

**Request for Proposal (RFP)  
for**

**Selection of Engineering, Procurement and Construction (EPC) Contractor for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and O&M of 2 MW (AC) Solar PV Power Plant (2.2MW<sub>p</sub> DC) 4.5 MWh Battery Energy Storage System having 12 years Plant O&M at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka**

KARNATAKA RENEWABLE ENERGY DEVELOPMENT LIMITED (KREDL)

---



**Contact details:**

KREDL, Head Office Bangalore  
#6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore-560072.  
Phone: 080-22207851/22208109.  
Fax: 080-22257399  
Email: [kredlmd@gmail.com](mailto:kredlmd@gmail.com), [agm.sgkredl@gmail.com](mailto:agm.sgkredl@gmail.com)

(This document is meant for the exclusive purpose of bidding against this RFP No. KREDL/07/2MW<sub>AC</sub> solar with 4.5 MWh BESS/EPC/PAVAGADA/RFP/2022-23/ dated 5<sup>th</sup> December 2022 and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.)

**RFP consists of the following volumes:**

**1. VOLUME-I**

1. **Section I: Notice Inviting Tender (NIT)**
2. **Section II: Instructions to Bidders (ITB)**
3. **Section III: Terms and Conditions of Contract (TCC)**
4. **Section IV: Forms and Procedures**

**2. VOLUME-II**

1. **Section I: Scope of Work**
2. **Section II: Technical Specifications**
3. **Section III: Special Technical Specifications**
4. **Section IV: Annexures**

**3.VOLUME-III: Schedule of Rates/Price Bid**

## **VOLUME-I**

- 1. Section I: Notice Inviting Tender (NIT)**
- 2. Section II: Instructions to Bidders (ITB)**
- 3. Section III: Terms and Conditions of Contract (TCC)**
- 4. Section IV: Forms and Procedures**

## **Contents**

1. <b>Section I: Notice Inviting Tender (NIT) .....</b>	<b>6</b>
2. <b>Section II: Instructions to Bidders (ITB) .....</b>	<b>19</b>
3. <b>Section III: Terms and Conditions of Contract (TCC).....</b>	<b>37</b>
4. <b>Section IV: Forms and Procedures .....</b>	<b>88</b>

## **1. Section I: Notice Inviting Tender (NIT)**

### **1.1. Abridged NIT**

**Type of bidding:**National Competitive Bidding (NCB)

**Mode of bidding:** Short Term, Open Tender, Single Stage Two Envelope

KREDL is the Nodal Agency for facilitating and implementing the Renewable Energy projects in Karnataka. Short Term RFP is published and Bids are invited for selection of Engineering, Procurement and Construction (EPC) Contractor for design, engineering, supply, construction, erection, testing, commissioning and O&M of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System (excluding all variants of lead acid batteries) having 12 years Plant O&M at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka.

Bidders are requested to contact e-procurement, GoK portal for registration (Contact no.: 080-22230960, 080-22234115, eproc help desk + 91-4601 0000, +91 – 6894 8777).

Note: KREDL reserves the right to annul the bidding process and invite fresh Bids without liability or obligation for such invitation and without assigning any reasons.

Sd.

**Assistant General Manager (Solar Grid), KREDL**

## **1.2. Detailed NIT**

**Type of bidding:**National Competitive Bidding (NCB)

**Mode of bidding:** Short Term, Open Tender, Single Stage Two Envelope

1.2.1. KREDL invites short term online Bids from eligible Bidders on Single Stage Two Envelope basis including submission of **Envelope-I: Techno-Commercial Bid** and **Envelope-II: Price Bid** for development of aforesaid Facilities.

### **1.2.2. Brief scope of work:**

The overall scope involves in selection of Engineering, Procurement and Construction (EPC) Contractor for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh (excluding all variants of lead acid batteries) Energy Storage System having 12 years Plant O&M including interconnection with KSPDCL substation No.4 at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka.

The brief scope of work includes the following:

- 1.2.2.1. Scope of Supply & Work includes all design & engineering, procurement & supply of equipment and materials, testing at manufacturers works, multi – level inspections, packing and forwarding, loading, supply, receipt, unloading and storage at site, associated civil works, services, permits, licenses, installation and incidentals, insurance at all stages, erection, testing and commissioning of a total of 2MW (AC) Grid Interactive Solar PV Power Plant with (2.2MWp DC) along with 4.5 MWh Battery Energy Storage System (BESS) excluding all variants of lead acid batteries, and performance demonstration with associated equipment and materials on turnkey basis at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka along with 12 (Twelve) years comprehensive operation and maintenance from the date of Operational Acceptance.
- 1.2.2.2. Design, engineering, procurement, supply, insurance, packing, forwarding, loading, transportation, unloading, storage, construction, installation, erection, testing, commissioning and operational acceptance of the Facilities having all Plant and Equipment and their Installation Services along with its associated auxiliaries including all solar photovoltaic modules, BESS, inverters, module mounting structures, string combiner boxes, inverter transformers, HT panels, metering infrastructure, auxiliary transformer, control room, gantry tower, potential transformer, current transformer, vacuum circuit breaker, lightening arrestor etc., single circuit 33 kV underground cables including provision of any cable tray support structures along the road side from the solar plant with BESS to the 220/ 33 kV KSPDCL pooling substation, bay area at 220/33 kV KSPDCL pooling substation, AC components, DC components, tools/ tackles and all the other assets, buildings, structures, machinery, facilities and related assets thereof.
- 1.2.2.3. Supply of components with respect to termination of UG cable at 220/33kV substation along with laying of 33kv UG cable for 1.5KMs from plant to existing 33kv Terminal Bay by adding additional 33 KV bay with metering at 220/33kV Sub- station No. 04, KSPDCL, Pavagada Solar Park.
- 1.2.2.4. Site-grading, cutting, filling, levelling, compacting, clearing of vegetation etc.

- 1.2.2.5. Design and construction of foundation and module mounting structures for placing solar photovoltaic modules.
- 1.2.2.6. Providing power supply and water supply during construction period.
- 1.2.2.7. Construction of pre-engineered type outdoor inverter room with power conditioning units associated with LT and HT switchgear for central inverter, as required.
- 1.2.2.8. Construction of central monitoring and control station with switchgear room, supervisory control and data acquisition (SCADA) room, storeroom, battery room with all electrical fitting, office furniture, fencing of solar PV plant, BESS, watch towers, security cabin etc. in line with the provisions of SRPC/CERC from time to time.
- 1.2.2.9. All associated electrical and civil works required for interfacing with grid including but not limited to establishing inverter transformers, breakers, isolators, panels, protection system, cables, metering at interconnection voltage level of 33kV, earthing of transformer etc. and evacuation of power to the assigned 33/220 kV KSPDCL pooling substation through single circuit 33 kV underground cables including provision of any cable tray support structures along the road side from the solar plant to the 220/ 33 kV KSPDCL pooling substation and bay area at 220/33 kV KSPDCL pooling substation.
- 1.2.2.10. Water supply for cleaning of solar PV modules including supply and installation of water based cleaning system during the construction period and thereafter during O&M Period of 12 (Twelve) years from the date of Operational Acceptance of the Facilities.
- 1.2.2.11. Construction of internal roads, pathways, fencing, peripheral boundary compound wall, storm water drains, drainage system, watch towers, weather monitoring stations, firefighting system, module cleaning system, necessary IT security system, surveillance system with camera and lighting system.
- 1.2.2.12. SCADA system for remote monitoring and control of inverters and BESS excluding all variants of lead acid batteries with all associated hardware and software.
- 1.2.2.13. Operation & Maintenance (O&M) of Facilities along with electrical equipment, consumables, any spares for a period of 12 (Twelve) years from the date of Facility Acceptance.
- 1.2.2.14. Supply of Mandatory Spares.
- 1.2.2.15. The Contractor, at its own cost, shall bear all Statutory charges for obtaining all statutory approvals except the statutory charges to be paid by KREDL to KSPDCL.
- 1.2.2.16. Obtaining all required approvals from CTU like LTOA and connectivity approvals shall vest with contractor. The solar PV plant along with BESS (excluding all variants of lead acid batteries) system should comply with regulations/instructions issued by CERC, KERC, CEA, SRPC, POSOCO, Grid India from time to time.

The detailed scope of work is as defined in the relevant clauses of this RFP.

- 1.2.3. Detailed Technical Specification, Scope of Work and Terms & Conditions are given in this RFP, which are available in eprocurement, GoK portal, as amended from time to time.
- 1.2.4. Prospective Bidders are compulsorily required to provide GST, TIN, PAN and PF details at the time of submission of Bids.
- 1.2.5. All Bids must be accompanied by original Cost of RFP, Bid Security and Power of Attorney for an amount as stipulated in the RFP. It can be noted that GST shall be applicable on the Cost of RFP.

ANY BID NOT ACCOMPANIED BY AN ACCEPTABLE COST OF RFP, BID SECURITY AND POWER OF ATTORNEY IN A SEPARATE SEALED ENVELOPE SHALL BE REJECTED BY KREDL AS BEING NON RESPONSIVE AND RETURNED TO THE BIDDER WITHOUT BEING OPENED.

**1.2.6. Qualifying Requirements (QR) for Bidders:**

In addition to the requirements stipulated under section Instruction to Bidders (ITB), the Bidder should also meet the Qualifying Requirements stipulated hereunder in Detailed NIT clause 1.2.6.2 (Technical Eligibility Criteria) and Detailed NIT clause 1.2.6.3 (Financial Eligibility Criteria).

