	a	Earthing Mat (Grounding System)											
283	i	Earthing mat	As agreed / required	Critical	Physical, review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043	SR/MTC	√	x	x	x	
284	ii	Weld sizes & length	Visual/Tape	Major	Visual/ Measurement	100%	Tech Specs and Const. Drawings	SR		x	x	x	Low hydrogen electrode as per approval shall be used.
285	iii	D P test	DP test Kit	Critical	Physical	10% at random	Tech Specs and Const. Drawings	TR	√	x	x	x	
286	iv	Earth test	Earthing test kit	Critical	Physical	100%	IS:3043, Tech Specs and Const. Drawings, Relevant IS 3043	SR/ Test Report	√	x	x	x	
287	b	Anti Weed Treatment											
288	i	Anti-weed treatment materials	As agreed / required	Critical	Physical, review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/ MTC	√	x	x	x	
289	ii	Execution of treatment	As agreed / required	Major	Physical	Random check for each treatment	Tech Specs and Const. Drawings	SR		x	x	x	
291	27	Road Work											
292	a	Construction of Sub-Grade and earthen/hard soulders											
293	i	Standard proctor Test	As per IS: 2720	Critical	Physical	One in every 2000 cum for each type and source of fill materials	As per Tech Specs and Const. Drawings,Section 900 of MORTH specification, IS 2720 (Pt.VII)	SR	√	x	x	x	In cutting or existing levelled ground - quantum of check shall be one per 1000 SQM
294	ii	Moisture content of fill before compaction	As per IS: 2720	Major	Physical	One in every 2000 cum for each type and source of fill materials	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification, IS 2720 (Pt.II)	SR		x	x	x	In cutting or existing levelled ground - quantum of check shall be one per 1000 SQM
295	iii	Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method	As per IS: 2720	Critical	Physical	One in every 500 SQM area for each compacted layer.	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification, IS 2720 (Pt. XXIX)/ IS 2720 (Pt. XXVIII)	SR	√	x	x	x	Both for embankment and cut formation quantum of check - One in every 1000 SQM area for each compacted layer.
296	iv	Lines, grade and cross section	As required / agreed	Major	Physical	One in every 500 SQM area	As per Tech Specs and Const. Drawings	SR	√	x	x	x	Template, straight edge

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297	b	Water Bound Macadam (Non-Bituminous) for base course and sub-base course											
298	i	Aggregate Impact value	Aggragate Impact value Test Apparatus	Critical	Physical	One test per 200 cum of Test aggregate	As perTech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
299	ii	Grading	Set of IS Sieves	Major	Physical	One test per 100 cum of aggregate	As perTech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
300	iii	Flakiness index and elongation index	Flakiness test gauge	Major	Physical	One test per 200cum of agregate	As perTech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
301	iv	Atterberg Limits of binding material	Atterberg limits determination	Critical	Physical	One test per 25 cum of binding material	As perTech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
302	v	Atterberg Limits of portion of agreggate passing 425 micron sieve	Atterberg limits determination	Critical	Physical	One test per 100cum of aggregate	As perTech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
303	vi	Camber, surface, slope	As required / agreed	Major	Physical	One in every 500 SQM area	As per Tech Specs and Const. Drawings	SR	√	x	x	x	Template, straight edge
304	c	Bituminous Macadam for base and binder course											
305	i	Quality of binder	Penetrometre with St. needle	Critical	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification, IS 73	SR	√	x	x	x	
306	ii	Aggregate Impact Value / Los angeles abrasion value	Aggregate Impact ValueTest apparatus	Major	Physical	Once per source	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
307	iii	Flakiness Index and elongation index of aggregates	Flakiness test gauge	Major	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
308	iv	Stripping value of aggregate (Immersion tray test)	As required / agreed	Major	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
309	v	Water sensitivity of mix	As required / agreed	Critical	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
310	vi	Grading of aggregates	Set of Sieves	Major	Physical	Two test per day per plant both on individual constituents and mixed aggregate from dryer	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		x	x	x	
311	vii	Water absorption of aggregate	As required / agreed	Major		Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		x	x	x	

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312	viii	Soundness (Magnesium and Sodium Sulphate)	As required as per IS:2386	Critical	Physical	Once per source by each method and on every change of source	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	√	x	x	x	
313	ix	Percentage of fractured faces	As required / agreed	Major	Physical	When gravel is used one test per 50cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		x	x	x	
314	x	Binder content and aggregate grading	Bitumen extractor	Critical	Physical	Periodic, subject to a min of two tests per day per plant	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
315	xi	Control of Temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	Thermometer	Major	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
316	xii	Rate of spread of mixed materials	As required / agreed	Major	Physical	Regular control through checks of layer thickness	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
317	xii	Density of compacted Layer	As required / agreed	Critical	Physical	One test per 250 sqm of area	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
318	c	Bituminous Surfacing - Open graded premix carpet and Seal coat											
319	i	Quality of binder	Penetrometre with St. needle	Critical	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable	IS 73,Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
320	ii	Aggregate Impact Value / Los angeles abrasion value	Aggregate Impact ValueTest apparatus	Major	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
321	iii	Flakiness Index and elongation indexof aggregates	Flakiness test gauge	Major	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
322	iv	Stripping value of aggregate (Immersion tray test)	As required / agreed	Major	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
323	v	Water absorption test		Critical	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
324	vi	Water sensitivity of mix	As required / agreed	Critical	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
325	vii	Grading of aggregates	Set of Sieves	Major	Physical	One test per 25 cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	

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326	viii	Soundness (Magnesium and Sodium Sulphate)	As required as per IS:2386	Critical	Physical	Once per source by each method and on every change of source	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
327	ix	Polished stone value	As required as per BS:812(Part 114)	Major	Physical	As required	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
328	x	Temperature of binder at application	Thermometer	Major	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
329	xi	Binder content	Bitumen extractor	Critical	Physical	One test per 500 cum& not less than two tests per day	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
330	xii	Rate of spread of materials	As required / agreed	Major	Physical	One test per 500 cum and not less than 2 tests per day	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
331	xiii	Percentage of fractured faces	Bitumen extractor	Critical	Physical	When gravel is used one test per 50cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
332	d	Tack Coat/ Prime coat/ fog coat											
333	i	Quality of binder	Penetrometre with Standard needle	Critical	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable	IS 73,Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
334	ii	Temperature of binder at application	Thermometer	Major	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
335	iii	Rate of spread of binder	As required / agreed	Major	Physical	One test per 500 cum and not less than 2 tests per day	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
336	e	Alignment, Level, Surface regularity and rectification											
337	i	Horizontal alignment, Surface levels and Surface regularity	As required / agreed	Major	Physical	At Random	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
338	ii	Rectification	As required / agreed	Major	Physical	Each rectification	As per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR		x	x	x	
340	28	Geotechnical Investigations											
341	i	Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc	As required / agreed	Critical	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	√	x	x	x	
342	ii	Execution of Geotechnical Investigation - locations, type etc as per scheme	As required / agreed	Major	Physical	Each Location	As per technical specifications and relevant IS Codes	SR		x	x	x	
343	iii	Collection of disturbed and undisturbed samples , their packing and storage	As required / agreed	Major	Physical	each sampling	As per technical specifications and relevant IS Codes	SR		x	x	x	
344	iv	Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc	As required / agreed	Major	Physical	each field test	As per technical specifications and relevant IS Codes	SR		x	x	x	

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345	v	Submission of Field Borelogs in approved format	As required / agreed	Major	Review	Within 24 hours after completion of each BH	As per technical specifications and relevant IS Codes	SR		x	x	x	
346	vi	Submission of laboratory test schedule and selection of samples for laboratory testing	As required / agreed	Critical	Review and acceptance	as per consultation with engineer during dispatch of samples to approved laboratory	As per technical specifications and relevant IS Codes	SR	√	x	x	x	
347	vii	Submission of Final Geotechnical investigation report along with recommendations	As required / agreed	Critical	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes	SR		x	x	x	
349	29	Topographical Survey Works											
350	i	Deployment of approved Topographical Surveying Agency - Equipments, Manpower etc	As required / agreed	Critical	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	√	x	x	x	
351	ii	Transfer of Permanent Bench mark to site from known location	As required / agreed	Major	Physical	Before commencement of work	As per technical specifications and relevant IS Codes	SR		x	x	x	
352	iii	Establishment of boundary pillars and survey grid, Temporary bench Marks, Measurement & recording spot levels	As required / agreed	Major	Physical		As per technical specifications and relevant IS Codes	SR		x	x	x	
353	iv	Recording features like trees, roads, transmission lines, lake, nala, river, temple, house, culverts etc. with coordinate locations	As required / agreed	Major	Physical		As per technical specifications and relevant IS Codes	SR		x	x	x	
354	vi	Submission of final Counter map showing all topographical features, record of spot levels	As required / agreed	Critical	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes	SR	√	x	x	x	
356	30	Internal Switchyard - Site Leveling & Grading											
357	i	Leveling Switchyard area	As required / agreed	Major	Visual / Physical	100%	As perTech. Specification and Approved Drawing	SR		x	x	x	
358	ii	Grading of 20/40mm stone / Gravel Spreading in sitchyard area	As required / agreed	Major	Physical	100%	As per Tech. Specification & Approved Drawing	SR		x	x	x	
360	31	Plant Boundary Fencing (if applicable) & Gate (Also refer S.No. 3 for Steel works as applicable)											
361	i	Fence posts (Intermediate, Stay & Corner Posts etc.) - Section size, Length, Galvanization - Grade/ Thickness, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC	Each lot received at site Random	IS:226; IS:2721; IS:278; IS:480; IS:4826 , Tech. Specs & Construction Drawings	MTC/ SR	√	x	x	x	For Structural steel checks refer S.No. 3
362	ii	Barbed wire - Dia. of line wire and barb wire, Grade of galvanization etc, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC				√	x	x	x	
363	iii	Tie wire - Diameter, Galvanization-Grade, tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/				√	x	x	x	
364	iv	Blade barbed/ Concertina Wire - Thickness/ Diameter, galvanization, Diameter of concertina coil, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC				√	x	x	x	

	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	Sr.No.	Activity & Operation	Instruments	Class of Check	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vender in QA documentation)	Cheking Agency			Remarks	
2								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner		
365	v	Fence Fabric- Mesh size, Wire Diameter, Galvanization-Grade, Selvage, Knuckling, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC				√	x	x	x		
366	vi	MS Gate - Caster weels, ball & bearings, Fixtures & fasteners etc.	As agreed/ Required	Major	Visual	100%	Tech. Specs & Construction Drawings	SR		x	x	x		
367	vi	Acceptance of Boundary Fence and gate	As agreed/ Required	Major	Physical	100%	Tech. Specs & Construction Drawings	SR		x	x	x		
369	32	Tranformer Yard Fencing & Gate (Also refer S.No. 3 for Steel Works as applicable)												
370	i	Fence posts (Intermediate, Stay & Corner Posts), Concertina Wire Support Angles - Section size, Length, Galvanization, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC	Each lot received at site Random	IS-226; IS 2721; IS-4948 , IS:480; IS:4826 Tech. Specification and Approved Drawing	MTC/ SR	√	x	x	x	For structural steel checks refer S.No. 3	
371	ii	Tie wire (as aplicable) - Diameter, Galvanization, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC				√	x	x	x		
372	iii	Fence Fabric (chain link/ welded wire as aplicable)- Mesh size, Wire Diameter, Galvanization, Selvage, Knuckling, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC				√	x	x	x		
373	iv	MS Gate - Fixtures and fasteners	As agreed/ Required	Major	Visual	100%	Tech Specs andApproved Drawings	SR		x	x	x		
374	v	Acceptance of Fence & Gate	As agreed/ Required	Major	Physical	100%	Tech Specs and Approved Drawings	SR		x	x	x		
376	33	Installation of Pre Engineered Building (PEB) - Security Cabin												
377	a	Receipt												
378	i	Receipt of materials and Checking as per packing list	As agreed/ Required	Major	Visual	100%	As per Approved Drawings & Method Statement, Relevant BIS standards	SR	√	x	x	x		
379	iii	Dimensional Check	As agreed/ Required	Major	Measurement	100%			√	x	x	x		
380	iv	Visual checks for damages, rusting, pitting etc.	As agreed/ Required	Major	Visual	100%				x	x	x		
381	v	Visual checks for defects, primer coating and painting/galvanising as applicable.	As agreed/ Required	Major	Visual	100%				x	x	x		
382	vi	Nut/Bolt/Washers Checks	As agreed/ Required	Major	Visual	100%				x	x	x		
383	b	Pre-Installation												
384	i	Check that the work area is ready and safe to start installation	As agreed/ Required	Major	Visual / Dimension					x	x	x		
385	ii	Check readiness of Foundations	As agreed/ Required	Major		100%				x	x	x		
386	c	Installation (as aplicable)												
387	i	Readyness of concrete platform, foundations for installation- Size, Location, Level etc.	As agreed/ Required	Major	Visual					x	x	x		
388	ii	Check PUF side walls/ roof are installed properly	As agreed/ Required	Major	Physical					x	x	x		
389	iii	Check tightening of all Nut/Washers/Bolts	As agreed/ Required	Major	Physical					x	x	x		

