ANNEXURE-I TO AMENDMENT-1

2.2 ANNUAL GENERATION GUARANTEE

The Contractor shall demonstrate minimum guaranteed annual generation from Part 1: Solar Plant of the Plant Facilities year-on-year as measured on the Energy metered at the 33kV incoming feeder(s) of the Ramagiri 33/220 kV Pooling Substation (Losses proportional to solar capacity shall be added with the energy metered for solar part before the solar/wind pooling point) as per below table:

Year	Guaranteed Solar Energy generation (kWh)*
1	23,12,64,000
2	22,96,45,152
3	22,80,37,636
4	22,64,41,372
5	22,48,56,283
6	22,32,82,289
7	22,17,19,313
8	22,01,67,278
9	21,86,26,107
10	21,70,95,724
Total	2,24,11,35,153

* The given guaranteed solar energy generation numbers are derived with capacity utilization factor (CUF) of 22% considering 0.7% annual degradation from second year.

Estimated generation loss due to grid unavailability shall be considered as deemed generation for the purpose of calculation of annual generation guarantee as in table above. It shall be calculated as below.

Estimated generation loss due to grid unavailability in kWh = (Total annual generation in kWh / Total number of hours of generation during the year) x (Number of hours of grid unavailability during the year)

ANNEXURE-II TO AMENDMENT-1

2.3.2 Annual Generation Guarantee

i. During the demonstration of annual generation guarantee, any shortfall will be penalized @ PPA tariff for each unit shortfall. Committed annual generation for a given year shall be determined after accounting for non-availability of grid in

accordance with the formula given in 2.2. Shortfall in generation during any year may be compensated through 75% of excess generation during previous or subsequent years subject to total generation over the O&M Period being in accordance with the annual generation guarantee. LD levied, if any, on account of shortfall in generation in any year shall be refunded without interest when the same is compensated through 75% excess generation in subsequent years. Determination of penalties on account of shortfall, if any, shall be made after such adjustment, up to adjusted generation not already accounted in an earlier year.

ii. If the Contractor fails to achieve 10 year cumulative guaranteed generation at the end of O&M period, then the Contractor will pay compensation to Owner an amount equal to the Net Present Value (NPV) of the estimated revenue loss due to shortfall in generation for 11th to 25th year calculated at a discount factor of 9.08% as below.

$$COM = \sum_{n=1}^{15} \left[\frac{\left(\frac{Eg - Ea}{10}\right) \times C}{(1 + 0.0908)^n} \right]$$

Where, COM is the compensation payable to Owner in INR

Eg is 10 year cumulative guaranteed generation in kWh

Ea is 10 year cumulative actual generation in kWh

C is applicable PPA tariff in INR

iii. In case the Project fails to generate any power continuously for 1 month any time during the O&M period, apart from the force majeure and grid outages as certified by competent authority from STU/CTU, it shall be considered as “an event of default”. In the case of default, the entire Contract Performance Security will be forfeited.

iv. Penalty during O&M period against breakdown of other Infrastructure of Solar Power Plant which doesn’t affect the generation of power, directly such as but not limited to civil infrastructure, water supply system/network, other Infrastructure developed by the Contractor as a Scope of Work for the Project shall be penalised @ Rs.1000/day, per incident of breakdown reported beyond 48 Hours of such reporting. Cumulative value of such penalty shall be limited to 50% of yearly O&M cost.

ANNEXURE-III TO AMENDMENT-1

1.2 Technical Requirements

Parameter	**Specification**
Cell type	Mono-crystalline or Multi-crystalline or Thin

	Film
Minimum DC Capacity	156 MWp
Module Efficiency	Minimum 18% for mono-crystalline Minimum 17% for multi-crystalline Minimum 17% for Thin Film
Rated power at STC	No negative tolerance is allowed.
Temperature co-efficient of power (Pmax)	Not less than -0.40%/°C for Crystalline Si Not less than -0.32%/°C for Thin Film
Lamination (in case of Thin Film Modules)	Glass-Glass with Anodized aluminium frame
Wind speed	Suitable for site condition or As per IS:875 Part-3 whichever is higher
Application Class as per IEC 61730	Class A

ANNEXURE-IV TO AMENDMENT-1

29.8 Site-Specific Implementation Requirements

Procurement-Specific Location and Site Characteristics for Design: Table-1 below lists supply-specific location and site characteristics

Table 1: Procurement-Specific Location and Site Characteristics

Item	Characteristic
Location	Ramagiri Village, Ananthapuramu District, Andhra Pradesh
Site characteristics:	
Annual Temperature Range	15°C – 45°C
Precipitation	Mean Annual: 535 mm (316 mm during southwest monsoon (June-September)
Seismic Zone (Geological Survey of India, 2014)	Zone II
Design elevation	544 m above sea level
Electrical infrastructure: AC system interconnection requirement at Point of	The BESS will be connected to the 33 kV incoming feeder of Pooling Substation with respect to voltage, frequency, and phase configuration along with necessary protection requirements as per regulation. The BESS control functions

Common Connection (PCC)	shall be designed for maximum flexibility with regard to use cases identified to meet the performance metrics as identified in this document.