**1.2.6.1. General criteria**

- 1.2.6.1.1. The Bidder should be a body incorporated in India under the Companies Act, 1956 or 2013 including any amendment thereto, engaged in the business of power/ energy/ renewable energy/ solar PV plant development/ construction of solar PV plant/energy storage. In this regard, a copy of Certificate of Incorporation, Income tax returns, Memorandum of Association (MOA) and Article of Association (AOA) shall be furnished along with the Bid in support of above. The MOA and AOA shall highlight the provisions relating to construction or generation or sale of power/ energy/ renewable energy/ solar PV plant development. In case of consortium, the members of the consortium can collectively meet the Qualification Requirement (as mentioned in Clause 1.2.6.2 for meeting Technical Eligibility Criteria and Clause 1.2.6.3 for meeting Financial Eligibility Criteria) and number of members in a Consortium would be limited to 02 (two) including the Lead Bidder. It is clarified that Partnership Firms, LLP and LLC are not eligible to participate in this Bid.

The Sole Bidder/Consortium partner may seek qualification based on technical and/or financial capability of its Parent(s) and/ or its Subsidiaries/Affiliate(s) for the purpose of meeting the technical/financial qualification requirements. Authorization for use of such financial capability shall have to be provided from its Parent(s) and/or Subsidiaries/Affiliate(s).

- 1.2.6.1.2. A Bidder is eligible to submit Bids for developing the Facilities with solar PV technology along with BESS as mentioned in the Volume II. Bidder is allowed to choose either fixed tilt, seasonal tilt or tracker-based solution (single axis/ double axis) etc.

1.2.6.1.3. The 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System (excluding all variants of lead acid batteries) will be developed in the land parcel with Survey No 83 of the Pavagada ultra-mega solar park at Pavagada Taluk of Tumakuru District in Karnataka. The Bidders are requested to visit KSPDCL website (<http://kspdcl.karnataka.gov.in>) and KREDL website (<http://kredl.karnataka.gov.in>) to obtain the specific information on the solar park in which the Facilities will be developed. The details of the land parcel are given below:

<b>Land parcel no.</b>	<b>Extent of approx. allotted area in acres</b>	<b>220/ 33 kV KSPDCL Substation allotment</b>	<b>Approx. distance of the allotted land parcel in km with respect to Substation No.4</b>
<b>Survey No 83</b>	17Acres 38 Gunta acres out of which about 11 acres would be used for developing 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System. However based on the justification by the contractor additional land may be provided.	S-4	1.5 km

#### 1.2.6.1.4.

The Bidders are required to quote only for the capacity of 2 MW<sub>AC</sub> with 4.5MWh BESS. The Bidder shall quote the AC capacity of Facilities in whole number only along with their corresponding DC capacity. The maximum capacity to be allotted to any Bidder including its Parent, Ultimate Parent, Affiliate, Group Business Entity (ies) or any other Group Entity(ies) either bidding as Single Bidder or as a Consortium shall not exceed the maximum capacity of 2 MW<sub>AC</sub> with 4.5 MWh BESS.

1.2.6.1.5. The lowest evaluated successful Bidder shall get all the land within Pavagada Ultra Mega Solar Park for implementation of the Facilities for the capacity of 2MW<sub>AC</sub> with 4.5 MWh BESS.

1.2.6.1.6. The Bidder shall provide the interconnection to the S-4 substation at the voltage level of 33 kV (Point of Injection) of 220/ 33 kV KSPDCL pooling substation No. 04, All associated electrical and civil works required for interfacing with grid including but not limited to establishing inverter transformers, breakers, isolators, panels, protection system, cables, metering at interconnection voltage level of 33 kV, earthing of transformer etc. and evacuation of power to the assigned 33/220 kV KSPDCL pooling substation through single circuit 33 kV underground cables including

provision of any cable tray support structures along the road side from the solar plant to the 220/ 33 kV KSPDCL pooling substation.

The metering arrangement for the Project will be made at 3 (three) metering points connected at various voltage levels viz. 33 kV (at the outgoing feeder of the Project), 33 kV (at the incoming side of the 220/ 33kV KSPDCL substation), and 220 kV (at the incoming side of the 400/220 kV PGCIL CTU substation).

First metering point (M1): At the plant end, the metering shall be at the 33 kV side of the outgoing feeder of the Project.

Second metering point (M2): Metering shall be at 33 kV side at the incoming side of the 220/ 33 kV KSPDCL substation, where the power from the Project is first injected into the Solar Park.

Third metering point (M3): Metering shall be at the 220 kV side at the incoming side of the 400/220 kV PGCIL CTU substation, where the Project power will be injected into the PGCIL CTU substation.(This meter is already available).

The metering point at the plant end (M1) will be required as standby meter; however, the metering points (M2) (Main and Check meters) at the KSPDCL substation will be required for energy accounting purposes. For commercial settlement, an interconnection point, or delivery point shall be the point at 220 kV side (M3) of 400/ 220 kV PGCIL substation of CTU which is already available.

The Annual Generation corresponding to the CUF to be met by the Bidder shall be measured as the aggregate of the unit's measured at 33 kV HT Switchgear panel.

The units measured at 220 kV side of 400/220 kV PGCIL substation = units measured at 33 kV side of 220/33 kV KSPDCL substation – loss in units for the corresponding capacities connected to the 220/33 kV KSPDCL substation, as per REA notified by POSOCO.

- 1.2.6.1.7. Notwithstanding anything to the contrary contained in this NIT, the detailed terms specified in the Contract Agreement shall have overriding effect; provided, however, that any conditions or obligations imposed on the Bidder hereunder shall continue to have effect in addition to its obligations under the Contract Agreement.
- 1.2.6.1.8. The Bid should be furnished as per the formats mentioned in the RFP, which shall be duly signed by the Bidder's authorized signatory.
- 1.2.6.1.9. The Bidder should submit a Power of Attorney as per the format provided in the RFP authorizing the signatory of the Bidder for signing and submission of the Bid duly supported by Board Resolution.

- 1.2.6.1.10. Any condition or qualification or any other stipulation contained in the Bid may render the Bid liable to rejection as a non-responsive Bid. The complete Bid shall be without alterations, interlineations or erasures, except those to accord with instructions issued by KREDL, or as necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the person or persons signing the Bid.
- 1.2.6.1.11. The RFP including annexures, if any, are transmitted to the Bidders solely for the purpose of preparation and the submission of a Bid in accordance herewith. Bidders shall treat all information as strictly confidential and shall not use it for any purpose other than for preparation and submission of their Bid. KREDL will not return any Bid or any information provided along therewith.
- 1.2.6.1.12. The successful Bidder i.e., Contractor, shall ensure submission of PF code number allotted by Regional PF Commissioner along with the Performance Securities. Failure to do so is likely to result in the offer being rejected.
- 1.2.6.1.13. Bidder to note that Price Bids of those Bidders shall be opened who are found techno-commercially qualified and are found reasonably responsive to KREDL's tender terms and conditions along with the scope of work as mentioned in the RFP.

**1.2.6.2. Technical Eligibility Criteria  
BESS QR**

- 1.2.6.2.1 The Bidder should have manufactured or supplied batteries for battery energy storage system(s) of cumulative installed capacity of 5MWh with dispatchable capacity of 4.5MWh or higher out of which atleast one battery energy storage system should be of 3MWh capacity or higher. The reference battery energy storage system of 3MWh or higher capacity must have been in successful operation for atleast 12 months prior to the date of techno commercial bid submission.

OR

The Bidder should have consortium agreement/MOU with technical partner who has manufactured or supplied and installed batteries for energy storage system(s) of cumulative installed capacity of 5MWh with dispatchable capacity of 4.5MWh or higher out of which atleast one battery energy storage system should be of 3MWh capacity or higher. The reference battery energy storage system of 3MWh or higher capacity must have been in successful operation for atleast 12 months prior to the date of techno commercial bid submission.The bidder should upload the consortium agreement/MOU and submit the hard copy of the original MOU before the bid opening date.

**Solar QR**

1.2.6.2.2 The Bidder should have consortium agreement/MOU with an EPC contractor and should have designed, supplied, erected/ supervised erection and commissioned solar PV based grid connected power plant(s) of cumulative installed capacity of not less than 2MW<sub>AC</sub>, out of which one project should be a minimum of 1.5MW or above at single location for public or /Government or private client. The reference plant(s) of at least 1.5 MW<sub>AC</sub>, through which the Bidder is meeting this Technical Eligibility Technical Eligibility Criteria, must have been in successful operation for at least twelve (12) months prior to the date of Techno-Commercial Bid submission.

OR

The Bidder either as a EPC contractor or as a developer should have designed, supplied, erected/ supervised erection and commissioned solar PV based grid connected power plant(s) of cumulative installed capacity of not less than 2 MW<sub>AC</sub>, out of which one project should be a minimum of 1.5MW or above at single location for public or /Government or private client. The reference plant(s) of at least 1.5 MW<sub>AC</sub>, through which the Bidder is meeting this Technical Eligibility Technical Eligibility Criteria, must have been in successful operation for at least twelve (12) months prior to the date of Techno-Commercial Bid submission.

#### **Transmission substation QR**

1.2.6.2.3 The bidder or his consortium partner should be a government approved Super Grade License/Class I license and have executed at least one (1) Electrical Sub-station of minimum 33kV voltage level, consisting of equipments such as 33kV or above voltage level circuit breakers and power transformer, either as developer or as Contractor. In addition, the bidder/contractor should have required QMS certifications like ISO 9001:2015 and ISO 14001:2015.

The bidders have to meet all the eligibility criteria's like BESS QR, Solar QR and Transmission substation QR along with all other requirements.

Notes :

- a. The reference criteria through which the Bidder/consortium partner is meeting the above Technical Eligibility Criteria, should have been developed for the requirement of any Government clients, Central/ State Utilities, Public Sector Undertakings (PSU), Private Players as on the date of Techno-Commercial Bid submission. In this regard, the Bidder shall submit the following:
  - Letter of award/ work order/ purchase order (as applicable)
  - Detailed contract agreement along with any amendment, if any.
  - certificate received from any Government entity, Central/ State utilities.
  - Certificate from the owner of the solar PV plant and BESS Plant

OR

submission of latest Joint Meter Reading report issued by the power utilities mentioning the successful operation of the solar PV Plant and BESS plant for continuous period of last twelve(12) months prior to the date of Techno-Commercial Bid submission.