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Sr.No.	Activity & Operation	Instruments	Class of Check	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vender in QA documentation)	Cheking Agency			Remarks
1								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
2													

496	37	Inverter Panel					Design Specification, Drawings, Manufacturer Manual Method Statement	SR					
497		Pre Installation											
498	i	Check for site physical layout as per drawing.		Major	Visual	100%			√	x	x	x	
499	ii	Ensure that no fouling with civil/structural		Major	Physical	Random				x	x	x	
500	iii	Check for Foundation readiness and level of foundation.		Major	Physical	100%				x	x	x	
502	38	Burried Cables					Design Specification, Drawings, Manufacturer Catalogue Method Statement (SW-SEPC-MS-CAB-006)						
503	i	Cable Trench - Dimensions, alignment		Critical	Physical	100%	Design Specification, Drawings, Manufacturer Catalogue Method Statement	SR		x	x	x	
504	ii	Sand filling before cable laying, sand filling after cable laying, placing of precast concrete slabs/ bricks, backfilling with soil		Major	Visual	100%				x	x	x	
586													
587													
588													
589													
590													
591													

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Sr.No.	Activity & Operation	Instruments	Class of Check	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vender in QA documentation)	Cheking Agency			Remarks
1								SR - Site Register SECI-SPV-QA-F-XXX SECI-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	SECI or Owner	
2													
592			LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA documentation.							DOC. NO.: SECI - XXX - XXX -XXX - FQP & MQP - 001 REV: 0			
593			Legend to be used:										
594			Class # : A = Critical, B=Major, C=Minor										
595			Format of Record # : SR=Site Register, TR=Lab Test Report, IR=Inspection Report, MTC=Manufacturer's Test Certificate										
596			All MTC's shall be correlated with batch of material supply, Tech specs and drawings										
597			Category 'A' - Sub-contractor/ sub-vendor, EPC Vendor, SECI/ Owner										
598			Category 'B' - Sub-Contractor/ Sub-Vendor, EPC Vendor, SECI										
599			Category 'C' - Sub-Contractor/ Sub-Vendor										
600									Reviewed By	Approved By		Approval Seal	
601			This document shall be read in conjunction with Tech. Specifications and Drawings										

SUB-SECTION C

GENERAL ANNEXURE G

Quality Assurance & Inspection of Civil Works

TABLE OF CONTENTS

1	Introduction	3
2	QA and QC Manpower	3
3	Laboratory and Field Testing.....	4
4	Sampling and Testing of Construction Materials	5
5	Purchase and Service	5
6	Field Quality Plan	6
7	General QA Requirements	6

1 Introduction

- 1.1 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification.
- 1.2 This part of the technical specification shall be read in conjunction with other parts of the technical specifications, general technical requirements & erection conditions of the contract which covers common QA requirements. Wherever IS code or standards have been referred they shall be the latest revisions.
- 1.3 The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part of the technical specifications.
- 1.4 The QA and QC activities in all respects as specified in the technical specifications/ drawings / data sheets / quality plans / contract documents shall be carried out at no extra cost.
- 1.5 The contractor shall prepare detailed construction and erection methodology scheme which shall be compatible to the requirements of the desired progress of work execution, quality measures, prior approvals from statutory authorities etc. if any and the same shall be got approved from the Engineer.
- 1.6 If required, work methodology may be revised/ reviewed at every stage of execution of work at site, to suit the site conditions, work progress commensurate with project schedule by the contractor at no extra cost to the Engineer

2 QA and QC Manpower

- 2.1 The contractor shall nominate one overall QA coordinator for the contract detailing the name, designation, contact details and address at the time of post bid discussions.
- 2.2 All correspondence related to Quality Assurance shall be addressed by the contractor's QA coordinator to the Engineer.
- 2.3 Employer/ Consultant shall address all correspondence related to Quality issues to the contractor's QA coordinator. The contractor's QA coordinator shall be responsible for co-ordination of Quality activities between various divisions of the contractor and their sub-vendors on one hand & with Engineer on the other hand.
- 2.4 The contractor shall appoint a dedicated, experienced and competent QA & QC in-charge at site, preferably directly reporting to the Project Manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP.

- 2.5 The contractor shall finalize and submit a deployment schedule of QA & QC personnel along with their details to Engineer for approval/ acceptance and further shall ensure their availability well before the start of the concern activity.

3 Laboratory and Field Testing

- 3.1 The contractor shall make necessary provisions to provide all facilities required for QA & QC activities by setting up a field laboratory for QA and QC activities in line with the indicative field QA & QC laboratory set-up.
- 3.2 The Laboratory building shall be constructed and installed with adequate facilities to meet the requirement of envisaged test setup. Temperature and humidity controls shall be available wherever necessary during testing of samples.
- 3.3 The quality plan shall identify the testing equipment/ instrument, which the contractor shall deploy and equip the field quality laboratory for meeting the field quality plan requirements.
- 3.4 The contractor shall furnish a comprehensive list of testing equipment/ instrument required to meet the planned/scheduled tests for the execution of works for Engineer's acceptance/ approval.
- 3.5 The contractor shall mobilize the requisite laboratory equipment and QA & QC manpower at least 15 days prior to the planned test activity as per the schedule of tests.
- 3.6 In case contractor desires to hire the services of any established laboratory nearby for any field tests then he shall ensure that the subject laboratory is well equipped with all requisite testing facilities and qualified QA & QC staff and this shall not affect in anyway the work progress.
- 3.7 All equipment and instruments in the laboratory/ field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the Engineer. The calibration certificates shall specify the fitness of the equipment and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipment and instruments by an NABL / NPL accredited agency and the calibration report shall be submitted to Engineer.
- 3.8 The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute. This includes selected IITs, NCB, CSMRS, reputed government / autonomous laboratories / organizations, NITs and other reputed testing laboratories. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by Engineer. Test report along with the recommendations shall be obtained from the laboratories without delay and submitted to Engineer.
- 3.9 Based on the schedule of work agreed with the Engineer and the approved FQP, the

contractor shall prepare a schedule of tests and submit them to the Engineer and organize to carry out the tests as scheduled/agreed.

4 Sampling and Testing of Construction Materials

- 4.1 The method of sampling for testing of construction materials and work / job samples shall be as per the relevant BIS / standards / codes and in line with the requirements of the technical specifications / quality plans.
- 4.2 All samples shall be jointly drawn, signed and sealed wherever required, by the contractor and the engineer or his authorized representative.
- 4.3 The contractor shall carry out testing in accordance with the relevant IS standards/ codes and in line with the requirements of the technical specifications / quality plans. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer.
- 4.4 All testing shall be done in the presence of Engineer or his authorized representative in a NABL accredited / Govt. Laboratory acceptable to Engineer.
- 4.5 The test samples shall be jointly selected and sealed and signed by the Site-in-charge and thereafter these shall be sent to the concerned laboratory.
- 4.6 The test report along with the recommendations shall be obtained from the laboratory without delay and submitted to Engineer.

5 Purchase and Service

- 5.1 All structural steel shall be procured only from main steel producers. In case of non-availability of some of the sections with main steel producers, the contractor may propose to procure the sections from the re-rollers of the main steel producers, the name of such re-rollers will have to be cleared by the Engineer for which details such as BIS approval, main steel producer's approval, past experience for production of sections of specified material, details of machines, plant, testing facilities etc.
- 5.2 Confirmation that the process control and manufacturing of steel sections by re-rollers shall be same as that of main steel producers, that billets for re-rolling will only be sourced from main steel producers shall be furnished with regard to re-roller.
- 5.3 For Module Mounting Structures (MMS), sources of steel other than those specified under this clause may also be used subject to the condition that they otherwise meet the requirements of the Technical Specifications / Bid documents. Even after clearance of re-rollers, induction of billets with identified and correlated Mill test certificates (MTC) in the process of re-rolling, sampling of steel, quality checks thereof and stamping of final product for further identification and correlation with MTC prior to dispatch shall be the responsibility of the contractor and these shall be performed in presence of the

authorized representative of the main Contractor.

- 5.4 Reinforcement steel shall be procured only from main steel producers and Mill test certificates (MTC) shall be obtained and submitted to the Engineer for correlation.

6 Field Quality Plan

- 6.1 Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans to Employer for approval, which shall detail out for all the works, equipment, services, quality practices and procedures etc. in line with the requirement of the technical specifications to be followed by the contractor at site.
- 6.2 This FQP shall cover all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at site.
- 6.3 An Indicative Field & Manufacturing Quality Plan for civil, structural and MMS works is enclosed with this specification for reference as Annexure-F.

7 General QA Requirements

- 7.1 The contractor shall ensure that the works, BOIs and services under the scope of Contract, whether manufactured or performed within contractor's works or at his subcontractor's premises or at the project site or at any other place of work, are in accordance with Technical specification, applicable standards / codes, approved drawings / data sheets / quality plans and BOQ. All the works, BOIs and services shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer.

Equipment	UOM	Approx. Qty.
Cube moulds for cement testing	nos.	4
Sieve shaker	nos.	1
Sieve for sand, coarse and fine aggregate	set	1
Sieve for coarse aggregate	set	1
Slump testing equipment	nos.	6
Oven	nos.	2
Physical balance	nos.	1
Thermometer	nos.	4
Burret	nos.	2
Measuring cylinder	nos.	9
Measuring flask	nos.	3
Compression testing machine	set	1
Cube mould for concrete	nos.	10

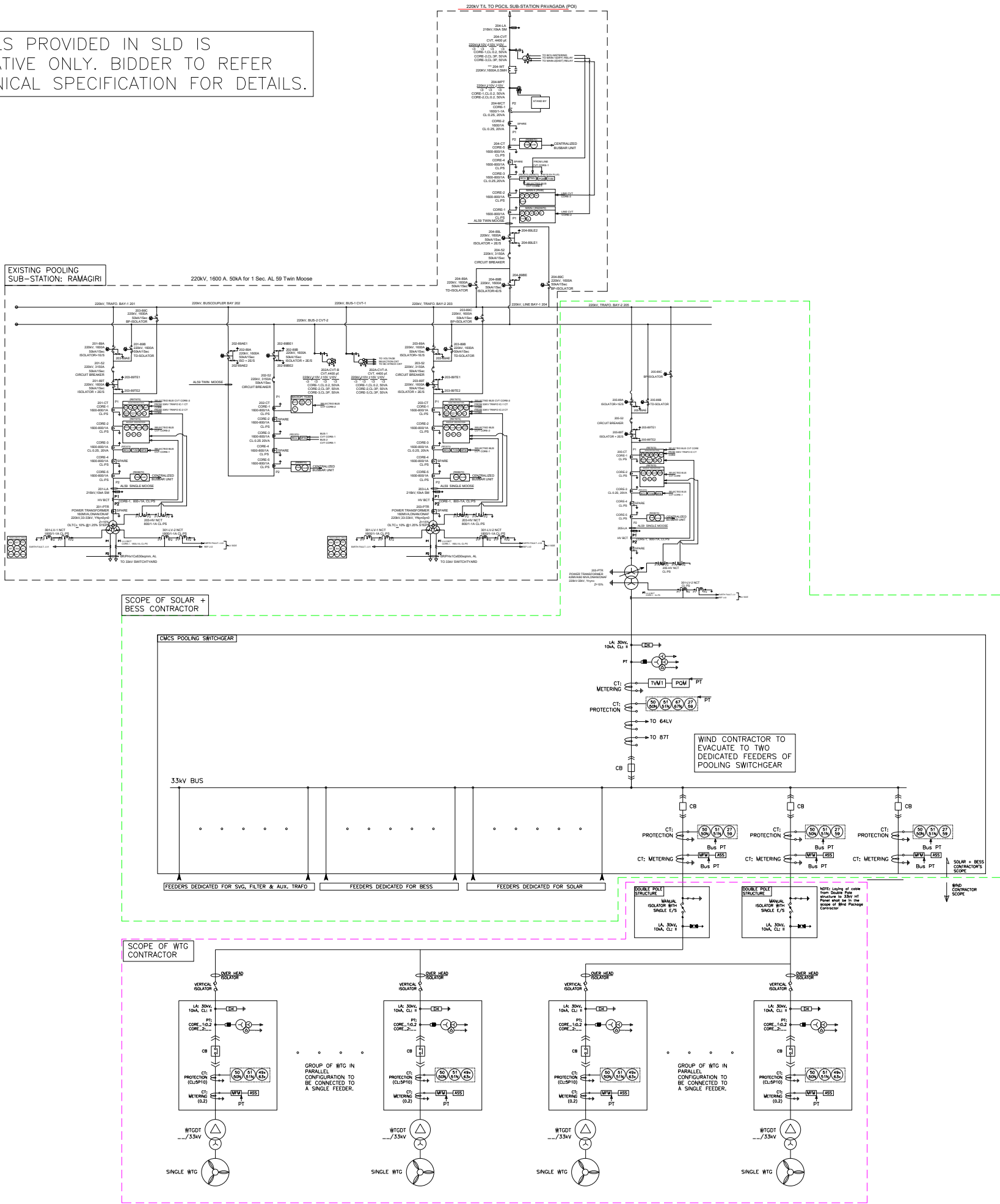
Mechanical weighing machine	nos.	1 (100kg capacity)
Drum type concrete mixer (for trial mixes)	nos.	1
Proctor testing equipment	set	1

7.2 Notes

- The equipment listed above is indicative and minimum required. Additional equipment, if any, required for successful completion of work shall be provided /arranged by the contractor.
- All test reports/ inspection reports shall be submitted in soft copy also and shall be available at site for easy access to the Engineer.