Codes and Standards

IEC 61427	Secondary cells and batteries for renewable energy storage for On-grid applications: Non-chemistry Specific (applicable to all secondary battery types)
IEC 62619 (2017)	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for large format secondary lithium cells and batteries for use in industrial applications
IEC 62620 (2014)	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Large format secondary lithium cells and batteries for use in industrial applications
UL1973	Energy storage for stationary applications such as for PV: Non-chemistry Specific (applicable to all secondary battery types)
IEC 62485-2-	Safety requirements for secondary batteries and battery installations - to meet requirements on safety aspects associated with the erection, use, inspection, maintenance and disposal: Non-chemistry Specific (applicable to all secondary battery types)
IEC 61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems: Applicable for all Battery Energy Storage Systems
UL 1642	Standard of Lithium Batteries (Safety of Lithium Ion Batteries)
IEC 62281	Safety of primary and secondary lithium cells and batteries during transport: Applicable for storage systems using Lithium Ion chemistries
IEC 61850/ DNP3	Communications networks and management systems. (It shall be ensured that Plant SCADA and the BESS control system communicate with each other over the protocol and the combined parameters are accessible over a common HMI.)
IEEE 1375	IEEE Guide for the Protection of Stationary Battery Systems
IEEE 1491	IEEE Guide for Selection and Use of Battery Monitoring Equipment in Stationary Applications
IEC 60076	Power transformers

IEC 60947	Low-voltage switchgear and control gear
IEC 61439	Low-voltage switchgear and control gear assemblies
IEC 62933	Electrical Energy Storage (EES) System

ANNEXURE-V TO AMENDMENT-1

35 SCADA

35.1 General Requirements

35.1.1 The Contractor shall provide complete SCADA system with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation and monitoring of entire Plant facilities including Solar, Wind and BESS part, and its auxiliary systems.

35.1.2 The Contractor shall provide all the components including, but not limited to, Hardware, Software, Panels, Power Supply, HMI, Laser Printer, Gateway, Networking equipment and associated Cables, firewall etc. needed for the completeness.

35.1.3 SCADA System shall have the provision to perform the following features and/or functions:

(i) Web enabled Operator Dashboards: Showing key information on Generation, Performance and Current Status of various equipment in Single Line Diagram (SLD) format with capability to monitor PV array string level parameters.

(ii) Real time Data Logging with Integrated Analytics & Reporting: Logging of all parameters - AC, DC, Weather, System Run Hours, Equipment Status and Alarms as well as derived/ calculated/ integrated values. The SCADA User interface shall be customizable and enable Report Generation and Graphical Analysis.

(iii) Fault and System Diagnostics with time stamped event logging.

(iv) Support for O&M Activities: The interface shall allow integration with Surveillance System(s), Module Cleaning System and various other O&M support systems to provide a Data Analysis and Decision Support System for smooth and efficient Plant Operations.

(v) AI based Distributed Analytics for Predictive Maintenance, trend analysis and Alerts.

(vi) Generate, store and retrieve user configurable Sequence of Event (SOE) Reports.

Interface with different field equipment in the plant and work seamlessly with field equipment supplied by different companies.

(vii) Transfer of plant data reliably, to an Owner designated server or Cloud (Option: check with client) on any kind of remote network including low bandwidth and wireless links such as 2G/3G/VSAT

(Note: Telecom Lease line connection, if required for transferring data from Plant over internet shall be taken by Contractor in the name of Employer for O&M period)

35.1.4 The Control system shall be designed to operate in non-air-conditioned area. However, the Contractor shall provide a Package/ Split AC of suitable capacity decided by heat load requirement in SCADA room at Main Control Room.

35.2 Architecture

35.2.1 The SCADA System shall be built over Industrial IoT architecture with integrated Analytics, secure web access, enterprise software and Database.

35.2.2 Data acquisition shall be distributed across MCR, LCRs, WTGs. Each WTG shall have a Local Control System (WTG-LCS) and it shall be designed for automatic, unattended operation with adequate power backup. Besides the WTGs, the LCS is to measure voltage on three phases and frequency of the grid. Plant level data aggregation shall be done in both local and remote server (as specified by Owner).

35.2.3 Analog and Digital IO modules shall have integrated processor for distributed IO processing and control.

35.2.4 Data communication system shall be built over fibre optic cables/ wireless network with high bandwidth TCP/IP communication (Fast Ethernet or 802.11a/b/g/n) across all Inverter and Control Rooms with Internet/Intranet access at Main Control Room. Firewall shall be provided for network security.

35.2.5 Plant SCADA Server shall have Industrial Grade server hardware running SCADA & Monitoring Software with data storage (complete plant data) space for 2 years.