- b. Facilities executed by Bidder's Group Company, Holding Company, Subsidiary Company or Affiliate under the same management as defined in Companies Act, 1956/ 2013.
- c. In case the award for the reference works has been received by the Bidder either directly from owner of plant or any other intermediary organization, a certificate from such owner of plant or the intermediary organization shall be required to be furnished by the Bidder along with its Techno-Commercial Bid in support of its claim of meeting requirement stipulated above. Certificate from owner of the plant OR submission of latest Joint Meter Reading report issued by the power utilities shall also be furnished by the Bidder for successful operation of the reference plant.
- d. The documentary evidence (submitted by the Bidder in its letter head) for value of executed reference work, name of the client, name of the ultimate user of energy, project arrangement, date for commercial operation date (COD), energy generation in units (kWh) for a continuous period of at least twelve (12) months prior to submission of Techno-Commercial Bid, capacity of the plant in AC/ DC terms, location (GPS/ Google coordinate, village, taluk, district and state) of the plant, shall be submitted by the Bidder along with the Bid.

#### 1.2.6.3. Financial Eligibility Criteria

- 1.2.6.3.1. The average annual turnover of the Bidder, should not be less than "**Rs.96 Crores (Indian Rupees Ninety Six Crores only )**" during any two (2) FYs out of the preceding five (5) FYs viz. from FY 2017-18 until FY 2021-22. Other income shall not be considered for arriving at calculation of average annual turnover.
- 1.2.6.3.2. In case a Bidder does not satisfy the average annual turnover criteria, stipulated above on its own, its Holding Company would be required to meet the stipulated turnover requirements as above, provided that the Net Worth of such Holding Company as on the last day of the preceding financial year (FY 2021-22) is at least equal to or more than the paid up share capital of the Holding Company. In such an event, the Bidder would be required to furnish along with its Techno-Commercial Bid, a letter of undertaking from the Holding Company, supported by the Holding Company's Board Resolution, as per the format enclosed in the RFP, pledging unconditional and irrevocable financial support for the execution of the Contract by the Bidder in case of award of the Contract.
- 1.2.6.3.3. The Bidder shall also submit a certificate issued by Charted Accountant citing the calculation of average annual turnover as provided in RFP also citing break-up of calculation along with the audited annual accounts for FY 2017-18 until FY 2021-22.
- 1.2.6.3.4. The Net Worth of the Bidder as on the last day of the preceding financial year FY 2021-22 should not be less than one hundred percent

(100%) of the Bidder's paid up share capital, subject to a minimum of INR 14 Crores per annum.

1.2.6.3.5. For avoidance of doubt, "Net Worth" as per section 2 (57) of the Companies Act, 2013 means the aggregate value of the paid up share capital and all reserves created out of the profits and securities premium account, after deducting the aggregate value of the accumulated losses, deferred expenditure and miscellaneous expenditure not written off, as per the audited balance sheet, but does not include reserves created out of revaluation of assets, write-back of depreciation and amalgamation.

1.2.6.3.6. In case the Bidder does not satisfy the Net Worth criteria on its own, it can meet the requirement of Net Worth based on the strength of its Subsidiary (ies) and/or Holding Company and/or Subsidiaries of its Holding companies wherever applicable, the Net Worth of the Bidder and its Subsidiary (ies) and/or Holding Company and/or Subsidiary (ies) of the Holding Company, in combined manner should not be less than one hundred percent (100%) of their total paid up share capital. However individually, their Net worth should not be less than seventy five percent (75%) of their respective paid up share capitals.

Net Worth in combined manner shall be calculated as follows:

$$\text{Net Worth (combined)} = (X_1+X_2+X_3) / (Y_1+Y_2+Y_3) \times 100$$

Where X<sub>1</sub>,X<sub>2</sub>,X<sub>3</sub> are individual Net worth which should not be less than seventy five percent (75%) of the respective paid up share capitals and Y<sub>1</sub>,Y<sub>2</sub>,Y<sub>3</sub> are individual paid up share capitals.

1.2.6.3.7. In case the Bidder is not able to furnish its audited financial statements on standalone entity basis due to unavailability as on the date of original Techno-Commercial Bid submission, the unaudited unconsolidated/consolidated financial statements of the Bidder can be considered acceptable provided the Bidder further furnishes the following documents on substantiation of its qualification:

- a. Copies of the unaudited unconsolidated/ consolidated financial statements of the Bidder along with copies of the audited unconsolidated/ consolidated financial statements of its Holding Company.
- b. Certificate from the CEO/ CFO of the Holding Company, stating that the unaudited unconsolidated/ consolidated financial statements form part of the unconsolidated/ consolidated financial statement of the Holding Company.

1.2.6.3.8. In case where audited annual accounts for the required financial years as on date of original Techno-Commercial Bid submission are not available, the financial results certified by a practicing Chartered Accountant shall be considered acceptable. In case the Bidder is not able to submit the Certificate from a practicing Chartered Accountant certifying its financial parameters, the audited annual accounts for five (5) consecutive financial years from FY 2017-18 until FY 2021-22 of the preceding financial year FY 2021-22 shall be considered for evaluating financial parameter. Further, a certificate would be required from the

CEO/ CFO stating that the financial results of the company are under audit as on the date of original Techno-Commercial Bid submission and the Certificate from a practicing Chartered Accountant certifying that the audited annual accounts for FY 2021-22 are not available as on the date of original Techno-Commercial Bid submission.

- 1.2.6.3.9. The Bidder shall also submit a certificate issued by Charted Accountant citing the calculation of Net Worth as provided in RFP also citing break-up of calculation along with the audited annual accounts for FY 2021-22.
- 1.2.6.3.10. In case of a Consortium, for the computation of Financial Capacity, the average annual turnover and Net Worth of only the lead bidder shall be considered. In computing the turnover and Net Worth of the lead bidder the turnover and Net Worth of their respective Group Business Entities would also be eligible hereunder.
- 1.2.6.3.11. In case the lead Bidder is found not having the minimum Financial Capacity covering average annual turnover and Net Worth for the Facilities for which the Bid have been submitted, KREDL shall have the right to reject such Bid.
- 1.2.6.3.12. For the purpose of ascertaining qualification, the Financial Eligibility Criteria of group business entity ("Group Business Entities") can also be submitted by the Bidder in addition to its own Financial Capacity. The Financial Capacity would be summation of the Financial Capacity of the Bidder and the Group Business Entities. For the purpose of this RFP, a Group Business Entity shall mean;
  - a. A Business Entity, which directly or indirectly holds not less than twenty six percent (26%) of voting securities in the Bidder; or
  - b. A Business Entity in which the Bidder directly or indirectly holds not less than twenty six percent (26%) of voting securities.
  - c. For the purposes of meeting financial requirements, only unconsolidated/ consolidated audited annual accounts shall be used. However, audited unconsolidated/ consolidated annual accounts of the Bidder may be used for the purpose of financial requirements provided the Bidder has at least twenty six percent (26%) equity in each Company whose accounts are merged in the audited unconsolidated/ consolidated account and provided further that the financial capability of such Companies (of which accounts are being merged in the unconsolidated/ consolidated accounts) shall not be considered again for the purpose of evaluation of any other Bid.
  - d. The Group Business Entity shall be a Company incorporated under the Companies Act 1956/ 2013.
  - e. The details of Group Business Entities must also be provided as per the format provided in the RFP.

f. Financial capacity shall cover both average annual turnover and Net Worth.

1.2.6.3.13. The Bidder shall provide a copy each of audited annual accounts of previous five (5) financial years from FY 2017-18 until FY 2021-22 for ascertaining their turnover and Net Worth for the purpose of verification.

1.2.6.4. KREDL reserves the right to reject any or all Bids or cancel/ withdraw the Invitation for Bids without assigning any reason whatsoever and in such case no Bidder / intending Bidder shall have any claim arising out of such action.

1.2.6.5. A complete set of RFP may be downloaded by any interested Bidder from the e-procurement, GoK portal and the payment of the Cost of the RFP (non-refundable) as mentioned above in the form of a crossed account payee demand draft in favor of "Karnataka Renewable Energy Development Limited", payable at Bengaluru shall be submitted as per clause 2.3.2.2.

Note: No hard copy of RFP shall be issued to any Bidder.

1.2.6.6. Issuance of RFP to any Bidder shall not construe that such Bidder is considered to be qualified. Bids shall be submitted online. Bidder shall furnish original copies of Cost of RFP, Consortium Agreement /MOU, Bid Security and Power of Attorney separately offline as detailed in Bidding at the address of communication.

1.2.6.7. Applicable documents in hard copies before the stipulated Bid submission closing date and time at the address given below in the address of communication.

1.2.6.8. Transfer of RFP purchased by one intending Bidder to another is not permissible.

1.2.6.9. Any queries regarding RFP may be submitted in writing to the address mentioned above. Bidders are requested to contact e-procurement, GoK for registration (Contact no.: 080-22230960, 080-22234115, eproc help desk +91-4601 0000, +91 – 6894 8777).