Based on the schedule (L2/L3 Network), Quality control & Quality Assurance Work plan shall be finalized by the contractor and the same shall be submitted to Engineer for acceptance/approval.

DETAILS PROVIDED IN SLD IS
INDICATIVE ONLY. BIDDER TO REFER
TECHNICAL SPECIFICATION FOR DETAILS.

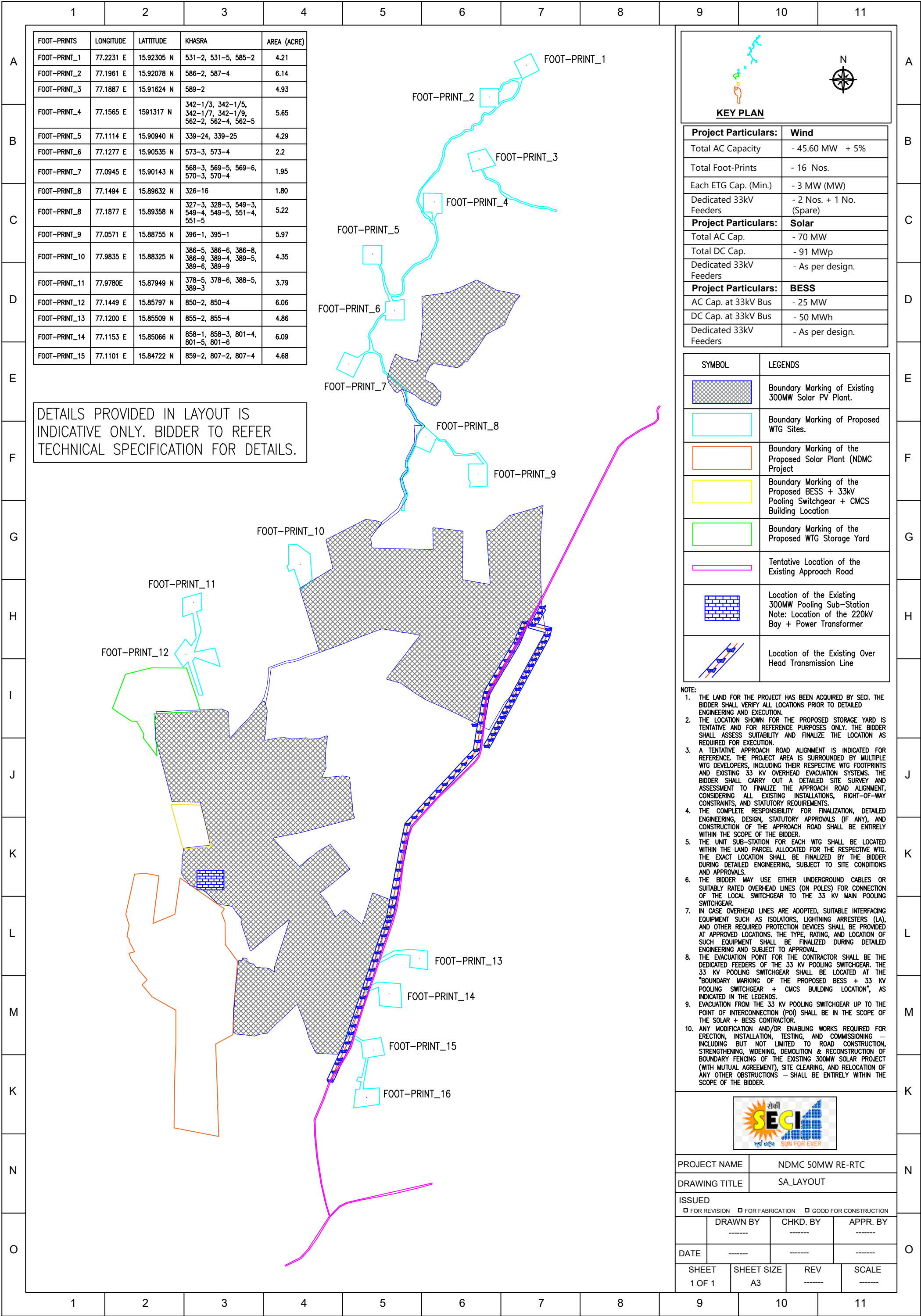


KEY PLAN

SYMBOL	LEGENDS
	LIGHTNING ARRESTOR/ SURGE ARRESTOR
	CURRENT TRANSFORMER
	CIRCUIT BREAKER
	ISOLATOR & EARTH SWITCH
	WTG TRANSFORMER
	POTENTIAL TRANSFORMER
	SINGLE WTG
	SCOPE DEMARCATION OF SOLAR + BESS PACKAGE
	SCOPE DEMARCATION OF WTG PACKAGE



PROJECT NAME	50 MW ISTS-Connected RE Hybrid Project at Ramagiri, Andhra Pradesh		
DRAWING TITLE	Single Line Diagram		
DRAWING NO.	-----		
ISSUED			
☐ FOR REVISION ☐ FOR FABRICATION ☐ GOOD FOR CONSTRUCTION			
	DRAWN BY -----	CHKD. BY -----	APPR. BY -----
DATE	-----	-----	-----
SHEET 1 OF 1	SHEET SIZE A3	REV R0	SCALE NTS





Tender for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and Maintenance of 45.6 MW ISTS Connected Wind Power Project at Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Packge-2: Wind)

SECTION VII

SUB-SECTION E

OPERATION & MAINTANANCE AGREEMENT

1 CONTRACT PERIOD

The term of employment under this Agreement shall begin on the date of signing of this O&M Agreement, by and between the Employer and the Contractor (the “Effective Date” or “Commencement Date”) and unless terminated earlier as set forth herein, shall continue through and including the tenth (10th) anniversary of the Effective Date.

Unless otherwise agreed, the Effective date shall be the date of Issue of Operational Acceptance by the Employer.

Note: Operational Acceptance of the Plant Facilities by the Employer shall be a necessary condition for signing of the O&M Agreement. The Contractor shall, however, maintain the plant facilities, in the interim period between the Plant Commissioning and the signing of the O&M Agreement

2 CONTRACTOR'S OBLIGATIONS

2.1 Services

During the Term of the Contract, the Contractor shall perform the services in accordance with the Operation and Maintenance Scope of work as described in Annexure-1 (Scope of Work for Operation and Maintenance) (hereafter the “Services”), and also in accordance with the other conditions as prescribed related to the operational performance under

2.2 Section - VII of the Bid Document.

The Contractor shall be deemed to have allowed correct and sufficient O&M Price to cover all its obligations under the Contract and to have allowed the necessary resources to enable it to perform the Services to the standards and in the manner required. The

2.3 Contractor's failure to acquaint itself with or assess any applicable condition shall neither relieve it from the responsibility for performing its obligations under the Contract nor entitle the Contractor to any additional costs or any other relief.

To the extent the Contractor reasonably believes that it is necessary to enhance the overall performance or safety of the Plant, the Contractor may propose changes and improvements to the Plant [(including the software included with respect thereto)]. The Contractor shall ensure that no modification of any equipment, change of software settings or any other alteration of equipment shall:

- (i) cause a negative impact on the performance of the safety and reliability of the Plant;
- (ii) adversely impact the Warranties;
- (iii) adversely affect the warranties provided by the Contractors under the Contract;
- (iv) conflict with the requirements under the contract; or
- (v) bypass any protective equipment.
- (vi) Violates any National/International Trade & IPR laws.

2.4 Any proposed modifications/changes shall not be carried out without the approval of the original equipment manufacturer and the Employer and in accordance with Performance Standards, and Technical Specifications. The Employer shall be notified of the proposed modifications along with reasons and technical note for such modifications, changes, alterations, etc., and after the modifications are carried out in accordance with the contract, an alterations activity report is to be shared with the Employer.

2.5 The Contractor shall, while rendering the Services, observe and comply with all the Applicable Laws, good Wind Industry Practices, Ministry of New & Renewable Energy (MNRE), Ministry of Power (MoP), CEA, CERC, GRID India, SLDC/RLDC, Local DISCOM & TRANSCO, CTU guidelines and Performance Standards pursuant to the contract. The Employer shall have the right to, to the extent applicable to Services rendered by the Contractor, conduct monthly audit on Applicable Laws, health, safety and environment and all other relevant compliances. The Contractor shall provide all necessary access and supporting documents during audit which are applicable to the same. However, such audits will be planned well in advance in coordination with the Contractor, without affecting the site operation plan.

2.6 The Contractor shall provide and make available as necessary, all such skilled, experienced and qualified labour and other competent personnel as are required to perform the Services the Contractor shall ensure that its Personnel hold and continue to maintain all qualifications and licenses as required under Applicable Law to allow its Personnel to lawfully undertake performance of the Services and carry out the Contractor's other obligations under the contract. For works/services being performed on a continuous basis, the O&M Price shall be deemed to include and the Contractor shall obtain all required Government Approvals and bear any costs related thereto (including any shift or permitted overtime working, allowances, wage orders, night shift differentials, etc.).

The Contractor shall ensure that all its Personnel deployed for providing the Services have

undergone adequate safety training and are appropriately skilled, qualified and experienced in performing the Services for wind farms of a similar size, scope and complexity as the Plant. The Contractor shall be responsible for all matters relating to labor relations, working conditions, training, employee benefits, safety programs and related matters pertaining to its Personnel. The Contractor shall at all times have full supervision and control over its Personnel and shall at all times maintain appropriate order and discipline among its Personnel.

2.8 Contractor shall be solely liable for and, at its sole cost and expense, arrange for the response, reporting, removal, transportation, disposal, investigation, cleanup or other remedial action (in all cases by licensed, insured, competent and professional contractors in a safe manner and in accordance with Applicable Laws) for any hazardous substances/waste existing at, in, on or under the Project.

2.9 The Contractor shall ensure availability of such Consumable Parts, Spare Parts, and Contractor's Equipment as may be necessary for the performance of the Services. The Contractor shall ensure that such Contractor's Equipment does not interfere with the operational or structural integrity of the Plant.

2.10 The Contractor shall make available to the Employer the Reference Documents set forth in the Reference Documents and shall also provide the Employer with updates and revisions to the Reference Documents to the extent such updates and revisions are necessary and applicable to the performance of the Services. The Contractor shall provide the Employer with a latest version of update available of all the Reference Documents at the time of termination of the contract.

2.12 The Contractor acknowledges and agrees that other contractors of the Employer may be present at the Plant and it shall cooperate with such other contractors to allow the performance of its and their respective obligations to occur concurrently.

2.13 The Contractor shall through relevant agencies, if applicable, promptly investigate all accidents, damage or destruction, diagnosis, assessment of any potential consequential effects, estimating cost of repair, arranging for any remedial action required, making of any claims under the insurance policies and co-operating with and making reports required by the Employer or insurers.

2.14 The Contractor shall ensure that any Warranties provided under the Project Contracts are not invalidated or adversely affected by any act or omission of the Contractor during the period of such warranties.

The Contractor shall ensure complete integration of the Wind Plant LCS/DAS with the Plant Level PPC and SCADA system under the Solar + BESS Package. The Contractor

shall provide all necessary communication hardware, interfaces, protocol compatibility, data mapping, configuration support, and commissioning assistance required for seamless integration with the Plant SCADA and SLDC/RLDC systems.

The Contractor shall ensure real-time transmission of all operational, alarm, event, and energy generation data from the Wind Plant to the Plant SCADA system and shall submit periodic performance reports as specified in the Contract.

The Employer and its authorized representatives shall have unrestricted access to all real-time and historical Wind Plant data through the Plant SCADA system during the Contract Period. The Wind Contractor shall remain responsible for communication healthiness, signal availability, and correctness of integrated Wind Plant data and controls.

2.15 Upon expiry or earlier termination of the Contract, the Contractor shall hand over all operational data, logs, configuration files, software backups, interface documents, and records related to the Wind Plant to the Employer.

The Contractor shall provide necessary technical support for smooth transition of monitoring and operation activities, including transfer of communication configurations, access details, and interface documentation.

2.16 The Contractor shall ensure continued accessibility of the Wind Plant through the existing Plant SCADA system without dependency on proprietary access or additional cost to the Employer.

2.17 The Contractor shall further provide support for the operation and maintenance of any Employer installed scope including any third-party support as may be required by any relevant Government Authority.

3.1 The Contractor shall notify and communicate to the Employer about any condition which may cause any malfunction or failure in the Project.