35.2.6 Plant data for monitoring and control operations should be accessible without dependence on external network.

35.2.7 A physical/virtual server running SCADA & Monitoring Software shall be configured in parallel with Plant Server to enable easy access to plant data from outside the plant without having to login to plant server. Effectively, the plant data shall be replicated in both places i.e. between systems at the Plant Server and Remote Server to provide

data redundancy for critical plant data.

35.2.8 Operator Workstation/PC shall be of Industrial Grade for browser based access to plant data from Plant or remote server. Plant control & SLDC/Utility related operations shall only be initiated through browser based interface requiring no client software or database to be installed on the Workstation. All critical software and Plant Data shall be installed/stored on local and remote servers only with user access control for protecting the software and data assets from accidental deletion or corruption.

35.2.9 Internet/Intranet at Plant: Public or private network access shall be provided at the plant through any broadband/VSAT connectivity of 2Mbps or higher bandwidth. In case no broadband/VSAT connectivity can be provided at the plant, a 3G/4G data card from any Internet Service Provider (ISP) may be provided. SCADA system shall be capable of sending all plant data in real time to the Remote Server.

35.2.10 GPS based Time Synchronization System: The SCADA system shall have a Master/Slave Clock system along with antenna, receiver, cabinet and internal interconnection cables. All SCADA controllers, servers, OWS and communicating equipment shall be synchronized to the GPS clock.

35.3 Industrial IoT Controllers & Data Acquisition

The Plant SCADA and Monitoring System may use one or more IIoT Controllers at each Inverter Control Room, WTG and MCR for the purpose of data acquisition and data forwarding to the Local and Remote SCADA Servers. The IIoT Controllers shall meet the following minimum requirements:

35.3.1 The IIoT Controllers shall be distributed in nature and work independently of other IIoT Controllers or any central controller in the system.

35.3.2 Shall be capable of supporting wide range of field protocols to communicate with different field equipment (Modbus over RS485/Ethernet, etc.)

35.3.3 Shall have local storage for a minimum of 2 weeks (in case of network failure).

35.3.4 Provide web based interface to configure the controller for various equipment in the field.

35.3.5 IO Functionality: Shall support status monitoring of VCBs & Trip relays on RMU/HT & Transformer panels through distributed DI/AI modules. The final I/O list of parameters shall be determined in consultation with the Owner.

35.3.6 Data Communication with Servers: Shall send the data collected, from all the equipment at Inverter Control Room and/or Main Control Room, to the Monitoring &

Control Server.

35.3.7 Controllers shall be capable of sending data over Internet connections USB data cards.

35.3.8 Shall not require a static public IP address, at the plant for the purpose of remote access.

35.4 Functionalities

35.4.1 The SCADA system shall monitor instantaneous and cumulative electrical parameters from all DC& AC Equipment including inverters, string combiner boxes, weather station, MFM, Transformer and Switchgear (LT & HT Panels) at regular intervals not greater than one minute.

35.4.2 The SCADA system shall monitor Instantaneous and cumulative environment parameters from weather sensors or data loggers at same interval as electrical parameters and provide Key Performance Indices on the fly.

35.4.3 The SCADA system shall provide Alarms and Alerts on equipment faults and failure in less than 5 seconds. Alarms on status change of hardwired DI shall also be provided. It must be possible to specify maximum and minimum limits for all alarms.

35.4.4 The SCADA system shall provide configurable alerts on any parameter crossing settable thresholds. The list of such parameters shall be finalised in consultation with the Owner.

35.4.5 The SCADA system shall enable integration with other sub-systems at the plant for supporting O&M activities. The list shall include but not limited to:

(i) Surveillance Cameras,

(ii) Module Cleaning System – For monitoring of water usage and efficacy of cleaning process.

35.4.6 Controls: The SCADA system shall be capable of controlling breakers (ON/OFF). ON/OFF and Parameter control of solar inverters shall be supported. After certain faults as per LCS settings, the WTGs are restarted automatically. To avoid excess voltage drops, the SCADA must inhibit start of more than one WTG at a time. The time between start of WTGs must be adjustable. The following operation of the individual WTGs shall be possible to carry out from SCADA:

- Stop the WTGs
- Start the WTGs
- Reset the counters

- Change the alarm limit.

35.4.7 The SCADA system shall have user-friendly browser-based User Interface for secure access from anywhere, for minimum ten concurrent connections from the Operator PC or other securely connected laptop/mobile, for plant monitoring, O&M, daily reporting, and analysis. A dashboard providing summary details of total plant generation, day's export, Control Room level generation, weather monitoring station parameters – temperature, humidity, wind speed and directoin , electrical parameters – Voltage, current, frequency, power factor, status, alarms, , any mechanical parameters and key performance indicators.