1.2.6.10. Address of communication:

Contact details:

KREDL, Head Office Bangalore  
#6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore-560072.  
Phone: 080-22207851/ 22208109.  
Fax: 080-22257399

Email: [kredlmd@gmail.com](mailto:kredlmd@gmail.com), [agm.sgkredl@gmail.com](mailto:agm.sgkredl@gmail.com), [tosgkredl@gmail.com](mailto:tosgkredl@gmail.com)

1.2.6.11. Schedule of Events

1	<a href="#">Availability of Bid documents</a>	From 12-12-2022
2	The last date for seeking clarifications	20-12-2022 up to 17:30Hrs
3	Pre Bid Meeting date (in KREDL Head Office)	22-12-2022 at 11:30Hrs
4	Last date and time for receipt of Technical and Price Bids	11-01-2023 up to 16:30Hrs
5	Date and time of Opening of Technical Bids	12-01-2023 at 16:30Hrs
6	Date and time of Opening of Price Bids	Will be intimated later

1.2.6.12. Amount put to tender: Rs.48.07/- crores (Indian Rupees Forty Eight Crores seven lakhs) including GST, freight charges, insurance and NPV of 12 years plant O&M etc.,

**Sd.**

**Asst. General Manager (SG), KREDL**

## 2. Section II: Instructions to Bidders (ITB)

### 2.1. Introduction

#### 2.1.1. Source of funds

- 2.1.1.1. KREDL intends to finance the Facilities through own resources and/ or utilizing the incentive grant of 13<sup>th</sup> finance commission received from MNRE.

#### 2.1.2. Eligible Plant, Equipment and Installation Services

- 2.1.2.1. For the purposes of this RFP, the word "Facilities" means the Plant and Equipment to be supplied along with Installation Services to be carried out by the Contractor under the Contract. The words "Plant and Equipment", "Installation Services" etc. shall be construed in accordance with the respective definitions given to them in the Terms and Conditions of Contract.

- 2.1.2.2. All countries and areas are the eligible source countries for goods and services to be supplied under this Contract; accordingly, goods and services to be supplied under this Contract may have their origin in any country and area.

- 2.1.2.3. For purposes of this clause, "origin" means the place where the Plant and Equipment or component parts thereof are mined, grown or produced. Plant and Equipment are produced when, through manufacturing, processing or substantial and major assembling of components, a commercially recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

- 2.1.2.4. The origin of the Plant and Equipment along with Installation Services is distinct from the Nationality of the Bidder.

#### 2.1.3. Cost of Bidding

- 2.1.3.1. The Bidder shall bear all costs associated with the preparation and submission of its Bid, and KREDL will, in no case, be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

## 2.2. RFP

### 2.2.1. Clarification on RFP

- 2.2.1.1. A prospective Bidder requiring any clarification to the RFP may notify KREDL through e-mail or in writing by post at KREDL's address indicated as below:

KREDL, Head Office Bangalore  
#6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore-560072.  
Phone: 080-22207851/22208109.  
Fax: 080-22257399  
Email: kredlmd@gmail.com, agm.sgkredl@gmail.com

KREDL will respond to any request for clarification or modification of the RFP that it receives not later than the last date of receipt of queries as specified in NIT. KREDL will post the clarifications on KREDL website and e-procurement,

GoKportal and Bidders can view these clarifications once they are posted. It shall be the responsibility of the Bidders to keep a track of such an update. In no case, KREDL shall be responsible if the Bidder misses out seeing any clarification.

- 2.2.1.2. The Bidder is advised to visit and examine the Site where the Facilities will be installed and its surroundings. The Bidder shall obtain, on its own, all information that may be necessary for preparing the Bid and entering into a Contract Agreement for development of the Facilities. The costs of visiting the Site shall be borne by the Bidder fully.
- 2.2.1.3. The Bidder and any of its personnel or agents will be granted permission by KREDL to enter upon its premises and lands for the purpose of such inspection, but only upon the express condition that the Bidder, its personnel and agents will release and indemnify KREDL, its personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of the inspection.
- 2.2.1.4. The Bidder or its authorized representative is invited to attend pre-bid conference, which will take place at the office address of KREDL. The purpose of the pre-bid conference will be to clarify any issue regarding the RFP. The Bidder is requested to submit questions in writing to submit KREDL at the address/ email indicated under address of communication in the detailed NIT, prior to the pre-bid conference as per the format provided in the RFP (Format for Pre Bid queries). Record notes of the pre-bid conference including KREDL's responses to the queries released by the Bidders in writing shall be published in the KREDL website and e-procurement, GoKportal and can be viewed by the prospective Bidders who have purchased the RFP. Further, any modifications of the RFP, which may become necessary as a result of the pre-bid conference shall be made by KREDL exclusively through a clarification to the queries raised by the bidders and not through the record notes of the pre-bid conference.
- 2.2.1.5. Non-attendance at the pre-bid conference will not be a case for disqualification of a Bidder.

## 2.2.2. Content of the RFP

- 2.2.2.1. The Facilities required, bidding procedures, Contract terms and technical requirements are prescribed in the RFP. The RFP include the following sections:

### **VOLUME-I**

Section I - Notice Inviting Tender (NIT)

Section II - Instructions to Bidders (ITB)

Section III - Terms and Conditions of Contract (TCC)

Section IV - Forms and Procedures (FP)

Section –IV (Part 1 of 3): Bid Form & Attachments (Envelope-I:  
Techno-Commercial Bid)

Section –IV (Part 2 of 3): (Envelope-II: Price Bid)

Section –IV (Part 3 of 3): Contract Agreement & Attachment.

## **VOLUME-II**

1. SectionI: Scope of Work
2. Section II: Technical Specifications
3. Section III: Special Technical Specification
4. Section IV: Annexures

## **VOLUME-III**

1. Schedule of Rates/ Price Bid
- 2.2.2.2. The Bidder is expected to examine all instructions, forms, terms, conditions, specifications and other information in the RFP. Failure to furnish all information required as per the RFP or submission of a Bid not substantially responsive to the RFP in every respect will be at the Bidder's risk and may result in rejection of its Bid.
- 2.2.3. **Amendment to RFP**
- 2.2.3.1. At any time prior to the deadline for submission of Bids, KREDL may, for any reason, whether at its own initiative, or in response to a clarification requested by a prospective Bidder, amend the RFP.
  - 2.2.3.2. The amendments will be posted on KREDL website and e-procurement, GoK portal for viewing by the Bidder. It shall be the responsibility of the Bidders to keep a track of such an update. In no case, KREDL shall be responsible if the Bidder misses out seeing any clarification. The amendments will be binding on Bidders and it will be assumed that the information contained therein will have been taken into account by the Bidder in its Bid. Bidders are also advised to regularly check KREDL website and e-procurement, GoK portal regarding posting of Amendment, if any.
  - 2.2.3.3. The prospective Bidders will be given reasonable time to consider the amendment into account while preparing their Bid. In such a case, KREDL may, at its discretion, extend the deadline for the submission of Bids.
  - 2.2.3.4. Bidders are advised to regularly check KREDL website and e-procurement, GoK portal and e-mail for any update on the Bid.

## **2.3. Preparation of Bids**

### **2.3.1. Language of Bid**

- 2.3.1.1. The Bidder shall bear all costs associated with the preparation and submission of its Bid and KREDL shall in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process. The Bid prepared by the Bidder and all correspondence and documents related to the Bid exchanged between the Bidder and KREDL shall be written in English language, provided that any printed literature furnished by the Bidder may be

written in another language, as long as such literature is accompanied by a translation of its pertinent passages in English language in which case, for purposes of interpretation of the Bid, the translation in English language shall govern.

2.3.1.2. The English Translation of the documents shall be carried out by professional translators and the translator shall certify that he is proficient in both languages in order to translate the document and that the translation is complete and accurate. Further, translation shall be authenticated by the Indian Consulate located in the Country where the documents have been issued or the Embassy of that Country in India.

2.3.1.3. In such cases, the Bidder shall bear all the charges related to translation to English language.

#### **2.3.2. Documents comprising the Bid**

2.3.2.1. Single Stage-Two Envelope Bidding procedure shall be followed through e-tendering for the subject package as hereunder:

##### **Envelope – I: Techno-Commercial Bid**

##### **Envelope – II: Price Bid**

The Envelope - I: "Techno-Commercial Bid" shall be evaluated for completeness and in regard to fulfillment of the qualification requirements and eligibility conditions.

#### **2.3.2.2. Envelope - I: Techno-Commercial Bid**

2.3.2.2.1. The Techno-Commercial Bid submitted shall comprise of the following documents:

1. Bid Form (Techno-Commercial Bid) Section-IV, (Part 1 of 3) duly completed and digitally certified by the Bidder, together with all Attachments identified in ITB clause 2.3.2.2 and uploaded on e-procurement, GoK portal through online bid submission process.
2. Cost of RFP, Consortium Agreement/MOU, Bid Security and Power of Attorney shall be submitted in physical form in original in a separate sealed envelope through hardcopy submission and the scan copies of these documents duly uploaded on the e-procurement, GoKportal website as per the requirement.
3. Other details shall be filled up in e-procurement, GoKportal along with any other document mentioned in the RFP. The attributes, if mentioned in General Data, Electronic Form, requiring any confirmation/information shall be ticked/ filled up suitably by the Bidder.

2.3.2.2.2. Techno-Commercial Bid should not contain any price content entry. In case, the Techno-Commercial Bid is found to contain any price content, such Bid shall be liable for rejection.

2.3.2.2.3. **Key Submissions:** The Techno-Commercial Bid submitted by the Bidder shall comprise of the following documents:

Bid Form (Techno-Commercial Bid) Section-IV, (Part 1 of 3) duly completed and signed by the Bidder together with following Attachments shall be uploaded in the e-procurement, GoKportal along with submission of hard copies of Cost of RFP, Consortium Agreement/MOU, Bid Security and Power of Attorney, as mentioned in the following manner:

- 1. Attachment 1: Covering Letter (to be submitted online):** The scan copy of the Covering Letter shall be uploaded in e-procurement, GoK portal.
- 2. Attachment 2: Cost of RFP (to be submitted offline and online)**

Cost of RFP shall be furnished in accordance with ITB clause 2.3.5 in a sealed envelope separately, super scribed on the top as under and be addressed to KREDL at its address:

*"Original Cost of RFP for, RFP No. ... dated ... from ... (Name of the Bidder)."*

The Bidders are requested to submit the hardcopy of original Cost of RFP as described in the time schedule in NIT, failing which the Bid shall be liable for rejection. KREDL shall not be liable for loss/ non-receipt/ late receipt of Cost of RFP in postal transit. The scan copy shall also be uploaded in e-procurement, GoK portal as described in the time schedule in NIT.