3 FUNCTIONAL GUARANTEES/WARRANTIES

Technical and Functional Performance Guarantee

3.1.1 The Contractor shall be responsible for meeting the performance guarantee of the Plant Facility as described in the contract.

3.1.2 In case of failure to meet the functional guarantees as described in section 2.1.1 above, the Contractor shall be liable to pay applicable Liquidated damages as described in the Bid Document and represented in Annexure-2 of this document.

General Repair Warranty

3.2.1 All repairs and replacements performed by the Contractor pursuant to the contract, shall cover a warranty for defects in materials and workmanship for the entire terms of O&M

contract.

3.2.2 The Contractor shall disassemble, repair or, replace and reinstall any defective Equipment parts and/or re-perform any defective work covered by this warranty, at no cost or expense to the Employer.

3.2.3 In the event that Contractor replaces Parts that failed during the final year of the Term in accordance with its obligations under the Contract, Contractor hereby warrants to Employer that the replacement Parts installed in the Plant Equipment during such period shall not fail due to a defect for one (1) year following the date of installation of such replacement Parts; provided that in no event shall any such warranty extend beyond earlier of (i) the period that is one (1) year following the expiration of the Term or (ii) the date of any termination of the contract for reasons other than attributable to Contractor. During such period, if the contract is not in effect for any reason other than being terminated by Employer for cause, Contractor's obligation will be limited to supplying all needed Parts on to the Site delivered basis. For the avoidance of doubt, this Clause may survive the termination or expiry (as the case may be) of the contract for a period of one (1) year.

3.2.4 During Defect Liability Period if any repair and replacement are done, then the warrantee of the equipment shall be extended from the data of such repair and replacement to the period of original equipment warrantee w.r.t. that replaced component.

3.2.5 Any latent defect which may not come to knowledge or discovered in the course of normal inspection/operation during two years from the operational acceptance but, may arise within a period of 5(five) years from expiry of warranty period of two years, shall be under warranty by free replacement/rectification.

3.3 3.2.6 The acceptance of the equipment by employer shall in no way relieve contractor of his obligations under the contract.

Guarantee of compliance in relation to Curtailment Plans (acoustic or other curtailment plans)

The Employer may communicate to the Contractor any curtailment plans either linked to acoustic requirements; load management, or Applicable Law, the (“**Curtailment Plans**”).

The Contractor shall ensure compliance with all Curtailment Plans provided by the Employer in accordance with Performance Standards and Technical Specifications. If either the Contractor or the Employer detects a variation with respect to the Curtailment Plans or in noise emission the Contractor will, at its own expense, characterise the problem, isolate the source of the problem and propose solutions to solve the problem to Employer (at the Employer’ expenses in all cases other than cases where it’s ascertained that the deviation was caused by a non-respect of the obligations under the contract).

Grid Connection and balance of electricity commitments

3.4 The Contractor acknowledges that continuous compliance with Applicable Laws, Grid Code/CEA requirements, Good Industry Practices, Performance Standards, and Grid connectivity requirements is essential for successful evacuation of power from the Wind Plant and for maintaining the Employer’s entitlement under the applicable Power Purchase Agreement (PPA).

The Contractor shall operate and maintain the Wind Plant in compliance with all applicable grid requirements, instructions of SLDC/RLDC, and technical requirements communicated by the Employer from time to time. The Contractor shall ensure proper functioning of all systems related to grid connectivity, communication, protection, SCADA/LCS integration, forecasting interfaces, reactive power control, and other grid compliance functions within the scope of the Wind Package.

4.1 Any non-compliance attributable to the Contractor resulting in avoidable generation loss, grid non-compliance, or penalties imposed by statutory authorities shall be the responsibility of the Contractor to the extent attributable to its scope of work and obligations under the Contract.

4 PERFORMANCE STANDARDS

Contractor shall perform its obligations under the contract in compliance with the contract and otherwise, as applicable, in accordance with the following order of precedence (collectively, the "Performance Standards") as from time to time in force:

4.1.1 the Applicable Laws, and the requirements from the Grid Operator/SLDC/RLDC;

- 4.1.2 the Permits and all the related documents;
- 4.1.3 the terms of the contract;
- 4.1.4 the functional Guarantee;
- 4.1.5 the Reference Documents including the manufacturers recommendations;
- 4.1.6 Employer's health and safety manuals and procedures and ESMP;
- 4.1.7 the Site Regulations;
- 4.1.8 the Equator Principles and the Equator Principles Requirements;
- 4.1.9 Good Wind Industry Practice;
- 4.1.10 Any relevant and reasonable instructions issued by the Employer, relevant to the scope of the contract, to the Contractor at least 15 days before the implementation of such instructions without any cost to the Contractor.
- 4.1.11 The terms of insurances directly relating to the Project and
- 4.1.12 Comply with all operation and maintenance obligations as set out under the PPA or do anything which results in a breach of the Employer's obligations under the PPA.

- 4.2 If there is any inconsistency between the Performance Standards, [it shall be interpreted in the order of precedence listed above provided that (i) the application of a Performance Standard does not derogate, breach, contradict, obstacle or circumvent the application of a Performance Standards appearing above such standard in the above order of precedence, and, in addition, (ii) provided that this such application does not cause a breach of Performance Standards or the Parties shall discuss and agree upon the manner
- 4.3 in which such conflict shall be resolved.

Notwithstanding any other provision in the contract, the Contractor shall have no responsibility or obligation:

- (a) to save and to the extent that the Contractor is required to do so pursuant to the provisions of Additional Services, to ensure that the Plant complies with the requirements of Applicable Law, Permits, if and to the extent that the same are introduced or amended following the Commencement Date; or
 - (b) subject to Additional Services, to ensure that the Plant or the Plant (as a whole or in part) complies with any noise or acoustic emissions requirements under
- 4.4 Applicable Laws Permits.

Without prejudice to the foregoing, the Contractor is required to comply with the quality of supply limits determined in accordance with the Applicable Law and the Contractor will be deemed to have knowledge of its content.

The Contractor shall not do or omit to do anything in the performance or discharge of its obligations or the exercise of its rights under the contract or in breach of the contract,

which would cause any breach of any of the terms of the Supply Contract, Works Contract, the Applicable Law, the Permits or the terms of any Permits or the Direct Contract, and should the Contractor be in breach of the Performance Standards, it shall, on demand of the Employer, indemnify the Employer against any direct Losses arising from a breach of this Clause by the Contractor, always subject to the aggregate liability cap of the Contractor (except as otherwise agreed herein).

If the Contractor is aware of a conflict between any of the above requirements, it shall inform the Employer accordingly and the Parties shall discuss and agree upon the manner in which such conflict shall be resolved.

4.5

5 EXCLUSION

General

(i) Force Majeure events as per GCC

5.1

The rights of the Contractor under Exclusions shall only apply to the extent that the Excluded Risk Event has caused actual delays or substantial interference to the performance of the Contractor's obligations under his Contract, which could not have been mitigated by the Contractor's best efforts, and to such portions of Contractor's obligations directly affected by such delays or interference.

5.2

5.3

Notification of Excluded Risk Event

To the extent Contractor has actual knowledge of any loss or damage to the Plant caused by or arising from an Excluded Risk Event, it shall give Employer immediate notice of the same and provide a written report to Employer within five (5) Business Days; and the employer and Contractor shall be mutually agreed upon within (30) business day. However, that any failure of Contractor to provide such notice shall not waive, prejudice or otherwise affect the other provisions in Exclusions, except to the extent that the failure to timely notify Employer results in any additional damage or loss to the Plant. Notwithstanding the foregoing, in case of delay to provide the aforementioned notice, the Contractor shall be liable towards the Employer for any additional damage or loss caused by the delay to notify the Employer.

6.1

6 ADDITIONAL SERVICES

Employer may, with respect to the Plant, request that Contractor perform work, provide services, or supply other equipment or parts, not included within Services for the successful operation of the plant for the duration of this O&M Agreement. Any such requested service or supply that the Parties mutually agree to in writing shall, subject to any specific terms and conditions agreed with respect to such service or supply, be an

“Additional Service”.

7 SERVICE PERSONNEL

7.1 Contractor shall provide the Services and any Additional Services to be performed on Site using a sufficient number of suitably skilled, qualified and experienced (including any licensing, certifications or training required by Applicable Laws or the local transmission system operator) and adequately equipped and properly trained Personnel and/or Subcontractors, all appropriately skilled and experienced in their respective trades or occupations as may be reasonably necessary to fulfil its obligations hereunder in relation to the Services and Additional Services

7.2 The Employer may request the Contractor to remove (or cause to be removed) any Person or Subcontractor employed on the operation of the Plant, including the Contractor’s Representative if applicable, who:

- (i) engages in material or persistent misconduct or lack of reasonable care;
- (ii) carries out duties incompetently or negligently;
- (iii) fails materially to conform with any provisions of the Contract;
- (iv) engages in conduct which is prejudicial to safety, health or the protection of the environment or in violation of any related Performance Standards or Applicable Laws;
- (v) engages in conduct which might reasonably result in a breach of any provision of the contract and threaten public health, safety or security.

7.4 The Employer shall give notice to the Contractor of the same giving reasons and request the Contractor to replace such Personnel with a suitable candidate. The Contractor shall then as soon as reasonably possible but no later than seven (7) days upon receiving such notice from the Employer, Contractor will look in to the facts and claims of the case in all sincerity and deploy the required actions with the notice to the Employer.

7.5 Contractor shall have full supervision and control over its Personnel at the Site and shall maintain appropriate order and discipline among such personnel and shall cause any Subcontractor to maintain similar standards with respect to such Subcontractor’s personnel at the Site.

The Contractor shall be responsible for all matters relating to labour relations, working conditions, training, employee benefits, employee drug testing in accordance with the Contractor’s standard drug testing policy, safety programs and related matters pertaining to its employees and other Personnel engaged by the Contractor. The Contractor shall at all times have full supervision and control over its employees and other personnel

engaged by it and shall at all times maintain appropriate order and discipline among its Personnel and shall cause any Subcontractor (or any subcontractor appointed by such Subcontractor) to maintain similar standards with respect to such Subcontractor's or any subcontractor appointed by such Subcontractor) employees and Personnel.

The Employer shall have the right, acting reasonably and following prior notification, to require the Contractor to remove from the Site any employee or Personnel of the Contractor or any of its Subcontractors (or any subcontractor appointed by such Subcontractor) engaged in activity which presents a risk of injury to persons or property at the Site.

8 SAFETY PRECAUTION

During performance of the Services, Contractor shall:

- 8.1.1 comply with the safety standards and any safety procedures established by Contractor and same shall be approved by employer after the Commencement Date;
- 8.1.2 take all precautions required by Applicable Laws or Site Regulations, or otherwise according to the Performance Standards, for the health and safety of Contractor, its Affiliates and Subcontractors in the performance of the Services and any other Persons with temporary or perpetual access to the Site; [provided that the foregoing shall not limit Employer's responsibility for the safety of the Site as provided in Safety Precautions.

9.1 9 CONSUMABLES, SPARE PARTS, TOOLS AND EQUIPMENT

During the Term, Contractor shall provide equipment Spare Parts and Consumables and Tools, all as part of the Services and without Additional Cost to the Employer in accordance with the contract. Unless otherwise specified in the contract, the Contractor shall provide the Employer with an initial Spare Parts inventory. At the end of the Term or upon termination of the contract, the Supplier will replenish the equal quantity of the Spare Parts and Consumables and Tools as provided during the start of Contract.

Consumables and Tools

- 9.3 Contractor shall supply Consumables and Tools to the extent required for performance of the Services. All Consumables provided by Contractor in the performance of its Services, shall be compatible with the applicable requirements of the Reference Documents and Applicable Laws.

Equipment and Spare Parts

Contractor shall supply Equipment and Spare Parts to the extent required for its performance of the Services and to maintain its obligations thereunder. The Contractor

has the right to use renovated Equipment and Spare Parts. If the Contractor intends to use any refurbished Major Components, it will seek prior written approval from the Employer. Contractor's right to procure and use renovated / refurbished Spare Parts is subject to: (i) standards of good workmanship and Good Industry Practice; (ii) compliance with the applicable requirements of the Reference Documents; (iii) the Spare Part(s) are of the type being replaced or of another type insofar as same does not invalidate any applicable Type Certification of the Equipment (iv) the same warranty as equivalent new parts in terms of scope, nature and duration, (v) being renovated in conformity with the original equipment manufacturer's standards, and (v) being listed in the monthly maintenance report when used (track record of the Part). All such renovated/refurbished parts will be allowed by Employer only for any long lead items and also considering uninterrupted generation from the Project. However, the contractor shall immediately reinstate and order new items in order to replace the refurbished items provided for emergency purposes.