35.4.8 Reporting: The SCADA system shall provide downloadable reports in Excel/PDF, configurable for equipment parameters – Solar, Wind and BESS across the plant. The complete list of display parameters shall be finalized with the Owner during detailed engineering stage.

35.4.9 The system shall have Configurable Analysis page for self-configured as well as on demand Analytics charts.

35.4.10 The SCADA system shall be extensible to include maintenance of O&M schedules and related activities for plant equipment as per the O&M Manual.

35.4.11 Connectivity shall be provided to Owner's Data Monitoring Centre. Data collected by Plant SCADA shall be replicated in real-time, using industry standard interfaces such as Web Services, data files, as required – with Owner's Central Monitoring System at Owner's Corporate Office at Delhi. The data recording intervals for different parameters from different devices in the Plant Facilities shall be considered when creating schedules to "push" the data from Plant SCADA to data receivers stationed at Owner's Corporate Office at Delhi.

35.4.12 *Mobile* User *Interface***:** summary of plant performance and issues should be accessible in a mobile Native UI or browser UI.

35.4.13 Data Communication to SLDC: SCADA system shall provide required interface to integrate with TRANSCO-SLDC, in compliance with grid code, to send any parameters specified by SLDC.

Note: *The methodology and specification of SLDC interface will be provided separately by SLDC/TRANSCO and it shall be the responsibility of the Contractor to determine the same.*

35.4.14 Power Plant Control: SCADA system shall provide required interface to the local SCADA operator to set various power control modes (active/reactive power/frequency/PF)

through the inverters over industry standard communication protocols like Modbus over TCP/IP.

35.4.15 Forecasting and Scheduling: SCADA shall provide day ahead and week ahead forecasting and scheduling for power generation at the plant as per SLDC/Utility stipulations.

35.4.16 Predictive Maintenance: SCADA system shall have in-built or pluggable frameworks to support AI based Predictive Maintenance for all key equipment including inverters, transformers and switchgear at the plant.

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

35.4.18 The Contractor shall provide software locks and passwords to Employer for all operating & application software. Also, the Contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.

35.5 Cable Specifications:

35.5.1 RS485 & IO Cables shall meet the following minimum specifications:

- For RS485: 0.5sq.mm ATC multi-strand (class-5), insulated core, twisted pair, overall screened with ATC drainwire, GI wire Armored, PVC sheathed, DIN47100 color standard, FRLS, 1.1KV grade
- For IO cabling (between HT/RMU panels and SCADA panel) – 1.0 sq.mm multi-strand, 4/8/12 core screened, armored, FRLS cable, 1.1KV grade.
- For Optical Cabling: 6F, Armored, Single/Multi mode laid through HDPE conduits to minimize cable breaks.

35.6 Earthing:

35.6.1 Two isolated electronic earth pits near to SCADA panel at every Inverter and Control Room with < 1 Ohm resistance shall be provided. One earth pit shall be used for protective/body earth and the other to be used for Signal Earth.

35.6.2 Apart from providing separate earth pits, manufacturer specified earthing recommendations shall be followed for all communicating equipment connected to SCADA. This includes but is not limited to SMBs, Inverters, WMS and Switchgear panels.

35.7 Communication Cable Laying:

35.7.1 All RS485, IO and CAT6 cables shall be laid in separate conduits with a minimum

separation of 1.5ft from AC/DC power cables all along.

35.7.2 Power cables shall be laid deep in the trenches first. Data cables shall be laid in separate conduits after partially filling the trenches to ensure minimum 1.5 ft separation between power and communication cables all along the trench.

35.7.3 IO Cables between switch gear panels and SCADA panel shall be laid on separate cable trays, with a minimum of 1.5ft separation from trays carrying AC Power cables.

35.7.4 RS485 & CAT6 cables between switch gear panels or Inverters and SCADA panel shall be laid on separate cable trays, with a minimum of 1.5ft separation from trays carrying AC Power cables.

35.8 Control Cabinets / Panels / Desks at Main Control Room

35.8.1 The cabinets shall be IP-22 protection class. The Contractor shall ensure that the temperature rise is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets.

35.8.2 The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications.

35.9 Software Licences

The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project and shall not be hardware/ machine-specific.

35.10 Hardware at Main Control Room

35.10.1 The Hardware as specified shall be based on latest state of the art Workstations and Servers and technology suitable for industrial application & power plant environment.

35.10.2 The Local Monitoring & Control Server and the Operating Work station, to be deployed in the Plant Control Room, shall have the following server hardware and operating system along with accessories:

Plant Server	
Server Hardware	Hex/Octal Core Xeon, 32GB RAM (expandable to 64 GB RAM), 4 X 2TB SATA hard discs in RAID 5 configuration, 2TB external USB hard disc (for backup), dual power supplies, 2 LAN ports, LCD console, keyboard & mouse.