Any Bid without an acceptable Cost of RFP submitted, as per the above procedure, shall be treated as nonresponsive by KREDL and shall not be opened pursuant to ITB sub-clause 2.3.5.2.

- 3. Attachment 3: Bid Security (to be submitted offline and online)**

Bid security shall be furnished in accordance with ITB clause 2.3.6 in a sealed envelope separately, super scribed on the top as under and be addressed to KREDL at its address:

*"Original Bid Security for, RFP No. ... dated ... from ... (Name of the Bidder)."*

The Bidders are requested to submit the hardcopy of original Bid Security well as described in the time schedule in NIT, failing which the Bid shall be liable for rejection. KREDL shall not be liable for loss/non-receipt/late receipt of Bid Security in postal transit. The scan copy shall be uploaded in e-procurement, GoK portal as described in the time schedule in NIT.

Any Bid without an acceptable Bid Security shall be treated as nonresponsive by KREDL and shall not be opened pursuant to ITB sub-clause 2.3.6.3.

**4. Attachment 4: Power of Attorney (to be submitted offline and online)**

A Power of Attorney, duly notarized by a Notary Public, indicating that the person signing and submitting the Bid digitally/ submitting the documents which are required to be submitted in physical form has the authority to sign the Bid and the Bid is binding upon the Bidder during the full period of its validity in accordance with ITB clause 2.3.7.

Power of Attorney shall be furnished in a sealed envelope separately, super scribed on the top as under and be addressed to KREDL at its address:

*"Original Power of Attorney for, RFP No. ... dated ... from ... (Name of the Bidder)."*

The Bidders are requested to submit the hardcopy of original Power of Attorney as described in the time schedule in NIT, failing which the Bid shall be liable for rejection. KREDL shall not be liable for loss/non-receipt/late receipt of Power of Attorney in postal transit. The scan copy shall be uploaded in e-procurement, GoK portal as described in the time schedule in NIT.

Any Bid without an acceptable Power of Attorney shall be treated as nonresponsive by KREDL and shall not be opened pursuant to ITB sub-clause 2.3.6.3.

**5. Attachment 5: Bidder's Qualification (to be submitted online as a part of Techno-Commercial Bid)**

The documentary evidence of the Bidder's Qualifications to perform the Contract, if the Bid is accepted, shall establish to KREDL's satisfaction that the Bidder has the capabilities to complete the Facilities and meeting the Qualification Requirements mentioned in Detailed NIT clause 1.2.6 (Qualifying Requirements for Bidders) and submission of all required documents mentioned under Detailed NIT clause 1.2.6 (Qualifying Requirements for Bidders).

Whether Consortium are permitted: YES

Whether Joint Ventures are permitted: NO

Whether Associate / Collaborator permitted: YES

**6. Attachment 6: Declaration on no blacklisting (to be submitted online as a part of Techno-Commercial Bid)**

Declaration that the Bidder was or is in the process of blacklisting from any previous employer as per the format attached in this RFP.

**7. Attachment 7: Signing of the Bid(to be submitted online as a part of Techno-Commercial Bid)**

Copy of RFP, any amendments/ addenda/ corrigenda/ errata/ clarification to the RFP issued by KREDL duly signed online using the digital signature of the Bidder in e-procurement, GoK portal as token of unequivocal acceptance to such documents.

**8. Attachment 8: No Deviation Certificate (to be submitted online as a part of Techno-Commercial Bid)**

No Deviation Certificate from the Bidder that the Bidder has not taken any deviation including the Target generation details from solar and BESS as detailed in Attachment No.10, in whatsoever form, from the terms and conditions mentioned in the RFP, any amendments/ addenda/ corrigenda/ errata/ clarification to the RFP issued by KREDL.

**9. Attachment 9: Consortium Agreement/MOU (to be submitted offline and online)**

A Consortium Agreement/MOU entered into between the parties who are responsible for executing the project and whose technical and financial qualifying criteria's collectively meets the stipulated requirements should be duly notarized by a Notary Public, indicating that the Bid is binding upon the Bidder and/or his consortium partners during the full period of its validity in accordance with ITB clause 2.3.7.

Consortium Agreement/MOU shall be furnished in a sealed envelope separately, super scribed on the top as under and be addressed to KREDL at its address:

*"Original Consortium Agreement/MOU for, RFP No. ... dated ... from ... (Name of the Bidder)."*

The Bidders are requested to submit the hardcopy of original Consortium Agreement/MOU as described in the time schedule in NIT, failing which the Bid shall be liable for rejection. KREDL shall not be liable for loss/non-receipt/late receipt of Consortium Agreement/MOU in postal transit. The scan copy shall be uploaded in e-procurement, GoK portal as described in the time schedule in NIT.

Any Bid without an acceptable Consortium Agreement/MOU shall be treated as nonresponsive by KREDL and shall not be opened pursuant to ITB sub-clause 2.3.6.3.

**10. Attachment 10: Target generation details from solar and BESS (to be submitted online as a part of Techno-Commercial Bid)**

No deviation Certificate from the Bidder that the Bidder has not taken any deviation with respect to Target generation details from solar and BESS, in whatsoever form, from the terms and conditions mentioned in the RFP,

any amendments/ addenda/ corrigenda/ errata/ clarification to the RFP issued by KREDL.

**2.3.2.3. Envelope - II: Price Bid:** The Price Bid will be submitted as per the format file named as "Price Bid format" in e-procurement, GoK portal.

**2.3.3. Submission of Bids**

The Bidder shall complete the Bid Form and Attachments submit the Techno-Commercial Bid and Price Bid in respective section on e-procurement, GoK portal.

**2.3.4. Bid Currencies:**

Bidders shall quote the entire Bid Price in Indian Rupees (INR).

**2.3.5. Cost of RFP AND Tender Fee:**

**2.3.5.1.** The Cost of RFP shall be in the form of a crossed demand draft from any of the nationalized or commercial banks.

Cost of RFP (non-refundable): INR 30,000/- (Indian Rupees Thirty Thousand) only plus applicable GST.

Cost of RFP shall remain valid for a period of One Hundred and Eighty (180) Days from the date of submission of original Techno-Commercial Bid.

**2.3.5.2.** The Bidder shall furnish, as part of its Techno-Commercial Bid, the Cost of RFP, in original, in a separate sealed envelope in the amount and currency as specified in the RFP before the stipulated Bid submission closing date and time. In case acceptable Cost of RFP in a separate sealed envelope is not received, then online Bid shall be rejected by KREDL as being non responsive and shall not be opened.

**2.3.5.3.** Tender Fee (non refundable) as applicable by e-procurement, GoK for this tender shall be borne by the Bidder. The payment mode towards Tender fee shall be as prescribed by e-procurement, GoK.

**2.3.5.4.** The Cost of RFP and Tender Fee shall be non-refundable.

**2.3.6. Bid Security:**

**2.3.6.1.** The Bidder shall furnish, as part of its Techno-Commercial Bid, a Bid Security in a separate sealed envelope in the amount and currency as stipulated in the RFP.

Bids shall be accompanied by Bid Security amount of INR 49 Laks/- (Indian Rupees Forty Nine Lakhs) only for the capacity of 2 MW<sub>AC</sub> with 4.5 MWh BESS as follows:

1) Upto Rs.10.00 Lakhs

Government of Karnataka has selected ICICI Bank, for provision of e-payment services for e-procurement project. The following modes of payment will be provided by ICICI as a part of e-payment services.

- Credit Card/Debit Card
- Net Banking
- NEFT/RTGS
- Over-the-Counter (OTC)
- IMPS

For further detail regarding mode of e-payment of EMD in e-procurement platform, contact e-procurement cell, Government of Karnataka.

2) Balance Rs.39 Lakhs in the form of Bank Guarantee covering 30 days after the validity period of the bid including period of extension, if any required by the Owner. The bidders shall scan the Bank Guarantee towards Bid Security/EMD and upload the same in the prescribed form failing which the offer will be rejected. Also, the Bidder shall ensure that the Bank Guarantee towards Bid Security/EMD shall be sent in original to the KREDL, Bengaluru, so as to reach after the last date of submission of bid & time and on or before the date and time notified for opening of Techno Commercial Bids, in a sealed cover, failing which their bid will not be opened.

- 2.3.6.2.** The Bid Security shall be in the form of a Bank Guarantee from any of the nationalized or commercial banks. In the event that the Bid Security is issued by a foreign branch of the banks, the same should be endorsed by the Indian branch of the Bank or the State Bank of India.

The format of the Bank Guarantee shall be in accordance with the form of Bid Security included in the RFP. Bid Security shall remain valid for a claim period of 30 (thirty) Days beyond the expiry period of 180 (one hundred and eighty) Days from the original date of submission of Techno-Commercial Bid and beyond any extension of Bid Validity subsequently requested under ITB sub-clause 2.3.7.2.