Inspection of Replaced Parts

9.4

Contractor shall give to the Employer seven (7) days' notice of the time when the Replaced Part is being transported to the Site. Contractor shall permit Employer to inspect, at Employer's sole cost and expense, any Part which is removed and replaced by a Spare Part pursuant to Consumables, Spare Parts, Tools and Equipment (such Part, a "Replaced Part"); provided however, any such inspection:

- (i) must not include physical alteration or disassembly of such Replaced Part; and

- (ii) must not result in any material increased costs to Contractor or delay

9.5

Contractor in the performance of its obligations under the contract or any Contract with, or warranty from, its Subcontractors, unless Employer agrees to cover such material increased cost.

Tools and Equipment

9.6

Contractor shall furnish its service personnel with such tools, instruments, or materials tools and equipment and equipment as are necessary to perform the Services (the "**Contractor's Equipment**").

Prices of Consumables, Spare Parts and Contractor's Equipment

Subject to GST, Taxation & Import Duties, the O&M Price payable to Contractor under the contract shall include (in addition to other components included in such Price) the Costs of any and all Equipment, Consumables, Spare Parts and Contractor's Equipment

required in connection with the performance of the Services.

Risk of Loss or Damage to Consumables, Spare Parts and Contractor's Equipment

Contractor shall:

- 9.7
- (i) be responsible at its own cost for the safe transportation and delivery to Site and adequate storage; of all Consumables, Spare Parts, and Contractor's Equipment, in each case, required for the carrying out of the Services;
 - (ii) bear the risk of loss and damage to all such Consumables and Spare Parts during transportation to the Site and, thereafter up to the date of their incorporation by Contractor into the Plant; and
 - (iii) at all material times bear all risk in any and all Contractor's Equipment on or off the Site and whether remaining separate or temporarily attached to the Plant.

Title

9.8 Contractor shall retain title to any and all Contractor's Equipment on or off the Site and whether remaining separate or temporarily attached to the Plant until transfer of Title occurs. Title to any Spare Part (or other Part) or Consumables provided by Contractor pursuant to the contract shall pass to the Employer upon:

- (i) incorporation by Contractor in the Plant free and clear of any Lien; or
- (ii) in the case of Additional Services, the date (if later) on which payment is made in full for such Spare Part or Consumable.

Title to any Replaced Part shall vest in Contractor upon such replacement, except if the Parties agree differently from time to time. In case of Additional Services, Employer shall retain title to any Replaced Part.

10 COMMUNICATION AND REPORTING

10.1 During the Term, Contractor shall exchange information and reports on daily, weekly, monthly, quarterly and annual basis:

10.2 Monthly Reports

Contractor shall provide Employer with the Monthly Performance Report by no later than the fifth (5th) day from the end of each month

Emergency Notices

Upon obtaining actual knowledge thereof, Contractor shall promptly notify Employer verbally (with written notice to follow within three (3) Days) of any emergency or other hazardous condition or occurrence that Contractor reasonable believes could cause an immediate threat to the safe operation of the Plant and/or the safety of Persons.

If, by reason of an emergency arising in the course of, as a result of or otherwise in connection with and during the performance of the Services, any protective or remedial

work is necessary as a matter of urgency to prevent damage to the Plant, the Contractor must immediately perform that work, provided that, Contractor shall have no obligation to perform such portions of the protective or remedial work which would be in violation with the Performance Standards, be a material breach of the contract or would cause a threat to the safety of Persons or property or would otherwise not be reasonably practicable or possible; and provided further, that Contractor shall have no obligation to retrofit or upgrade the Plant except if otherwise agreed.

Without prejudicing the liability attributable to the Contractor for failure to comply with the provisions of the paragraph above, it is clarified that if the Contractor does not perform the protective or remedial works referred to above immediately, the Employer may appoint a Replacement Contractor to perform such works. If the work (or parts thereof) which were performed or caused to be performed by the Employer is work which the Contractor was liable to do at its own expense under the contract, the costs incurred by the Employer as a result of appointing a Replacement Contractor shall be [substantiated to the Contractor on an open book basis and be] considered due and payable to the Employer and Invoices and Payment and Set Off shall apply. It is further clarified that the impact of Replacement Contractor's actions shall not be considered as an Excluded Risk Event.

10.3

Meetings

A representative of each of Contractor and Employer (the "**Representatives**") shall meet (either at the Site or alternatively at such other location as may be agreed between the Parties) at quarterly intervals or such other period as is agreed especially for the purposes set forth below:

10.4

- (i) to discuss projected dates for performance of the Services and the Additional Services in the following quarter;
- (ii) to discuss, the calculated Measured Average Availability of the Plant Facility for the past quarter under Annexure 2 [Functional Guarantees]; and
- (iii) to review the Services and Additional Services performed in the past quarter.

Visitors Log Book

Contractor shall provide Employer with a log book for the Plant to record the identity and activity of all visitors to site. Such log book will be kept at the entry Gate location of Plant. The Contractor shall cause that all personnel and representatives of each Party or any third parties visiting the [site] shall be required to record their identity, the date, time and purpose of any visit to site, the nature of any work performed thereon and such other details for which log books may reasonably be used. It is clarified that the Contractor shall not permit unauthorised third-party access to the Site unless such third parties have been

authorised by the Employer, are required to inspect or access the Site in accordance with Applicable Law or for performance of Services. Copies of these logs shall be provided to the Employer within ten (10) Business Days following its written request. Contractor shall create a digital back up of such logs at least every month. The log book shall be in English only.

Annual Calendaring of Maintenance Services

10.5 At the latest two (2) months after the beginning of commencement date, each year during the Term thereafter, the Contractor shall send to the Employer the projected dates and times for the immediately following period during which the Contractor shall perform the Maintenance/Preventive Services on the Plant, with the parties using reasonable efforts to minimize any Plant downtime during Operational Sunny periods (the “**Maintenance Services Calendar**”). Such Maintenance Services Calendar may be postponed by the Employer for 5 business days); provided, that the Maintenance Services Calendar shall be developed in accordance with the Operating Manual and the terms of the contract. The dates and times in the Maintenance Services Calendar may be amended thereafter by mutual Contract of the Parties. For clarity, the Maintenance Service Calendar shall include a maintenance plan established in accordance with the Maintenance Manual.

10.6 Status Reviews

As reasonably required, or requested by the Employer, the Representatives shall meet to discuss and review (i) the information contained in the Monthly Performance Reports, (ii) the availability of the Plant, (iii) any technical issues which may have arisen with respect to the performance, availability or maintenance and servicing of the Plant Equipment, (iv) Maintenance Services and Repair Services performed during the preceding calendar month, (v) any and all failures by a Plant equipment, and (vi) Maintenance Services to occur during the next following a calendar month.

11 CONTRACTOR'S PERMITS

Prior to the time in which such Permits are required in order to perform when the relevant Services and/or Additional Services, as applicable, are to be performed, Contractor shall obtain and maintain, as applicable, throughout the Term of the Contract all Permits (the “Contractor Permits”) required by the Applicable Law, Good Wind Industry Practices, Performance Standards and Technical Specifications which should be issued in the name of Contractor or are otherwise attributable or necessary to the provision of the Services and/or Additional Services, other than such Permits as are required to be obtained by Employer pursuant to *Employer Permits*.

12 CONTRACTOR'S MANAGER

On or prior to the commencement of the Term, Contractor shall designate a duly qualified and experienced person to manage and administer the Contractor's activities and shall provide notice thereof to the Employer, to act as its manager and coordinator of the contract on Contractor's behalf (the "**Contractor's Manager**"). The Contractor's Manager shall not have authority to amend or modify the contract or accept any commitment which would have an effect on the contract. In case the manager is on leave with prior intimation to employer, the deputy manager with equivalent qualification shall be provided at site by the Contractor

13 COOPERATION WITH OTHER SUBCONTRACTORS

Contractor acknowledges and agrees that the Employer or Other Subcontractors of Employer may be present at the Site and agrees, at no cost or expense to the Employer, to reasonably cooperate with such Other Subcontractors to allow the performance of its and their respective obligations to occur concurrently. Employer shall inform the Other Subcontractors of the clear demarcation of Contractor's scope of work so as to ensure non-interference in such work and operations by Employer's Other Subcontractors.

14 RESERVED RIGHTS

14.1

Plant

To the extent Contractor believes, in its reasonable discretion, that it is necessary to enhance the overall performance or safety of the Plant, Contractor may propose to Employer changes and improvements to the Plant (including the software included with respect thereto) and implement such changes or improvements proposed after obtaining the prior written consent of the Employer; provided that such changes and/or improvements shall not (i) be in conflict with the Performance Standards; (ii) adversely impact the technical performance of the Plant or the safety of the Plant; (iii) adversely impact the Availability Warranty in Annexure 2 [Functional Guarantees] (iv) increase the cost of operating the Plant; (v) place the Employer in breach of the technical requirements of the Power Purchase Contract; (vi) impair or vitiate any obligations of the Contractor under the contract; (vii) adversely affect the Supply Contract Warranties and the Works Contract Warranties; or (viii) result in non-compliance with the Type Certificate.

14.2

The Contractor shall only have the right to implement such changes or improvements if it has received the prior written consent of the Employer and such changes and improvements are carried out at no cost to the Employer and in accordance with Reserved Rights.

15 CERTAIN NOTIFICATIONS BY CONTRACTOR

Contractor shall, upon obtaining actual knowledge thereof, promptly give the Employer notice of:

- (i) any events or facts or observations that the Contractor believes could be reasonably likely:

15.1

- a. to have a material adverse effect on the operation of any of the Plant or the performance of the Employer's obligations under the contract; or
- b. to cause an immediate threat to the safe operation of the Plant (or any Plant therein) and/or the safety of Persons; provided that, in the case of this Clause, the Contractor shall provide immediate verbal notice of such event, fact or observation to the Employer with notice to follow within three (3) Business Days);

- (ii) any actual or proposed event that the Contractor believes would be reasonably likely to have a material adverse effect on the operation of any of the Plant or the performance of either Party's obligations under the contract;

- (iii) any (a) violation of Applicable Laws, or Permit, by the Contractor's agents, officers, directors, employees, representatives and Subcontractors, Employer or any Other Subcontractor; or (b) any notices of Liens (or claims of Liens) or investigations by Governmental Authorities related to the Plant;

- (iv) any actual or contemplated change in Law that Contractor believes would be reasonably likely to have a material adverse effect on the operation of any of the Plant or the performance of either Party's obligations under the contract.

15.2

If the Contractor does not comply with its obligations under Certain Notifications by Employer, the Contractor shall, subject to Limitations of Remedies and Liability, indemnify the Employer for any loss the Employer may suffer as a consequence, including, without limitation, compensation pursuant to Employer's Obligations.

16.1

16 ASSIGNMENT AND SUBCONTRACTING

The Contractor shall not sublet, transfer or assign the contract or any part thereof without the prior written permission of Employer. The Contractor shall not subcontract any of the Services having a value of more than 30% of the Annual O&M Price of the concerned year, except upon the Employer's advance written approval of the subcontracting of such works. Such approval shall refer to the specific identity of the Subcontractor and to the scope and terms of the subcontract. In any event, the Contractor shall not subcontract all, or materially all of the Operation and Maintenance Services or the ultimate supervision of

the performance of such services.

The Contractor agrees and acknowledges that any review, by approval of, or failure to approve, or rejection by the Employer as to any Subcontractor shall not relieve the Contractor of any of its obligations under the contract, and the Contractor shall be liable hereunder to the same extent as if any such Subcontract had not been entered into. The Contractor shall at all times ensure and cause the Subcontractors not to commit any act or omission which could release, void, impair or waive any guarantee or warranty on the Plant or any part thereof.

16.2

The Contractor shall supervise and direct the work of all Subcontractors and be fully responsible for the performance of the Subcontractors and to the methods, techniques, sequences and procedures of, and for coordinating the work of the Subcontractors and to the acts and omissions of all Subcontractors and their employees, directors, officers, advisors, agents and representatives, and those of their subcontractors ("Subcontractors' Parties). With regard to any Subcontract and Subcontractor's Parties, in particular, Contractor shall ensure that all wages, labor, health and safety and social related obligations are duly performed and timely discharged in accordance with Applicable Laws. It is agreed that if the responsibility of any such payments is transferred to the Employer pursuant to Applicable Law, the Employer shall have the right to adjust all such payments against the dues to the Contractor under the contract or otherwise recover the same from the Contractor under any other Contract. It shall be at Contractor's sole responsibility to ensure the payment and discharge of all its obligations with regard to the Subcontracts and shall indemnify the Employer and any Employer Indemnified Parties for any losses incurred by such parties in relation to the Subcontracts or to Subcontractor's Parties.

16.3

17.1

17 INSPECTION AND TESTING

The Contractor must provide the Employer, independent engineer, Grid Operator, Grid Administrator, and any other Contractor or Contractors employed by the Employer and their respective nominees, or other inspectors where required under the Applicable Law, the Permits, the Finance Documents and/or the Grid documents (collectively hereinafter referred to as the "**Project Parties**"), with access at any time to any place where the Services are being performed in order to inspect the progress and the manner of the Services, provided that the Employer (or its designated representatives) gives the Contractor twenty four (24) hours prior written notice.