	The Server hardware shall be housed in a rugged fan-cooled, and rodent-proof Server Rack.
Operating System	Operating System and Database shall be of enterprise scale (RedHat Linux or equivalent Linux OS, Oracle/MySQL or equivalent DB), with required AMC for 5 years.
Accessories	1. Monitor: Min 22" LED Flat Monitor with non-interfaced refresh rate min. 75 Hz. 2. Keyboard: ASCII type 3. Pointing Device: Mouse 4. Intelligent UPS (on line): Minimum 2 hour battery backup.
Operator Workstation	
Hardware	i7 CPU running at 3.0 GHz or faster with 8GB RAM, 500GB hard disk, 25" LED monitor, keyboard and mouse, 4 USB ports, LAN port
Operating System	Windows operating system with necessary tools, anti-virus software.
Accessories	1. Screen Display Unit: Min 50" LED Flat Monitor with wall mounted arrangement for the display of SCADA screen 2. A4 size monochrome laser printer. 3. UPS of required capacity with 2 hour battery backup.

35.10.3 All network components of LAN and Workstations shall be compatible to the LAN, without degrading its performance.

35.11 Factory Acceptance Test (FAT)

FAT procedure shall be submitted by bidder for approval. SCADA shall communicate with all third devices which are part of Plant Facilities and same shall be demonstrated during the FAT.

ANNEXURE-VI TO AMENDMENT-1

ANNEXURE 2

Functional Guarantees

I Solar PV Power Plant

1. Annual Generation Guarantee

A. In consideration for the payment of the O&M Price, from the Commencement Date until the end of the Term, the Contractor grants to the Employer the Generation Guarantee on the terms and conditions set forth in this Agreement.

B. The Contractor guarantees that the annual generation shall be hundred percent (100%) of the guaranteed annual generation for every Production Period ("**Annual Generation Guarantee**"). In the event the annual generation is less than the guaranteed annual generation, the Contractor shall immediately upon demand, indemnify the Employer, as liquidated damages and not as penalty, amount equivalent to remuneration of the equivalent Energy, subject to a maximum of performance security.

C. The Procedure for measurement and verification of the annual generation guarantee is as per Annexure-A Part-II of Employer's Requirements of the bid document.

D. Liquidated Damages for Shortfall in Annual generation guarantee for Solar PV Plant

(i) During the demonstration of annual generation guarantee, any shortfall will be penalized @ PPA tariff for each unit shortfall. Committed annual generation for a given year shall be determined after accounting for non-availability of grid in accordance with the formula given in Clause 2.2 of Employer's Requirements, Annexure-A, Part-II. Shortfall in generation during any year may be compensated through 75% of excess generation during previous or subsequent years subject to total generation over the O&M Period being in accordance with the annual generation guarantee. LD levied, if any, on account of shortfall in generation in any year shall be refunded without interest when the same is compensated through 75% excess generation in subsequent years. Determination of penalties on account of shortfall, if any, shall be made after such adjustment, up to adjusted generation not already accounted in an earlier year.

(ii) If the Contractor fails to achieve 10 year cumulative guaranteed generation at the end of O&M period, then the Contractor will pay compensation to Owner an amount equal to the Net Present Value (NPV) of the estimated revenue loss due to shortfall in generation for 11th to 25th year calculated at a discount factor of 9.08% as below.

$$COM = \sum_{n=1}^{15} \left[\frac{\left(\frac{Eg - Ea}{10}\right) \times C}{(1 + 0.0908)^n} \right]$$

Where, COM is the compensation payable to Owner in INR

Eg is 10 year cumulative guaranteed generation in kWh

Ea is 10 year cumulative actual generation in kWh

C is applicable PPA tariff in INR

E. In case the Project fails to generate any power continuously for 1 month any time during the O&M period, apart from the force majeure and grid outages as certified by competent authority from STU/ CTU, it shall be considered as "an event of default". In the case of default the entire Contract Performance Security will be forfeited.

F. Penalty during O&M period against breakdown of other Infrastructure of Solar Power Plant which doesn't affect the generation of power, directly such as but not limited to civil infrastructure, water supply system/network, other Infrastructure developed by the Contractor as a Scope of Work for the Project (Employer's Requirements, Annexure-A, Part-III & IV) shall be penalised @ Rs.1000/day, per incident of breakdown reported beyond 48 Hours of such reporting. Cumulative value of such penalty shall be limited to 50% of yearly O&M cost.

G. The Penalty specified on account of delays, as specified in Liquidated Damages and Penalty specified on account of deviations in Functional Guarantees as above shall be assessed independent of each other.