- 2.3.6.3.** The Bid Security in original shall be submitted in a separate sealed envelope before the stipulated Bid opening date and time. In case acceptable Bid Security in a separate sealed envelope is not received then online Bid original shall be rejected by KREDL as being nonresponsive and shall not be opened.
- 2.3.6.4.** The Bid Security of the Bidders whose Techno-Commercial Bid has not been found acceptable will be returned along with the letter communicating rejection of Techno-Commercial Bid.
- 2.3.6.5.** The Bid Security of the successful Bidder to whom the Contract is awarded shall be returned when said Bidder has signed the Contract Agreement pursuant to ITB clause 2.6.4 and has furnished the required Performance Securities pursuant to ITB clause 2.6.5. The Bid Security of the other Bidders who are qualified in Techno-Commercial evaluation but remained unsuccessful shall be returned after issuing the Letter of Award and Signing of the Contract Agreement with successful Bidder as per the stipulated time.

**2.3.6.6. *Forfeiture of Bid Security:***

The Bid Security shall be forfeited in any of the following circumstances by KREDL without any notice or proof of damage to the Bidder:

- 2.3.6.6.1.** If the Bidder withdraws or varies its Bid during the period of Bid validity, without the prior permission from KREDL.
- 2.3.6.6.2.** If the Bidder does not accept the arithmetical correction of its Price Bid pursuant to ITB sub-clause 2.5.7.2.
- 2.3.6.6.3.** If the Bidder refuses to withdraw, without any cost to KREDL, any deviation, variation, additional condition or any other mention

anywhere in the Bid, contrary to the provisions of the RFP, read in conjunction with its amendments / errata / clarification / addenda.

- 2.3.6.6.4. In case of a successful Bidder, if the Bidder fails within the specified time limit;
  - 1. to sign the Contract Agreement, in accordance with ITB clause 2.6.4, and/or
  - 2. to furnish the required Performance Securities, in accordance with ITB clause 2.6.5.
  
- 2.3.6.6.5. If the Bidder and its representatives commit any fraud, provide any wrong information or is blacklisted by any employer while competing for this Contract.

#### **2.3.7. Period of Validity of Bid (Techno-Commercial Bid and Price Bid):**

- 2.3.7.1. Bids shall remain valid for 180 (One hundred and eighty) Days from the original date of submission of Techno-Commercial Bid. The Bid valid for shorter period shall be rejected by KREDL as being non-responsive.
  
- 2.3.7.2. In exceptional circumstances, KREDL may solicit the Bidder's consent to an extension of the Bid validity period. The request and responses thereto shall be made in writing by post or by email followed by post confirmation. If a Bidder accepts to extend the period of Bid validity, the validity of Bid Security shall also be suitably extended. A Bidder may refuse the request without forfeiting its Bid Security. A Bidder granting the request will not be required nor permitted to modify its Bid.

#### **2.3.8. Format and Signing of Bid**

- 2.3.8.1. The Bid including all documents submitted online shall be digitally certified using Class-III signature by a duly authorized representative of the Bidder to bind him to the Contract. The authorization shall be indicated by written power of attorney as per ITB clause 2.3.2.2.3 (4) and shall be submitted in physical form prior to date & time for opening of Techno-Commercial Bid.

### **2.4. Submission of Bid**

#### **2.4.1. Bid Submission (Envelope I): Techno-Commercial Bid**

- 2.4.1.1. The Bidder shall submit the Bid online in Process/Display Bid Screen at e-procurement, GoK portal in the following manner after carefully examining the document/conditions etc.:
  - 2.4.1.1.1. Bid shall be submitted through e-procurement, GoKportal only in the manner specified elsewhere in RFP. Bidders to ensure that all uploaded documents on e-procurement, GoK portal must be digitally certified. Bidder to further ensure that documents uploaded on e-procurement, GoK portal is being downloaded properly. KREDL shall not be responsible for corrupted files, if any, uploaded online on e-procurement, GoK portal. Bidder should note that no zip file is to be uploaded online. Further file related to particular Attachment/Schedule including their annexures/ appendices, if any, shall be given name of that Attachment/Schedule only. No Manual / Hard Copy of the Bid

shall be acceptable except for the submission of Cost of RFP, Consortium Agreement/MOU, Bid Security and Power of Attorney.

- 2.4.1.1.2. No deviation, whatsoever, is permitted by KREDL, to any provisions of the RFP. The Bidders are advised that while making their Bid proposals and quoting prices, all conditions may appropriately be taken into consideration.

Bidders shall certify their full compliance to all the provisions of RFP and its subsequent Amendment(s) / Clarification(s) / Addenda / Errata, if any, issued by KREDL by accepting the following attribute in Main Screen of Bid Invitation:

Mandatory acceptance of above attribute shall be considered as Bidder's confirmation to the following:

1. Confirm that we comply with all terms, conditions and specifications of the RFP read in conjunction with Amendments(s)/ Clarification(s)/ Addend/ Errata (if any) issued by KREDL prior to opening of Techno-Commercial Bids and the same has been taken into consideration while making our Techno-Commercial Bid & Price Bid and we declare that we have not taken any deviation in this regard.
2. Any deviation, variation or additional condition etc. or any mention, contrary to RFP and its Amendments(s)/Clarification(s)/ Addend/Errata (if any) found anywhere in our Techno-Commercial Bid and/ or Price Bid, implicit or explicit shall stand unconditionally withdrawn, without any cost implication whatsoever to KREDL, failing which the Bid Security shall be forfeited.

- 2.4.1.1.3. Bids can be submitted following the specific instruction provided in the e-procurement, GoK portal.

- 2.4.1.2. The envelopes containing Cost of RFP, Consortium Agreement/MOU, Bid Security and Power of Attorney shall be sealed in an outer envelope super scribed on the top as under and be addressed to KREDL at its address mentioned in this RFP. The above documents shall be submitted well in advance so as to be received by KREDL before the Bid Opening Date and time of Bids as described in the time schedule in NIT or any corrigendum.

*"Original Cost of RFP, Consortium Agreement/MOU, Bid Security and Power of Attorney having RPF No. ..... dated ..... From..... (Name of the Bidder)."*

KREDL shall not be liable for loss/non-receipt/late receipt of above documents in postal transit. If Outer envelope is not sealed and marked as required above, KREDL will assume no responsibility for its misplacement.

#### **2.4.2. Bid Submission (Envelope II): Price Bid (Online submission only)**

- 2.4.2.1. The Price Bid will be submitted as per the format named as "Price Bid format".

**2.4.3. Deadline for Submission of Bids**

- 2.4.3.1. Bids must be submitted online no later than the time and date stated in the Bid Document or corrigendum, if any.
- 2.4.3.2. In the event of the specified date for submission of Bids being declared a holiday for KREDL, the Bids will be received up to the appointed time on the next working day.
- 2.4.3.3. Any Bid received by KREDL after the Bid submission deadline prescribed by KREDL, pursuant to ITB clause 2.4.3, will be rejected and returned unopened to the Bidder and online Bid of such Bidder, if submitted, shall also be rejected.

**2.4.4. Modification and Withdrawal of Bids**

- 2.4.4.1. The Bidder may modify or withdraw its Bid after submission, provided that written notice of the modification or withdrawal is received by KREDL prior to the deadline prescribed for Bid submission. KREDL shall return the Bid through e-procurement, GoKe-tendering mode for modification or withdrawal as requested.
- 2.4.4.2. No Bid shall be withdrawn in the interval between the Bids submission deadline and the expiration of the Bid validity period specified in ITB clause 2.3.7. Withdrawal, of any Bid during this interval may result in the Bidder's forfeiture of the Bid Security, pursuant to ITB sub-clause 2.3.6.6.

## **2.5. Bid Opening and Evaluation**

**2.5.1. Opening of Bids by KREDL**

Techno-Commercial Bid Opening

- 2.5.1.1. KREDL will open the Techno-Commercial Bids at the time, on the date specified in the NIT and at its address as mentioned in the RFP. In the event of the specified date for the opening of Bids being declared a holiday for KREDL, the Bids will be opened at the appointed time on the next working day. Bidder's attendance during the Techno-Commercial Bid opening in KREDL premises is not envisaged.
- 2.5.1.2. KREDL shall first open the Cost of RFP, Consortium Agreement/MOU, Bid Security and Power of Attorney (submitted offline) of all the Bidders. Based on the Cost of RFP, Consortium Agreement/MOU, Bid Security, and Power of Attorney, Bids of only those Bidders will be opened whose original Cost of RFP, Consortium Agreement/MOU, Bid Security and Power of Attorney are acceptable as per conditions of the RFP.
- 2.5.1.3. Bids not accompanied by requisite Cost of RFP and Bid Security in original in a separate sealed envelope pursuant to ITB clause 2.3.5 and ITB clause 2.3.6, and/or Bids not accompanied by Power of Attorney in original as per requirements of ITB clause 2.4.1.2 and Consortium Agreement/MOU, in a separate sealed envelope shall be rejected and shall not be opened.
- 2.5.1.4. Techno-Commercial Bids that are not opened during Bid opening shall not be considered for further evaluation, regardless of the circumstances.

- 2.5.1.5. Techno-Commercial Bids which are generally responsive as per RFP will then be considered for evaluation.
- 2.5.1.6. The Price Bid will remain unopened and shall be opened separately by KREDL after completion of evaluation of Techno-Commercial Bids.
- 2.5.1.7. Price Bid opening: After evaluation process of Techno-Commercial Bids is completed, Price Bids shall be opened for the bidders who will be responsive as a result of evaluation of Techno-Commercial Bids. Bidder's attendance during the Price Bid opening in KREDL Premises is not envisaged.

**2.5.2. Clarification of Bids**

- 2.5.2.1. During the Bid evaluation, KREDL may, at its discretion, ask the Bidder for a clarification of its Bid including documentary evidence pertaining but not limited to only the reference plants declared in the Bid for the purpose of meeting Qualifying Requirement. The request for clarification and the response shall be in writing and no change in the price or substance of the Bid including substitution of reference plants in the bid by new/additional plant for conforming to Qualifying Requirement shall be sought, offered or permitted.