17.2

The Project Parties and their respective nominees will have the right to examine and have access to documents relating to the Services

17.3 The Contractor must carry out all tests and/or inspections of the Plant or Spare Parts in a lawful, professional, timely, safe and environmentally responsible manner as may be necessary to ensure the safe, reliable, efficient, and optimal operation of the Plant and in accordance with the Performance Standards, Applicable Laws and Good Wind Industry Practice. All these tests and inspections are to be carried out at the Contractor's expense, as part of Services.

The Project Parties and their respective nominees are entitled to attend any test and/or inspection.

17.4 Whenever the Contractor is ready to carry out any test and/or inspection, the Contractor must give at least ten (10) days' advance notice to Employer of such test and/or inspection and of the place and time. The Contractor shall make its best efforts to obtain from any relevant third party or manufacturer any necessary permission or consent to enable the Project Parties to attend the test and/or inspection.

17.6 The Contractor must provide the Employer with a report of the results of such test and/or inspection within five (5) days after the completion of that test or inspection in question.

17.7 If the Employer and/or any of the Project Parties fail to attend the test and/or inspection, or if it is agreed between the Parties that the Employer and/or any of the Project Parties will not attend, then the Contractor may proceed with the test and/or inspection in the absence of the Employer's and/or any of the Project Parties' inspector and provide the Employer with a report in the approved form of the results.

17.9 If any Spare Parts or the Plant fails to pass any test and/or inspection, the Contractor must either rectify or replace those Spare Parts or repair the Plant and promptly repeat the test and/or inspection upon giving notice.

17.10 The Contractor agrees that neither the performance of a test and/or inspection of Spare Parts or the Plant, nor the attendance by the Employer's and/or any of the Parties' inspector nor the issue of any test report will release the Contractor from any of its obligations under the contract.

Inspection during the Term and at the End of the Term:

During the Term, the Plant may be submitted to a general inspection performed by a Contractor selected by Employer:

17.10.1 Inspection during the Term

From time to time during the Term, but not more than once every year (being specified that any additional tests and inspections instructed by the Employer under this Clause will be for the Employer's account unless the tests or inspections were necessary as a result of the failure of the Contractor to fulfil its obligations under the contract);

17.10.2 End of Contract inspection: six (6) to twelve (12) months before the end of the Term, at

the convenience of the Employer.

Subject to the Employer's reasonable advance notice as to the date of such inspection, Contractor is required to attend and assist the Employer and the designated inspector in performing such tests, without additional cost.

17.10.3 The final report shall be sent to the Contractor by the Employer and if any defect or damage found, same shall be rectified/replaced.

17.10.4 Without relieving Contractor from its obligations and without limiting Employer's ability to reasonably pursue the reliefs available to it, if applicable:

- (i) Contractor shall, promptly following receipt of the report, submit to the Employer (a) a recovery plan to remedy all breaches, defects and malfunctions detected in the report for which the Contractor is liable and shall perform such remedial actions without delay, and (b) provide detailed measures to be put in place to prevent such defaults from recurring;
- (ii) if the Contractor fails to timely complete all remedial actions before the end of the Term, the Employer shall be entitled, at Contractor's cost and risk, to employ a Replacement Contractor to perform the works.

17.11 Employer Site Visit

17.11.1 If Employer decides to visit the Plant, Contractor shall provide personnel on the Site for mutual inspection with no additional cost to Employer. If the Contractor is reasonably unable to attend such visit for unexpected reasons and/or safety reasons, Contractor shall immediately inform the Employer. As the case may be, the Contractor shall reschedule a new visit within the next seven (7) days. Rescheduling of the visits thereof shall no occur more than once per year the Employer shall adhere to the HSE practices of the Contractor.

17.11.2 If, upon request of the Employer made in accordance with Employer Site Visit, the Contractor does not provide dedicated personnel for such visits, subject to the aforementioned rescheduling allowance, any downtime of Plant Equipment(s) to perform the inspections thereof shall be considered as unavailable for the purpose of availability calculation described in Annexure 2 [Functional Guarantees] [(however never exceeding eight (8) hours per given visit)]. Notwithstanding the foregoing, Employer may request that Contractor provide personnel on the Site for additional inspections as an Additional Service.

17.11.3 If, upon request of the Employer made in accordance with Inspection and Testing, for inspection of the Plant, the Contractor provides access to have services in the Plant Equipment examined available for inspection and Employer does not carry out such

inspection, then any downtime of Plant Equipment(s) to perform the inspections thereof shall be considered as available for the purpose of availability calculation described in Annexure 2 [Functional Guarantees]

18 HAZARDOUS SUBSTANCES AND HAZARDOUS SITE CONDITIONS

Contractor shall not, nor shall it permit any other Person to bring any Hazardous Substances on the Site, other than Hazardous Substances to be used by Contractor or any Subcontractor in a manner that:

- 18.1 (i) does not violate any Applicable Laws, or Permits; and
(ii) is consistent in quantity and with Good Wind Industry Practices for operating and maintaining wind energy conversion plants, such as motor fuels, solvents and lubricants (collectively, "**Permissible Materials**").

Contractor shall bear all responsibility and liability for:

- 18.2 (i) any Hazardous Substances that are not Permissible Materials belonging to the Contractor or present on site; or
(ii) the handling of, or failure to handle, Permissible Materials in violation of Applicable Laws or otherwise in any manner that constitutes negligence or willful misconduct by Contractor or any Subcontractor.

- 18.3 Contractor shall use Hazardous Substances in performance of the Services in accordance with the Performance Standards, Applicable Laws and Good Wind Industry Practices and shall not:

- (i) utilize, or permit or cause any Subcontractor to utilize, on the Site such Hazardous Substances as are prohibited under Applicable Law from being used in India; or
18.4 (ii) import or use at the Site such Hazardous Substances as are prohibited under Applicable Law.

- 18.5 Contractor shall maintain a regularly updated log of all material safety data sheets for all hazardous substances used in connection with performance of the Services at or near the Site, which shall be available for Employer to review upon reasonable request. Contractor shall maintain an accurate record and current inventory of all hazardous substances used in performance of the Services at or near the Site, which record shall identify quantities, location of storage, use and final disposition of such hazardous substances.

Contractor shall arrange and agree for the disposal, transportation, reporting and certification (including provision of waste disposal vouchers and other certificates as required by Applicable Law or Permits) of Hazardous Substances, including waste

disposal vouchers, brought onto and released at the Site by Contractor or its Sub Contractors, which are expected to include but not be limited to used oil, grease and ethylene glycol, to the extent required by Laws, in each case, by licensed, insured, competent and professional Contractors in a safe manner and in accordance with Laws. As between the Parties, Contractor shall be solely liable for any response, removal, investigation, clean-up or other remedial action required by any Laws related to any Contractor,

18.6 In the event Contractor encounters any Hazardous Substance or other hazardous conditions at the Site that are inconsistent with the Performance Standard or would reasonably be expected to impact the performance of Contractor's obligations hereunder, Contractor shall promptly report the condition to Employer. In such event, Contractor shall stop work and remove, or take other actions necessary to remedy the hazards associated with, any Contractor Hazardous Substances such that Contractor can resume work.

18.7 The Contractor shall indemnify and hold harmless the Employer against any fine, penalty or third-party Claim incurred as a result of non-compliance by the Contractor with the terms of the contract, Applicable Laws, Good Wind Industry Practice and more specifically, with its obligations under Hazardous Substances and Hazardous Site Conditions.

19 EMPLOYER'S OBLIGATIONS

19.1 During the Term, Employer shall perform the following obligations:

Access

19.1.1 On and from the Commencement Date, Employer shall provide the Contractor (and its Subcontractors) full, free and safe Access to the Plant for the purpose of enabling Contractor to fulfil its obligations under the contract.

Notwithstanding the foregoing, the Contractor shall be required to perform any works (including obtaining permits for such works) related to the Access to the Site required for the delivery of any Spare Parts, if so requested by the Employer in writing, on the Time to time Basis.

19.1.2 The Employer shall give to the Contractor and the Contractor's personnel unrestricted Access to the Site to enable Contractor and the Contractor's personnel to carry out all elements of the Services at any time from the Commencement Date until the end of the Term. Such Access shall include the provision by the Employer of:

- (i) such keys or access codes as may be required by the Contractor to gain unhindered access to the Site (as the case may be);
- (ii) Access to the access roads to and on the Site If there is any deviation, and such

deviations are accepted by the transport contractor, then such deviations shall be accepted by the Contractor.

Notwithstanding anything else contained in the contract all Access to the Site and Plant is subject to the applicable site safety, security and environmental requirements and Applicable Law (and the Contractor should comply with the same). The Employer will have the right to limit Access or expel any Person off the Site in case of them not fulfilling the Emergency plan of the Site, the Emergency plan of the Plant Facility.

Employer's Permits

19.2

Contractor, on behalf of the Employer, shall obtain and maintain all Permits and any Permits required by Applicable Law to be obtained in the name of the Employer in order to (i) perform Employer's obligations under the contract and (ii) enable Contractor to lawfully access the Site at the point of entry to the Site and the Plant].

20 SITE REGULATIONS

Employer shall (directly or through a Subcontractor, advisor or agent) provide the Site Regulations and revisions thereof from time to time, and shall require the Other Subcontractors and their respective agents and employees to, (i) comply with the Site Regulations; and (ii) take all necessary precautions (as required by Applicable Law or otherwise) for the health and safety of all Persons (including Contractor's personnel) at the Site.

21 CERTAIN NOTIFICATIONS BY EMPLOYER

Employer shall, upon obtaining actual knowledge thereof, promptly give the Contractor, as soon as practicable, notice of:

21.1.1 Any events or facts or observations that the Employer believes has determined that would:

- (i) have a material adverse effect on the operation of any of the Plant or the performance of the Contractor's obligations under the contract; or
- (ii) to cause an immediate threat to the safe operation of the Project (or any Plant therein) and/or the safety of Persons; provided that, in the case of this current Sub-Clause, the Employer shall provide as soon as possible verbal notice of such event, fact or observation to the other;

21.1.2 any (a) violation of Applicable Laws, including environmental Laws or the terms of any Permit, by Contractor or any Other Subcontractor or (ii) any notices of Liens (or claims of Liens) or investigations by Governmental Authorities related to the Project.

Failure to furnish notice pursuant to Certain Notifications by Employer shall not affect the Contractor's obligations to perform its obligations. Contractor.

22 EMPLOYER 'S OWNERSHIP OF ENERGY, EQUIPMENT, SPARES AND PROJECT BENEFITS

21.2

The Contractor acknowledges that ownership of the Energy or any benefits arising out of the operation of the Plant remains at all times, and in all circumstances with the Employer at all times and the Contractor has no legal or equitable title to or interest in the Energy or other benefit.

22.1

The ownership of all item supplied by the Contractor, including under Additional Services shall be transferred to the Employer at the end of the term of the contract:

22.2

- (i) such items becoming a permanent part of the Plant against the mutually agreed payment by both the parties

22.3

The ownership of any item (not including Energy or benefits arising out of the operation of the Plant) supplied by the Contractor as part of the Services shall be transferred to the Employer upon such items becoming a permanent part of the Plant.

22.4

The Contractor agrees that any benefits, including any carbon credits, renewable energy certificates or similar royalty or credit that may arise as a result of having the Project undertaken belong to the Employer and the Contractor shall provide all reasonable assistance requested by the Employer in order to obtain such rights and benefits.

23.1 PRICE AND PAYMENT

Total Annual O&M Cost

Commencing on the Commencement Date and for the remainder of the Term, Employer shall, in consideration of the Contractor providing the Services and its prior receipt of an invoice with respect thereto, pay in accordance with Invoices and Payment to Contractor an annual O&M cost in INR in equal quarterly instalments at the end of every quarter for each year till contract period in the amounts set forth in and payable in accordance with Price Schedule No 5/SOR-5 [Schedule of Rates] of the bidding documents for the plant facilities. The yearly breakup of the Total O&M price shall be in line with the Price Schedule No 5/SOR-5.

Against the successful Operation and Maintenance of the entire Plant Facility payment will be released on quarterly basis at the end of every quarter for each year during the currency of the Contract Period.

The O&M of the plant will commence from the date of Operational Acceptance of the plant(s).

The Contractor acknowledges that the Total Annual O&M cost forms the sole and exclusive consideration and reimbursement due to the Contractor for the performance of the services included under the Services and Spare Parts and that the Contractor shall not be entitled to any additional amount for their performance, for whatever reason, including, amount others due to increased costs, changes in applicable GST, customs or duties (including, without limitation those set forth in GST, Taxation and Import Duties below), and except as may be specifically provided in the contract.

Payment of amounts due to the Contractor:

- 23.2 Amount shall not be considered as due and payable and the period for the payment of any Price stipulated under the contract shall not commence until the Contractor has duly fulfilled and delivered all obligations and deliverables required from the Contractor until the date of submission of the invoice for the payment to the Employer with relation to such invoice and/or within the period for which the Price included in the invoice are due.