II Wind Power Plant

1. Machine Availability

A. 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 Ramagiri 33/220 kV Pooling Substation.

B. 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. The Contractor shall maintain all WTGs so as to ensure average Machine Availability of the wind farm not less than

(i) 98% during high wind season i.e. 1st May to 31st October

(ii) 96% during low wind season i.e. 1st November to 30th April

D. The formula for calculating average Machine Availability of the wind farm shall be as follows.

Average Machine Availability = (Sum of the MA calculated for each WTG) / (No. of WTGs installed at site)

Machine Availability for each WTG, $MA = \frac{[D-(GF+FM+S+U)]\times 100}{[D-(GF+FM)]}$

where,

D is total number of hours for a machine in the applicable period

GF is Grid Failure hours

FM is Force Majeure hours

S is Scheduled Maintenance hours

U is Unscheduled or Forced Maintenance hours

E. Liquidated Damages for Machine Availability Shortfall

If the Average Machine Availability of complete wind farm is less than the guaranteed value, then the Contractor shall compensate the Employer an amount calculated as the following formula.

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

where,

COM is Compensation payable to the Employer in rupees

GMA is Guaranteed Machine Availability (98% in high wind season & 96% in low wind season)

AMA is Actual Average Machine Availability

C is the applicable PPA tariff

E is the actual energy generation in kWh during the period under consideration

F. The Contractor must provide evidence for calculation of the Machine Availability. Machine Availability value or figure as such provided by the Contractor under the Daily Generation Report (DGR) or Monthly report shall not be accepted directly unless the Contractor attach relevant proof for the values or calculation. Relevant arrangement for verification or validation or audit for the evaluation of MA must be provided by the Contractor to the Employer.

2. Power Factor / Reactive Power Warrantee

A. It will be the responsibility of Bidder to maintain power factor of the wind farm not less than the minimum requirement of TRANSCO/DISCOM so as to minimize reactive power drawl from state grid system. In any case, the actual reactive power drawl shall not be more than 3% of the active power generated from the Wind Turbines.

B. Liquidated Damages

(i) In the event of levy of any charges by state grid on account of low power factor than the minimum mandatory requirement, such charges at actual amount shall be deducted from the Contractor's bills/outstanding credit amount.

(ii) In case the reactive power drawl is more than 3% of the active power, then in such case the Contractor shall be responsible to compensate an amount equivalent to the reactive power charges required to be paid by the Employer to the DISCOM for the reactive power consumed over and above 3% of the total active power generated from the wind turbines.

(iii) In case of change in tariff for reactive power by SERC during O&M period, the difference will be paid by the Employer on written intimation by the Contractor as early as such change is notified.

III BESS

I. Equipment Availaiblity

A. The Contractor shall maintain all BESS equipment to ensure Annual Equipment Availability not less than 99%. Equipment Availability includes the availability of Batteries, Battery Management System (BMS), Power Conversion System (PCS), Energy Management System (EMS) as well as the power evacuation system for BESS up to the Point of Common Coupling (PCC).

B. BESS Equipment Availability is the percentage of hours that the BESS is available during the year. The availability guarantee shall begin upon facility commissioning till the end of O&M period. BESS annual equipment availability shall be calculated as follows.

$$\text{Equipment Availability} = 1 - \left(\frac{\sum Accountable\ \text{BESS}\ Outage\ duration\ in\ hours}{8760} \right) \times 100$$

C. Accountable BESS outage duration is the elapsed time of accountable BESS outages from the instant the BESS experiences reduced capacity or is out of service to the instant it is returned to service or full capacity. If the BESS experiences reduced capacity but is determined by the Employer to be available for service even if the Employer elects not to immediately return the equipment to full capacity, such time will be discounted from the outage duration.

D. Liquidated Damages for Shorfall in Equipment Availability

If the annual equipment availability for BESS is less than 99% during any year, then Contractor shall compensate the Employer an amount calculated as per the following formula.

$$COM = \left(\frac{99 - EA}{EA}\right) \times C \times E$$

where,

COM is Compensation payable to the Employer in rupees

EA is Annual BESS Equipment Availability

C is the applicable PPA tariff

E is the energy output from BESS in kWh during the respective year

IV Forecasting and Scheduling of Power

The Contractor shall be responsible for appointing a Qualified Coordinating Agency at the Ramagiri 33/220 kV Pooling Substation Level and shall be responsible for carrying out the forecasting and scheduling of the energy generation from the plant facility (In accordance with the Deviation Settlement Mechanism Regulations of the Andhra Pradesh Electricity Regulatory Commission). Scheduling given by the Contractor is such that no penalty is levied on the Employer due to any deviation of actual generation from scheduling beyond the allowed limit. If any penalty is imposed on the Employer due to such deviations beyond allowed limit the same shall be passed on to the Contractor and the recovery of the same will be done from the O&M price payable to the Contractor.

V Recovery of Compensation

The above compensations shall be deducted from price of comprehensive O&M Contract. During the free O&M period if any, compensation shall be paid by the Bidder else it will be deducted from the Security Deposit.