**2.5.3. Preliminary Examination of Techno-Commercial Bids**

- 2.5.3.1. KREDL will examine the Bids to determine whether the same are complete, whether required documents have been furnished, whether the documents have been properly signed and whether the Bids are generally in order.
- 2.5.3.2. During evaluation and comparison of Bids, KREDL may, at its discretion ask the Bidder for clarification on its Bid. The request for clarification shall be in writing and no change in prices or substance of the Bid shall be sought, offered or permitted. No post Bid clarification at the initiative of the Bidder shall be entertained as all such clarifications would have been obtained prior to the submission of the Bid.
- 2.5.3.3. KREDL may waive any minor informality, nonconformity, or irregularity in a Bid that does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Bidder.
- 2.5.3.4. Prior to the detailed evaluation, KREDL will determine whether each Techno-Commercial Bid is of acceptable quality, is complete, and is substantially responsive to the RFP. For purposes of this determination, a substantially responsive Bid is one that (a) materially conforms to all the terms, conditions and specifications of the RFP without material deviations, objections, conditionalities or reservations. A material deviation, exception, objection, conditionality, or reservation is one: (i) that affects in any substantial way the scope, quality, or performance of the Contract; (ii) that limits, in any substantial way that is inconsistent with the RFP, KREDL's rights or the Successful Bidder's obligations under the Contract; or (iii) whose rectification would unfairly affect the competitive position of other Bidders who have submitted substantially responsive Bids.
- 2.5.3.5. No deviation, whatsoever, is permitted by KREDL to any provisions of RFP. The Bidders are advised that while making their Bid proposals and quoting prices, all conditions may appropriately be taken into consideration. Bidders shall certify

their compliance to the complete RFP through e-procurement mode as per the required acceptance.

- 2.5.3.6. Acceptance of above attribute shall be considered as Bidder's confirmation that any deviation to any provisions found anywhere in their Bid Proposal, implicit or explicit, shall stand unconditionally withdrawn, without any cost implication whatsoever to KREDL, failing which the Bid Security shall be forfeited.
- 2.5.3.7. KREDL's determination of a Bid's responsiveness shall be based on the contents of the Bid itself without recourse to extrinsic evidence. If a Bid is not substantially responsive, it will be rejected by KREDL, and may not subsequently be made responsive by the Bidder by correction of the nonconformity.

#### **2.5.4. Qualification**

- 2.5.4.1. Bidders shall certify their compliance on "Qualifying Requirements" of KREDL by accepting the following attribute on e-procurement portal as required.
- 2.5.4.2. KREDL, by the examination of Techno-Commercial Bid, will determine to its satisfaction whether the participating Bidders are qualified to satisfactorily perform the Contract in terms of the Qualifying Requirements stipulated in the RFP. The determination will take into account the Bidder's financial and technical capabilities, in particular its Contracts, works in hand, future commitments and current litigation. It will be based upon an examination of documentary evidence of Bidder's qualification submitted by the Bidder in relevant attachment to the Bid Form of Techno-Commercial Bid as well as such other information as KREDL deems necessary and appropriate. Notwithstanding anything stated anywhere else in the RFP, KREDL reserves the right to seek in writing information relating to Qualifying Requirements in addition to details contained in the Bid. The Bidder shall furnish required information promptly to KREDL. KREDL shall shortlist the Bidders meeting the stipulated Qualifying Requirements.

#### **2.5.5. Evaluation of Techno-Commercial Bids**

Techno-Commercial Bid, prepared and comprising details/documents in line with ITB sub-clause 2.3.2.2, submitted by Bidder's will be evaluated as described below:

- 2.5.5.1. KREDL will carry out a detailed evaluation of Techno-Commercial Bids in order to determine whether the technical aspects are in accordance with the requirements set forth in the RFP. In order to reach such a determination, KREDL will examine and compare the technical aspects of the Bids on the basis of the information supplied by the Bidders, taking into account the following factors:
  - 2.5.5.1.1. The Bid that does not meet acceptable standards of completeness, consistency and detail will be rejected for non-responsiveness.
  - 2.5.5.1.2. Achievement of specified performance criteria by the Facilities
  - 2.5.5.1.3. Any other relevant factors, if any, listed or that KREDL deems necessary or prudent to take into consideration.

2.5.5.2. Bidder may note that deviations, variations and additional conditions etc. found elsewhere in the Bid, shall not be given effect to in evaluation and it will be assumed that the Bidder complies with all the conditions of RFP. In case the Bidder refuses to withdrawn deviation implicit or explicit found anywhere in the Bid, without any financial implication whatsoever to KREDL, the Bid Security shall be forfeited.

#### 2.5.6. **Qualification of Techno-Commercial Bid**

2.5.6.1. KREDL will ascertain to its satisfaction whether Bidders determined as having submitted responsive Techno-Commercial Bids are qualified to satisfactorily perform the Contract.

2.5.6.2. The determination will take into account the Bidder's financial, technical and past performance. It will be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB sub-clause 2.3.2.2.3 (5), as well as such other information as KREDL deems necessary and appropriate.

#### 2.5.7. **Preliminary Examination of Price Bids**

2.5.7.1. KREDL will examine the Price Bids to determine whether they are complete and whether the Bids are generally in order.

2.5.7.2. Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price, which is obtained by multiplying the unit price and quantity, or between subtotals and the total price, the unit or subtotal price shall prevail and the total price shall be corrected accordingly. If there is a discrepancy between words and figures, the amount in words will prevail. If the Bidder does not accept such correction of errors, its bid will be rejected and the Bid Security will be forfeited in accordance with ITB sub-clause 2.3.6.6.

#### 2.5.8. **Evaluation of Price Bids**

- The price bids of the technically qualified/responsive bidders will be opened by KREDL.
- KREDL will review the price bid proposals. Arithmetical errors will be corrected and lowest financial bidder will be awarded the contract.
- Evaluation of Price Bids shall be based on the lowest lump sum price quoted by the Bidders.
- Lump sum price or Contract Price shall be equal to Total Evaluated Bid Value (A+B+C+D+E+F+G) as appeared in Cell No.I 47 of SOR 1 (Price), which is inclusive of GST.
- Where

A=PART A : SCHEDULE OF RATES [SOR-1] - SOLAR PART (2 MW<sub>AC</sub>)

B=PART B : SCHEDULE OF RATES [SOR-1] - BESS PART (4.5 MWh) excluding all variance of lead acid batteries

C=PART C : SCHEDULE OF RATES [SOR-1] –33 kV Terminal bay integration

D=PART D : SERVICES FOR PART A , SOLAR PART (2 MW<sub>AC</sub>)

E=PART E : SERVICES FOR PART B , BESS PART (4.5MWh) excluding all variance of lead acid batteries

F=PART F : SERVICES FOR PART C - 33 kV Terminal bay integration

G=PART G: NPV of OPERATION AND MAINTENANCE PART

- The detailed breakup of SOR-1(Price) worksheet should be equal to Total Evaluated Bid Value as appeared in Cell No.I 47 of SOR-1 (Price) and the same is lumpsum price.
- The detailed breakup of O&M in worksheet in CELL NO L25 of SOR-2 (O&M) should be equal to NPV of O&M amount as appeared in CELL NO I 45 of SOR-1 (price).
- This article should be read in conjunction with Vol III- Schedule of Rates/Price Bid

#### 2.5.9. **Contacting KREDL**

- 2.5.9.1. Subject to ITB clause 2.5.2.1, no Bidder shall contact KREDL on any matter relating to its Bid, from the time of the opening of Bids to the time the Contract is awarded.
- 2.5.9.2. Information relating to examination, evaluation and comparison of Bids and recommendation for the award of Contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any effort by a Bidder to influence KREDL during the Bid evaluation, Bid comparison or Contract award decisions may result in rejection of the Bidder's Bid.

### 2.6. Award of Contract

#### 2.6.1. **Award Criteria**

- 2.6.1.1. Deleted
- 2.6.1.2. The Bidder shall be required to comply with all requirements of the RFP and subsequent amendment thereof, if any without any extra cost to KREDL, failing which the Bid Security shall be forfeited.
- 2.6.1.3. KREDL reserves the right to vary the quantity of any of Mandatory Spares and / or delete any item of Mandatory Spares altogether at the time of Award of Contract without any implication of cost.
- 2.6.1.4. The mode of contracting with the successful Bidder shall be as per stipulation outlined in TCC clause 3.1.3.5.

#### 2.6.2. **KREDL's right to accept any Bid and to reject any or all Bids**

- 2.6.2.1. KREDL reserves the right to accept or reject any Bid, for any reasons including national defense and security consideration and to annul the Bidding process and to reject all Bids at any time prior to award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders on the grounds for KREDL's action.

#### 2.6.3. **Letter of Award**

- 2.6.3.1. Prior to the expiration of the period of Bid validity, KREDL will notify the successful Bidder in writing by post or by email to be confirmed in writing by registered letter, that its Bid has been accepted. The Letter of Award will constitute the formation of the Contract.

- 2.6.3.2. Target date for Commissioning of Project/ Time to complete the Facilities from the date of **Contract Agreement between KREDL and the successful Bidder:****

The broader implementation schedule for the solar capacity of 2 MW<sub>AC</sub> with 4.5 MWh BESS as under:

Time to complete the Facilities related to BESS including Solar PV System is 12 months.