24 INVOICES AND PAYMENT

- 24.1 Contractor shall submit Goods & Service Tax (GST) compliant invoices to Employer for the amounts due under Total Annual O&M cost above and for any other amounts that may be due under the contract.
- 24.2 The Total Annual O&M Cost shall be invoiced by the Contractor quarterly against the completion of concerned quarter and each invoice may be submitted by Contractor no later than the day after the completion of the quarterly period in question and, subject to the terms of the contract, shall be paid by the Employer no later thirty (30) days from the date of submission of the invoice along with all other requisite documents (If so required).
- 24.3 The Employer shall make payments by wire transfer to the bank account designated from time to time and owned by Contractor. The payment of any invoice shall be subject to the Contractor submitting to the Employer the Monthly Performance Reports.
- 24.4 Additional Services may, for purposes of this Invoices and Payment, be invoiced upon full and proper completion of each individual task and shall, subject to the terms of the contract be paid by the Employer within thirty (30) days from the date of submission of the invoice along with all other requisite documents (If so required).
- 24.5

VOID.

To the extent permitted by Applicable Laws, if the amount of an invoice is disputed by the Employer, the Employer shall be entitled to withhold payment of the disputed amount for the next invoice (or part thereof), until the dispute is resolved between the Parties under Law Dispute Resolution or otherwise. The Employer shall pay at the applicable time the

undisputed amount of such invoice including any undisputed portion of the invoice item in dispute. Further, the Employer shall be entitled to withhold payment of any amount due to the Contractor, if, at the time, the Contractor is in breach of one or more of its material obligations in terms of the contract.

24.5.1 Subject to the provisions on the contract, the Contractor warrants that it has, and will be deemed to have, done everything that would be expected of a prudent, competent and experienced Contractor and in accordance with Good Wind Industry Practices in:

- (i) assessing all risks which it is assuming under the Contract; and
- (ii) ensuring that the O&M Price contain allowances to protect it against any of these risks eventuating,

and that it will not make a claim for an increase in the O&M Price if any of those risks eventuate.

24.5.2 Except for Liens arising out of a failure of the Employer to make any payment when due hereunder to Contractor or any other Person providing labour or services to the Project under Contract to the Employer, the Contractor acknowledges and agrees that it shall not file, claim or register any Liens and shall use its best efforts to prevent any Liens from being filed, claimed or registered by any Subcontractor or by any employee, or agent of the Contractor or Subcontractor, against the Services, Additional Services, the Plant as a whole or any part thereof, or any real or other property of the Employer, for any works done or any Services and/or Additional Services rendered under the Contract or any subcontract let by the Contractor and shall procure that all subcontracts contain undertakings to the like effect.

24.5.3 The Contractor shall indemnify the Employer against any loss, damage, cost or expense (including legal fees) of the Employer arising out of or in connection with any Lien being filed, claimed or registered as referred to Invoices and Payment.

24.5.4 The delay or failure of a party to pay any amounts due hereunder, or the withholding of any amounts which are claimed by a party to be due, shall not release the other Party from any of its obligations or liabilities under the contract.

25 SCADA, EMS

The Plant Level SCADA, PPC and EMS systems are under the scope of the Solar + BESS Contractor. The Contractor shall, however, ensure continuous compatibility and seamless integration of the Wind Plant LCS/DAS with such systems throughout the Contract Period.

The Contractor shall provide, install, configure, and update, whenever required, all software patches, firmware revisions, communication drivers, interface configurations, and protocol updates related to the Wind Plant systems necessary for reliable operation, monitoring, control, and grid compliance of the Wind Plant.

All such updates and integration support related to the Wind Package scope shall be provided by the Contractor at no additional cost to the Employer during the Contract Period.

26 INSURANCE

Contractor 's insurance

26.1

The Contractor, at his own cost and expense, shall take out and maintain in full force and effect and shall cause its Subcontractors to take out and maintain in full force and effect, throughout the Term of the Contract and any extensions thereof, the following insurance policies from reputable insurers and shall provide the Employer with copies of the corresponding insurance certificates:

- (a) Covering physical loss or damage to the all-plant facilities at the Site, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage for the entire term of the contract.
- (b) Workers compensation insurance, as required by the Applicable Law and Contracts made with employees.
- (c) Group Medical Claim, Group Term Policy & Group Personal Accident Insurances covering the financial consequences cause by damage and loss arising from sickness, disease, injury or death of any person employed by the Contractor in respect of the services performed Automobile Public Liability insurance, as required by the Applicable Laws, for all vehicles and automotive equipment owned hired, rented, leased and non-owned by the Contractor and used in the performance of the Services.
- (d) Comprehensive General third-party liability insurance including product and contractual liability covering the financial consequences of the liability arising out loss or damage caused to third parties or to the employer as consequence of the performance of the services.
- (e) All other insurance like – transit insurance (Marine/ Cargo/ others as applicable), Construction All Risk, Erection All Risk, workmen compensation, fire, third party liability, insurance against Insurance against theft, fire, act of God, Contractor's Equipments, machinery breakdown policy, business interruption insurance,

Property damage Insurance & Environmental risk insurance as required during the O&M period of the Plant shall be in the contractor's scope & shall borne by the Contractor.

The Service Provides shall ensure that under the aforementioned insurance policies, each of the insured has the ability to claim thereunder for a minimum period of three (3) months from the date of expiry of the insurance policies for any claims that arose prior to the expiry date.

The Employer shall be named as co-insured under all insurance policies taken out by the Contractor, except for the Third-Party Liability and Workers' Compensation Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor, except for the Cargo, Workers' Compensation. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.

Annual Status Report of Insurance Claims: The Contractor shall include the status of Insurance Claims made or required to be made during the year as part of the Annual Reporting Requirements.

26.2 Contractor's Insurance for the Plant Facility

The Contractor shall take out and maintain an insurance policy, seamlessly with CAR policy taken earlier during construction phase, preferably from same insurance company for the plant facility during the entire term of the contract

In the event of any incident or damage or loss that would be reasonably expected to result in an insurance claim, the Contractor shall:

- (a) Notify without delay to the Employer
- (b) Prepare and conduct all and any claims made under the policies effected by it, and all monies payable by any insurers shall be paid to the Contractor take all reasonable measures to mitigate the loss, its effects and to protect salvage.
- (c) Collaborate with Employer and the insurer and provide them with all information and documents they may request.
- (d) Arrange immediate reinstatement of the damage to the employer's satisfaction, without waiting for the settlement for the corresponding insurance claim.

26.3

- (e) Claim in pursuant to the contract to the insurance agencies, if the claim is accepted or rejected or not accepted or partly accepted by the insurance agency then it will not limit the contractor obligation in any case and also if any losses on account of this shall be in the scope of contractor.

General Insurance Requirements

26.3.1 The Contractor shall, provide copies of the corresponding insurance certificates mentioned above.

26.3.2 If the Contractor fails to effect or maintain any insurance policy required hereunder, or fails to produce copy of the corresponding insurance certificates, the Employer may (but as no obligation), without prejudice to any other right or remedy available to it under the contract, procure the insurance for the relevant coverage and/or pay the premiums due. Such payments shall be recoverable and deducted from the payments to be made to the Contractor by the Employer under the Contract. In the event if Contractor does not pay the premium, then the Employer may pay the premium however in such case the obligations of Contractor to undertake the coverage shall continue as envisaged, irrespective of premium being paid by Employer. The Premium if paid by the Employer shall be recovered from the Annual O&M Fees payable by the Employer to the Contractor.

26.3.3 The Contractor shall comply with the conditions stipulated in each of the insurance policies to be affected under the Contract and shall not make any alteration to the terms of any policy subscribed by it so it deviates from the requirements herein.

26.3.4 The Contractor must promptly notify to the Employer any notification received from an insurance company regarding any actual alteration to one of their policies.

26.3.5 On occurrence of any loss covered by an insurance policy contemplated under Insurance, the Contractor shall, as soon as reasonably possible, notify to insurance companies for the policy subscribed by it. The Contractor shall also take any appropriate measure to mitigate the effects to the loss to the maximum extent possible. The Contractor shall assist any assessment mandated by the insurance companies.

26.4 26.3.6 The required coverages referred to and set forth in this Article 33 (*Insurance*) shall in no way affect or limit the Contractor's liability with respect to its obligations under the Contract.

The Contractor shall also arrange suitable insurance to cover following during the O&M Period:

- (a) **Machinery Breakdown:** Electrical & or machinery breakdown of any machinery or other equipment resulting in costly repairs or even replacement of the wind turbines.
- (b) **Business Interruption:** Cover for period of operational downtime i.e., covering the cash flow of the wind business as a result of an insured peril, for example fire or storm damage, machinery breakdown or equipment failure.
- (c) **Property Damage:** The insurance should cover material damage due to external

causes such as fire, theft, vandalism, sabotage, hail damage, snow load, lightning strike, overload, operational mistakes, clumsiness, negligence & theft.

- (d) **Employers Liability:** Provides cover against the risk of accident from usual workplace risks such as working at height & manual handling during construction & O&M period.
- (e) **Environmental Risk Insurance:** Environmental damage coverage indemnifies wind system owners of the risk of either environmental damage done by their development or pre-existing damage on the development site.

ANNEXURE-1

Scope of Work for Operation and Maintenance

- i) The Contractor shall prepare the initial Annual Operating Plan for the Wind Plant Facility and shall indicate the proposed resources (manpower, materials, consumables, tools, tackles, and machinery) to be deployed for O&M.
- ii) The Contractor shall be responsible for the safe, reliable, and efficient day-to-day operation and maintenance of the Wind Plant.
- iii) The Contractor shall provide routine, predictive, and preventive maintenance schedules for the Wind Plant Facility for Employer's review/approval and shall execute the same accordingly.
- iv) The Contractor shall carry out periodic overhauls, inspections, condition monitoring, and preventive maintenance of all the plant equipment in accordance with OEM recommendations, applicable standards, approved O&M manuals, and prudent utility practices.
- v) Contractor shall perform all breakdown maintenance, corrective maintenance, troubleshooting, and restoration activities in the Plant Facility. The Contractor shall be responsible for achieving the performance guarantee of the plant as specified in the contract.
- vi) The Contractor shall operate and maintain all fire protection systems, firefighting equipment, safety systems, and emergency response arrangements associated with the plant.
- vii) The Contractor shall do maintenance of electricity system including overhead lines in the Plant Facility area up to the termination point at the 33 kV incoming feeders of the Pooling Switchgear / Pooling Substation under the Solar + BESS Package scope. Wind Contractor shall, however, provide all necessary operational coordination, technical inputs, protection coordination data, system studies support, and engineering assistance required by the the Employer, Solar + BESS Contractor, STU/CTU, SLDC/RLDC and other agencies as may be required during the Operation and Maintenance term for smooth operation of the plant.
- viii) Contractor shall coordinate with the Employer and/or Employer's designated agencies for

optimization of generation, plant availability, reactive power management, and grid-compliant operation of the Wind Plant Facility.

- ix) The Contractor shall provide all required spare parts, special tools, tackles, consumables, lubricants, test equipment, safety equipment, and maintenance accessories necessary for comprehensive O&M of the Wind Package during the Contract Period.
- x) The Contractor shall arrange procurement, storage, preservation, repair, refurbishment, overhaul, and replacement of spare parts and equipment as required for reliable operation of the Wind Plant Facility, including imported items, at its own cost unless specifically excluded in the Contract.
- xi) The list of consumables, mandatory spares, insurance spares, special tools, and recommended spares shall be submitted by the Contractor at the commencement of O&M services and finalized in consultation with the Employer.
- xii) Any critical spare or component essential for safe and reliable operation of the Wind Plant Facility, even if not explicitly identified in the mandatory spare list, shall be arranged by the Contractor without additional cost if attributable to normal O&M obligations.
- xiii) The Contractor shall be responsible for proper storage, preservation, inventory management, and handling of materials and spare parts at site warehouses, containers, or designated storage facilities.
- xiv) The Contractor shall deploy qualified, trained, experienced, and competent personnel for operation and maintenance of wind turbine generators (WTGs), associated transformers, HT systems, SCADA systems, and balance-of-plant equipment. Adequate manpower shall be available round-the-clock on all days during the O&M Period.
- xv) Contractor shall perform all O&M activities in accordance with OEM recommendations, approved O&M manuals, applicable Indian laws and regulations, grid code requirements applicable to Wind Plant operations, environmental, health, safety, labour, and factory laws, good industry practices and prudent utility practices.
- xvi) The Contractor shall comply with all applicable labour laws, statutory requirements, and HSE obligations specified under the EPC Contract and applicable laws.
- xvii) Contractor shall arrange necessary security personnel for watch and ward of Wind

Package facilities within its scope during the O&M Period.

xviii) Contractor shall be responsible for:

- Maximizing plant availability and generation,
- Minimizing downtime and forced outages,
- Optimizing equipment life and reliability,
- Maintaining operational readiness of all Wind Package systems.

xix) The Contractor shall maintain accurate operating logs, maintenance records, outage reports, breakdown analysis records, spares inventory records, and performance reports related to the Wind Plant Facility.