ANNEXURE-VII TO AMENDMENT-1

EMPLOYER'S REQUIREMENT

Annexure – A

PART V

Special Technical Specifications

1. The top soil at the proposed land is generally residual silty gravel, frictional in nature. The strata below is either hard rock or soft disintegrated rock (SDR). The SDR is weathered and fissured, and is relatively soft. The degree of weathering may be termed 'moderate'. In Ramagiri area, the rock is chlorite schist, green in color, with vertical and inclined fractures (metamorphic rock). However, the Bidder is advised to inspect the site and study the nature of soil to decide the foundation system to be provided before submission of the Bid. The Employer shall not be responsible for any variations in soil characteristics, between those observed during preliminary site visit and detailed investigations to be carried out by the Contractor during contract execution and there shall be no compensation what so ever in the contract price on this account. The bidder may generally follow the terrain for placement of Module arrays. However, related area grading and levelling for minor undulations, wherever required, shall be in the scope of EPC Contractor.
2. Geotechnical Investigations (Clause 49.3 , Part II Civil, A Civil, Mechanical and Plumbing Works for Solar PV Plant) – There shall be minimum 1 nos. of Borehole per 15 acres of the Solar PV area. Howewer, in case of separate (isloated) solar blocks, it shall be not less than 5.

   The scope also includes minimum 2 no. of plate load tests at each block
3. The basic wind speed '$\mathbf{V_b}$' = 44 m/sec.
4. Seismic zone – Zone II.
5. Design rainfall intensity for storm water drainage – 50mm/hr.
6. All exposed steel surfaces (except galvanized) shall be painted with min. 2 coats of epoxy paint over two coats of suitable primer. Total DFT of painting system shall not be less than 150 microns.

7. Fencing: The Solar Park peripheral boundary shall be Barbed Wire fencing type as per the Specifications laid down in EMPLOYER'S REQUIREMENT Annexure – A PART III (Please refer EMPLOYER'S REQUIREMENT Annexure – A PART VI: Attachments, S.No. 1: Solar Park Layout for tentative Park Boundary/perimeter). As the land is currently in the process of acquisition, the perimeter fencing may vary in the range of 18km +/-20%.
8. Specifications for Transformer yard in WTG area shall be same as Cl. 77.0.
9. The water supply and drainage system including storage tank, pipe network with associated fittings etc. shall be designed as specified in Technical specifications and to suit the local site conditions with due consideration to the ESMP attached with the Bidding Document. (Please refer Annexure B: ESMP for Hybrid Park: Table 1-2: Environmental and Social Management Plan (ESMP) for Infrastructure Development and Hybrid Park for details)
10. Control Room Building (Clause 97.2.1)

    Minimum carpet areas should be as below:

    - SCADA room: 20m^2
    - Conference room: 50 m^2
    - Supervisor cabin and office area: 20 m^2
    - Record room: 20 m^2
    - Toilet block with separate gents and ladies wash room facilities: 12 m^2 each
    - Pantry with service platform and utensil washing facilities: 10 m^2

    Other requirements shall be same as specified in Tech. Specifications.
11. A storage room of RCC type, separate from the Control Room Building but in close proximity, shall be provided for storage of spares. For general specifications Clause 62 of Annexure – A PART III for RCC Buildings may be referred. The minimum area of the storage room shall be 200 m^2 with all arrangements for material movement.
12. The BESS may be containerized or housed in a building. The BESS, if containerized, shall be supported on suitable foundation system with RCC framed structure and plinth (FFL) at 1000mm above FGL and the cables shall be laid in

RCC trenches properly sealed at entry/ exit points. The construction specifications for foundation, plinth filling, masonry wall etc. shall be same as specified under Solar Plant - Civil, Mechanical & Plumbing works. In case the BESS is housed in a Building, the relevant specifications as provided in Part II Civil, A Civil, Mechanical and Plumbing Works for Solar PV Plant shall prevail.

13. For containerized BESS, the Batteries and PCS along with necessary auxiliaries may not be housed in dedicated containers provided the necessary fire safety requirements are met and the design is supported by OEM recommendations along with warranties.
14. The provision for hybrid Plant auxiliary power may be made from the Solar-Wind-BESS Point of Common Connection or from the BESS.
15. Cl. No. 52.3: Roads in Solar Plant area:

    Min. road section details for Internal Road:

    (i) Topping: Surface dressing, compacted 75mm thick, with murrum blended with WBM Grade-III

    (ii) WBM (CBR>100%): compacted 75mm thick, Grade III

    (iii) WBM (CBR>100%): compacted 75 mm thick, Grade II

    (iv) Granular sub-base (CBR>15%): compacted 175 mm thick in two layers of 87.5mm thickness each

    (v) Compacted subgrade: top 300mm thick, compacted up to 98% of standard proctor

    Min road section details for peripheral road:

    (i) Topping: Surface dressing, compacted 75mm thick, with murrum blended with WBM Grade-III