xx) Separate and identifiable records shall be maintained specifically for the Wind Package to facilitate performance evaluation, availability assessment, warranty tracking, and operational accountability.

xxi) All O&M records shall be maintained for a minimum period of 120 months or as required under applicable regulations and shall be handed over to the Employer upon completion or termination of the O&M Contract.

xxii) Contractor shall submit daily, weekly, monthly, quarterly, and annual O&M and performance reports in formats approved by the Employer.

xxiii) Contractor shall develop and implement procedures relating to preventive and predictive maintenance, emergency response, fire protection, inventory and spare management, plant safety and security, breakdown response and restoration, Equipment condition monitoring, etc.

xxiv) Contractor shall provide and maintain updated copies of O&M Manuals, failure history and troubleshooting records, preventive maintenance schedules, Vendor and OEM details, root cause analysis reports for major failures, Spare parts and consumables records.

xxv) The Contractor shall provide the following information to the Employer on daily and monthly basis:

- Energy generation from each WTG,

- Energy exported from Wind Package,
- Auxiliary consumption,
- Reactive power data,
- Internal losses,
- Plant availability,
- Downtime details of WTGs and associated systems.

xxvi) Contractor shall coordinate with statutory authorities, local authorities, OEMs, and Employer-designated agencies for smooth operation of the Wind Plant Facility.

xxvii) Contractor shall provide remote monitoring and surveillance facilities for the Wind Plant Facility through SCADA/monitoring systems.

xxviii) Contractor shall provide software patches, firmware updates, cybersecurity updates, and revision management for Wind Package control and monitoring systems under its scope.

xxix) Contractor shall provide the Employer access to operational and historical data related to the Wind Package through SCADA and monitoring systems.

xxx) **Contractor shall allow unrestricted operational visibility and reasonable access to the Employer for monitoring the Wind Plant Facility performance and operational status.**

xxxi) Contractor shall provide operational training to Employer's personnel prior to expiry of the O&M Contract Period.

xxxii) Contractor shall maintain all insurances as specified in the Contract and shall cooperate during inspections, audits, and insurance claim processes.

xxxiii) Contractor shall coordinate with the Employer and Solar + BESS Contractor during integrated grid operations, shutdown planning, protection coordination, testing, and restoration activities affecting The 50 MW FDRE Project of SECI.

xxxiv) Coordination with SLDC/RLDC/STU/CTU for scheduling, forecasting, DSM compliance, reactive power management, and grid code compliance at Pooling Substation/Grid Interface level shall primarily remain under the scope of the Solar + BESS Package Contractor or Employer-designated agency.

- xxxv) The Wind Contractor shall provide all generation forecasts, machine availability data, outage planning information, and technical support required for consolidated forecasting and scheduling of The 50 MW FDRE Project of SECI.
- xxxvi) Contractor shall comply with all applicable Indian and international standards and statutory requirements related to environment, occupational health, safety, and electrical safety.
- xxxvii) Contractor shall coordinate with OEMs for warranty compliance, warranty claim management, technical support, and insurance-related activities pertaining to Wind Package equipment.
- xxxviii) Contractor shall carry out the performance monitoring for the Plant Facility on continuous basis and in case of any deviation, the Contractor shall perform the due diligence appropriately to find out the actual root cause of such deviation. Any test or inspection required such as thermal imaging, IV characteristics test etc. to analyze such deviation will be the responsibility of the Contractor. Thereafter the corrective action required to mitigate such deviation shall be undertaken by the Contractor without any additional cost.
- xxxix) Contractor shall be responsible, during the term of the O&M Contract, for routine operation, upkeep, inspection, and preventive and corrective maintenance of the Project's civil and site infrastructure within the Wind Farm and associated facilities, including but not limited to: buildings, cable trenches, fencing and gates, drainage and storm water systems, plumbing and sanitary systems, firefighting systems, CCTV systems, internal roads, earthing systems, foundations of WTGs and associated structures (limited to routine inspection and minor repairs), vegetation control including anti-weeding and clearing of bushes in the wind field, and general site housekeeping.
- xl) Contractor's obligations shall be limited to routine and normal wear-and-tear maintenance activities. Major civil works, structural rehabilitation, capacity augmentation, or repairs arising from force majeure events, design defects, latent conditions, or third-party damage shall be excluded unless such damage is attributable to the Contractor's negligence or breach of contract.
- xli) During the final quarter of the O&M Period, Contractor shall hand over the Wind Plant Facility in operational condition along with updated O&M records, spare inventory details,



Tender for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and Maintenance of 45.6 MW ISTS Connected Wind Power Project at Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Packge-2: Wind)

recommended spare parts list, replacement history, supplier information, maintenance history, MTBF/MTTR data, special tools and consumables inventory.

ANNEXURE-2

Functional Guarantees

1. Machine Availability

- A. **Definition:** Machine Availability includes the availability of WTG as well as the power evacuation system for Wind energy up to interface with the system of power utility, i.e. till Pooling Substation.
- B. **Commencement of Availability Test:** Machine Availability test shall start after stabilization period of 60 days from the date of commissioning and shall be continued till the end of O&M period.
- C. **Guaranteed Machine Availability:** The Contractor shall maintain all WTGs so as to ensure average Machine Availability of the wind farm not less than:
- 98% during high wind season i.e. 1st May to 31st October
 - 96% during low wind season i.e. 1st November to 30th April

D. Calculation of Average Machine Availability:

$$\text{Average MA} = \frac{\sum \text{MA of individual WTGs}}{\text{Total number of WTGs installed}}$$

E. Machine Availability for Individual WTG:

$$\text{MA} = \frac{[D - (GF + FM + S + U)] \times 100}{D - (GF + FM)}$$

Where:

D = Total number of hours in the applicable period

GF = Grid Failure hours

FM = Force Majeure hours

S = Scheduled Maintenance hours

U = Unscheduled / Forced Maintenance hours

F. Verification of Machine Availability: The Contractor shall submit detailed supporting documents for Machine Availability calculations, including event logs, SCADA data, outage classification, and maintenance records. Machine Availability figures stated in Daily Generation Reports (DGRs) or Monthly Reports shall not be accepted unless supported by verifiable documentary evidence. The Employer reserves the right to audit or validate Machine Availability calculations.

G. Liquidated Damages for Machine Availability Shortfall: In the event that the Average Machine Availability of the Wind Farm falls below the guaranteed value, the Contractor shall pay compensation calculated as follows:

$$COM = \left(\frac{GMA - AMA}{GMA} \right) \times C \times E$$

Where:

COM = Compensation payable to the Employer (INR)

GMA = Guaranteed Machine Availability

AMA = Actual Average Machine Availability

C = INR 4.5 per kWh

E = Actual energy generated (kWh) during the period under consideration

2. Preventive Maintenance

A. Scope of Work: The Contractor shall be responsible for planning and executing comprehensive preventive maintenance of all Wind Turbine Generators (WTGs) supplied and installed under this Contract, including but not limited to the rotor and blades, nacelle, drivetrain (gearbox, generator, main bearing, main shaft), pitch and yaw systems, hydraulic systems, electrical systems, control, protection and communication systems, tower, foundation interface, lightning protection system, and all associated auxiliary and balance-of-plant systems forming part of the Wind Power Plant.

Preventive maintenance shall be performed in accordance with:

- OEM Operation & Maintenance Manuals & technical instructions
- Applicable IEC 61400 series standards and relevant international standards
- Statutory and grid-code requirements
- Good industry engineering and safety practices

The objective of preventive maintenance shall be to:

- Ensure safe, reliable, and continuous operation of the WTGs and associated systems
- Achieve and sustain contractual availability, performance guarantees, and design life
- Minimize forced outages, unplanned shutdowns, and premature component degradation
- Enable early detection of defects and proactive condition-based maintenance

B. General Requirement: The EPC Contractor shall:

- Deploy OEM-trained and certified personnel for all preventive and corrective maintenance activities
- Use OEM-approved tools, consumables, lubricants, and spare parts
- Comply with applicable HSE regulations and site safety procedures
- Maintain detailed maintenance records, logs, and inspection reports
- Coordinate planned shutdowns with the Owner / Employer
- Ensure restoration of WTGs to operational condition after maintenance

C. Documentation & Reporting: The Contractor shall submit:

- Signed preventive maintenance checklists
- Oil, vibration, and thermography reports
- Annual preventive maintenance summary
- Statutory inspection and compliance certificates

The Contractor shall intimate the Employer and submit relevant reports at least fifteen (15) days prior to commencement of major maintenance activities.

Periodicity	Shutdown Requirement	Scope of Work
Continuous / Daily Monitoring (SCADA Based)	Not required	- Continuous monitoring of turbine operational status through SCADA - Monitoring of alarms, events, and fault trends - Monitoring of wind speed, power output, and turbine availability - Monitoring of temperatures of gearbox, generator, bearings, and converter - Monitoring of grid parameters including voltage, frequency, and power factor

		• Verification of data communication and logging systems
Monthly Preventive Maintenance (Once every calendar month)	Minor shutdown, if required	Mechanical Scope: • Visual inspection of rotor blades for visible damage, erosion, or cracks Monitoring of alarms, events, and fault trends • Monitoring of wind speed, power output, and turbine availability • Inspection of gearbox, hydraulic system, and yaw system for oil leaks • Verification of gearbox oil level • Inspection of yaw motors, yaw brakes, and cooling systems Electrical & Control Scope: • Visual inspection of nacelle and tower electrical panel • Inspection of UPS, DC systems, and battery health • Inspection and functional check of aviation and obstruction lighting • Inspection of earthing and bonding connections
Quarterly Preventive Maintenance (Once every three (3) months)	Planned shutdown	Mechanical Scope: • Lubrication of yaw bearings, pitch bearings, and slew rings • Torque verification of critical fasteners (hub, nacelle, yaw system) • Inspection of mechanical brake pads and brake discs • Inspection of hydraulic system pressure, hoses, and fittings Electrical Scope: • Thermographic inspection of generator terminals, converter panels, and transformers • Inspection and tightening of power and control cable terminations • Functional testing of pitch, yaw, and braking systems

Half-Yearly Preventive Maintenance (Once every six (6) months)	Planned shutdown	Mechanical Scope: • Gearbox oil sampling and laboratory analysis • Inspection of main bearing and main shaft • Inspection of yaw ring gear, pinions, and wear condition • Inspection of couplings and alignment checks Electrical Scope: • Insulation Resistance (IR) testing of generator, transformer, and power cables • Measurement of grounding resistance (representative WTGs) • Inspection of nacelle and tower internal cabling Civil / Structural Scope: • Internal tower inspection for corrosion or damage • Visual inspection of foundation and anchor bolts
Annual Preventive Maintenance (Major Service) (Once every twelve (12) months)	Major planned shutdown	Rotor & Blade: • Detailed blade inspection using rope access or drone methodology • Torque verification of blade root bolts • Continuity testing of lightning protection system Drive Train: • Gearbox oil replacement (where applicable, as per OEM) • Inspection of generator bearings • Inspection of main shaft and associated components Electrical & Grid Interface: • Transformer oil testing including BDV and moisture content (where applicable) • Testing and calibration of protection relays & coordination system • Verification of grid compliance requirements (LVRT/HVRT, reactive power, power quality), where applicable Safety & Compliance: • Testing of fire detection and fire suppression systems • Conducting emergency evacuation and rescue drills • Review and updating of maintenance documentation
Condition-Based / Special Maintenance	As and when required, based on condition monitoring	• Conation monitoring and corrective maintenance • Oil debris and particle count analysis • Blade repair for erosion or minor structural defects • Replacement of converter components (IGBTs, control cards) • Replacement of pitch system batteries

Note : *The Contractor shall submit the annual preventive maintenance plan and notify the Employer in writing at least fifteen (15) days in advance of any major planned maintenance activity or shutdown. For routine or minor preventive maintenance, prior intimation shall be provided within a reasonable timeframe as agreed in the O&M procedures. In case of emergency or condition-based maintenance, the Contractor shall notify the Employer at the earliest practicable opportunity and submit the requisite reports post-completion.*

A. Void

B. Independent Application of Penalties and Liquidated Damages: Penalties for delays in maintenance execution, liquidated damages for failure to achieve contractual availability or performance guarantees, and any penalties arising from deviations from functional guarantees shall be assessed and applied independently and cumulatively, to the extent permitted under applicable law. The imposition of any one category of penalty or LD shall not preclude the Employer from levying others arising from the same or different events of default, provided that no double recovery is applied for the same loss or breach.

C. Limitation of Contractor's Liability under O&M Contract: Except for the Contractor's indemnity obligations under this Contract, and except for actions or claims arising from gross negligence or intentional or willful misconduct, Contractor's total liability to Employer for a given year shall not exceed the corresponding year's Value of O&M Contract.



Tender for Design, Engineering, Supply, Construction, Erection, Testing,
Commissioning and Maintenance of 45.6 MW ISTS Connected Wind Power Project at
Ramagiri, Sri Sathya Sai District, Andhra Pradesh (Packge-2: Wind)

Appendices

1. **Reference Documents**
2. **Annual Preventive Maintenance Schedule**