    (ii) WBM (CBR>100%): compacted 75mm thick, Grade III

    (iii) WBM (CBR>100%): compacted 75 mm thick, Grade II

    (iv) Granular sub-base (CBR>15%): compacted 125 mm thick

    (v) Compacted subgrade: top 300mm thick, compacted up to 98% of standard proctor

16. Approach Road and Internal Road in WTG area

a. Layout, design and construction of roads (main trunk road and access roads to each wind turbine) shall be to allow smooth on-site transportation and delivery of required project components to respective installation and work locations without damage to the road. However, the min. road section shall be same as specified for 'internal road' under Part II - Civil, Mechanical and Plumbing Works except with carriage way of 5m width. At all road crossing, precast concrete pipes of min. class NP-3 with appropriate size shall be provided for laying of cable(s)/ pipe(s) and storm water drain crossings.

b. Geometrical design of internal and access roads in WTG area shall be as per below specifications:

   (i) Extra width at curves and hairpin bends shall be provided for easy movement of heavy vehicles carrying equipment

   (ii) Camber 1:35 for smooth flow of surface run-off

   (iii) Min. radius of horizontal curves - 20m

   (iv) Super elevation shall be provided at curves (max. limit of super elevation 1/15)

Additionally, turning areas for Trucks/Trailers/Cranes etc. near each WTG shall be provided. The dimensions of the turning area shall be minimum 25mx4m. These turning areas shall be made with the same specifications as that of the internal roads and shall be indicated in the layout plan.

17. Topographical Survey – The Topographical survey shall be conducted in 20m x 20m grid for the entire Plant area, except for the WTG locations where the Contour survey shall be done in a 5x5m grid. Min. area for topographical survey at each WTG location shall be 20mx50m. Other requirements shall be same as specified in Tech. Specifications.
18. Cl. No. 56: Design Loads:

    The Snow load is not applicable at the present project site
19. The Contractor shall set up an automated concrete batching plant at the project site with minimum capacity of 30m^3/hour.
20. The list of Mandatory Spares to be supplied is provided below:

S. No.	Equipment/Material	Quantity (for each type and rating)
1	PV Modules	0.5% of total supply
2	MC4 connectors (including Y-connector if used)	1% of total supply
3	String Monitoring Unit	1% of total supply
4	Power Conditioning Unit	
	(i) Central Inverter	1 nos.
	(ii) String Inverter	1% of total supply
5	Inverter Transformer	2 nos.
6	HT Switchgear	
	(i) Vacuum pole	2 nos.
	(ii) Closing coil	2 nos.
	(iii) Tripping coil	2 nos.
	(iv) Spring charging motor	2 nos.
	(v) Relay	2 nos.
	(vi) Meter	2 nos.
	(vii) Current Transformer	2 nos.
	(viii) Voltage Transformer	2 nos.
	(ix) MCCB	2 nos.
	(x) MCB	2 nos.
	(xi) Fuse	10% of total supply
	(xii) Indicating lamp	10% of total supply
	(xiii) Rotary switch	10% of total supply
7	LT Switchgear	
	(i) MCCB	2 nos.
	(ii) MCB	2 nos.
	(iii) Fuse	10% of total supply
	(iv) Relay	2 nos.
	(v) Meter	2 nos.
	(vi) Current Transformer	2 nos.
	(vii) Voltage Transformer	2 nos.

	(viii) Indicating lamp	10% of total supply
	(ix) Rotary switch	10% of total supply
8	Solar Cable	1% of total supply
9	DC Cable	1% of total supply
10	AC Cable	1% of total supply
11	Communication Cable	1% of total supply
12	Fuse	10% of total supply

Note –

1. All works shall be executed as per Technical specifications given in EMPLOYER'S REQUIREMENT Annexure – A PART III.
2. Annexure – A PART V (Special Technical Specifications) lays down Special Technical Specifications with reference to site specific design requirements. In case of any conflict in requirements given in Annexure – A PART III and Annexure – A PART V, Annexure – A PART V Special Technical Specifications shall have the precedence.
3. In absence of any specifications for the scope of work under in WTG, BESS and Common areas, the specifications for Scope of work under Solar Plant area shall be followed as applicable.

ANNEXURE-VIII TO AMENDMENT-1

EMPLOYER'S REQUIREMENT

Annexure – A

PART VI

Attachments

S.No.	Name	Description
1.	Solar Park Layout*	Project site layout with tentative areas marked for Solar Fields (AUTOCAD File)
2.	Contour Survey Map*	Contour Survey Map of the project site (AUTO CAD File)
3.	Single Line Diagram (SLD) - Ramagiri 220/33 kV Substation	Single Line Diagram (SLD) of the Ramagiri 220/33 kV Substation where the Incoming feeders shall terminate at 33kV.
4.	Indicative FQP+MQP for Civil & MMS works	Indicative FQP+MQP for Civil & MMS works

*The Contour Survey Map and Solar Park Layout are indicative only and the Employer shall not be responsible for any variations between those observed in attached files and during preliminary site visit/ the detailed investigations to be carried out by the Contractor during contract execution. Tthere shall be no compensation what so ever in the contract price on this account.