<b>Sl. No.</b>	<b>Activities/ Milestone</b>	<b>Period in months from signing of Contract Agreement</b>
1	Site mobilization, opening of Site office and preparatory works	1
2	Topography, soil testing and geotechnical investigations	1
3	Approval of Subcontractors	1
4a	Basic engineering and approvals (Approval of Layout, SLD and foundation drawings for MMS and control/inverter rooms, BESS and datasheet of module and inverters)	2
4b	Ordering of BOIs	3
4c	Detailed engineering and approvals	3
5	Civil works - foundations for module mounting structures and BESS	5
	Control room works---Civil and Electrical works	7
	Inverter Room works—Civil and Electrical works	7
	Fencing, Road and Drainage works and other civil works	7
6	Supply of module mounting structures	8
7	Installation of module mounting structures	8
8	Supply of solar PV modules,BESS	9
9	Installation of solar PV modules, BESS	9
10	Supply of cables, inverter transformer, inverters and other electrical equipment for solar PV modules, BESS	9
11	Installation of cables, inverter transformer, inverters and other electrical equipmentsolar PV modules, BESS	9
15	Testing of Equipment and readiness of SCADA	10
16	Commissioning of Solar PV Plant and BESS	11
17	Stabilization and trial run for Solar Plant along with BESS system integration including completion of all facilities	12
18	Operational Acceptance of the Solar PV Plant and BESS system	13

#### **2.6.4. Signing the Contract Agreement**

- 2.6.4.1. At the same time as KREDL notifies the successful Bidder that its Bid has been accepted, KREDL will send to the Bidder the Contract Agreement provided in the RFP, incorporating all Agreements between the Parties.**

- 2.6.4.2. Within thirty (30) Days of receipt of the Letter of Award, the Bidder shall sign the Contract Agreement with KREDL. KREDL shall be responsible for providing the access of the project locations to the Bidder within the thirty (30) Days of receipt of the Letter of Award.**

## 2.6.5. **Contract Performance Security**

- 2.6.5.1. Within thirty (30) Days after receipt of the Letter of Award, the successful Bidder shall furnish Contract Performance Securities for Five percent (5%) of Contract Price for all the Contracts and in the form provided in the section “Forms and Procedures (Part 3 of 3)” of the RFP. The Contract Performance Security or Performance Bank Guarantee (“PBG”) shall be submitted in three (3) parts of 20% (twenty percent) of **PBG value** (“PBG1”), 40% (forty percent) of **PBG value** (“PBG2”) and 40% (forty percent) of **PBG value** (“PBG3”). The format of the Bank Guarantee shall be in accordance with the form of Performance Security included in the RFP. The above Performance Security shall remain valid for a claim period of 30 (thirty) Days beyond 2 (two) Years from the date of Operational Acceptance and beyond any extension of Bid Validity subsequently requested by KREDL. In case any of the above PBGs are encashed by KREDL due to any default on the part of the Contractor, then the Contractor shall ensure that such PBGs are replenished within a maximum period of 15 (fifteen) Days from the date of such encashment. The PBG1 and PBG2 shall be returned once the obligations related to such PBGs are over.

Prior to the expiry of PBG3, the Bidder shall furnish fresh O&M performance BG towards O&M Performance Security (O&M PBG) @ 5% of the contract price through out O&M Period of 12 (Twelve) Years from the date of Operational Acceptance. The format of the Bank Guarantee shall be in accordance with the form of Performance Security included in the RFP. The O&M PBG shall remain valid for a claim period of 30 (thirty) Days beyond the date of expiry of O&M Period and beyond any extension of Bid Validity subsequently requested by KREDL. In case if O&M PBG is encashed by KREDL due to any default on the part of the Contractor, then the Contractor shall ensure that such PBGs are replenished within a maximum period of 15 (fifteen) Days from the date of such encashment.

- 2.6.5.2. Failure of the successful Bidder to comply with the requirements of ITB clause 2.6.4 or ITB clause 2.6.5 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.
- 2.6.5.3. The Performance Securities shall be in the form of a Bank Guarantee from any of the nationalized or commercial banks. The Bank Guarantee submitted from within India towards Performance Security shall be issued on Non-Judicial Stamp Paper of appropriate value as per Stamp Act prevailing in the states where the Bank Guarantee is submitted or is to be acted upon or the rate prevailing in the State where the Bank Guarantee is executed whichever is higher.

## 2.6.6. **Corrupt or Fraudulent practices**

- 2.6.6.1. KREDL requires that Bidders, Contractors and Subcontractors observe the highest standard of ethics during the procurement and execution of the Contracts. In pursuance of this policy, KREDL:
- 2.6.6.1.1. Defines, for the purposes of this provision, the terms set forth below as follows:
1. “corrupt practice” means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in Contract execution; and

2. "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of KREDL, and includes collusive practice among Bidders (prior to or after Bid submission) designed to establish Bid prices at artificial non-competitive levels and to deprive KREDL of the benefits of free and open competition;
  - 2.6.6.1.2. will reject a Bid for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the Contract in question;
  - 2.6.6.1.3. will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a Contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for or in executing a Contract of KREDL.
- 2.6.6.2. Furthermore, Bidders shall be aware of the provision stated in TCC sub-clause 3.8.3.2.
- 2.6.7. **Ineligibility for participation in re-tender**
- Notwithstanding the provisions specified in ITB sub-clause 2.3.6.6 and ITB sub-clause 2.6.5.2, if a Bidder after having been issued the Letter of Award, either does not sign the Contract Agreement pursuant to ITB clause 2.6.4 or does not submit an acceptable Performance Securities pursuant to ITB clause 2.6.5 and which results in tender being annulled then such Bidder shall be treated ineligible for participation in re-tendering of this particular Package.
- 2.6.8. **Deleted**
- 2.6.9. **Deleted**
- 2.6.10. **Deleted**

### 3. Section III: Terms and Conditions of Contract (TCC)

#### 3.1. Contract and Interpretation

##### 3.1.1. Definitions

- 3.1.1.1. The following words and expressions shall have the meanings hereby assigned to them:

Contractor and KREDL, where the context permits, shall be referred to collectively as "Parties" and individually as "Party".

"Contract or Contract Agreement" means the contract agreement entered into between KREDL and the Contractor, together with the Contract Documents referred to therein; they shall constitute the Contract and the term "the Contract" shall in all such documents be construed accordingly.

“Contract Documents” means the documents listed in Article 1.1 (Contract Documents) of the Form of Contract Agreement (including any amendments thereto).

“Contract Price” means the total contract price quoted by the Contractor in the Price Bid.

“TCC” means the Terms and Conditions of Contract hereof.

“Day” means calendar day of the Gregorian calendar.

“Business Day” means Monday to Saturday excluding national holidays, bank holidays and the local holidays in Karnataka.

“Month” means calendar month of the Gregorian calendar.

“Year” means calendar year of the Gregorian calendar.

“Financial Year” means the year begins with 1 April of a year and ends with 31 Mar of the subsequent year.

“KREDL” means Karnataka Renewable Energy Development Limited.

“Facilities Manager” means the person appointed by KREDL in the manner provided in TCC Sub-Clause 3.5.1.1 (Facilities Manager) hereof and named as such in the Contract to perform the duties delegated by KREDL.

Name of Facilities Manager: Assistant General Manager (Solar Grid)

“Contractor” means the person(s) whose Bid to perform the Contract has been accepted by KREDL and is named as such in the Contract Agreement, and includes the legal successors or permitted assigns of the Contractor.

“Contractor’s Representative” means any person nominated by the Contractor and approved by KREDL in the manner provided in TCC Sub-Clause 3.5.1.2 (Contractor’s Representative and Construction Manager) hereof to perform the duties delegated by the Contractor.

“Subcontractor”, including sub-suppliers, sub-vendors, means any person or any entity to whom execution of any part of the Facilities, including preparation of any design or detailed design or supply or services of any part of the Plant and Equipment and Installation Services for completing the Facilities, is subcontracted directly or indirectly by the Contractor, and includes its legal successors or permitted assigns.

“Adjudicator” means the person or persons named as such in the Contract to make a decision on or to settle any dispute or difference or disagreements between KREDL and the Contractor referred to him or her by the Parties pursuant to TCC Sub-Clause 3.1.6.1 (Mutual Consultation) hereof.

“Contract Price” or “Lumpsum Price” means the sum specified in Article 2.1 (Contract Price) inclusive of all applicable taxes and duties of the Contract Agreement as on the actual date of submission of Price Bid, subject to such additions and adjustments thereto or deductions therefrom, as may be made pursuant to the Contract. The Contract Price (exclusive of all taxes and duties) shall remain firm throughout the period of the Contract Agreement.

“Facilities” means the Plant and Equipment to be designed, engineered, procured, supplied, constructed, erected, tested, installed and Commissioned, as well as all the Installation Services to be carried out by the Contractor under the Contract.

“Plant and Equipment” means permanent plant, equipment, machinery, apparatus, articles, materials and things of all kinds to be provided and incorporated in the Facilities including but not limited to BESS system for carrying out assigned scope of work by the Contractor under the Contract (including the Mandatory Spares to be supplied by the Contractor), but does not include Contractor’s Equipment.

“Installation Services” means all those services ancillary to the supply of the Plant and Equipment for the Facilities and associated electrical and civil works, to be provided by the Contractor under the Contract; e.g., transportation through the modes (road, sea, air, rail etc.) as applicable and provision of marine or other similar insurance, loading, unloading, safe keeping of Plant and Equipment, inspection, expediting, Site preparation works (including the provision and use of Contractor’s Equipment and the supply of all civil, structural and construction materials required), installation, testing, Pre-commissioning, Commissioning, carrying out guarantee tests, operations, maintenance, the provision of operations and maintenance manuals, training and capacity building of KREDL’s personnel etc.

“Contractor’s Equipment” means all plant, facilities, equipment, materials, machinery, tools, apparatus, appliances or things of every kind required in or for installation, completion and maintenance of Facilities that are to be provided by the Contractor, but does not include Plant and Equipment, or other things intended to form or forming part of the Facilities.

“Site” means the land and other places upon which the Facilities shall be installed, and such other land or places as may be specified in the Contract as forming part of the Site for evacuation of power as allotted to KREDL.

“Effective Date” means the date from which the Time for Completion shall be determined as stated in Article 3 (Effective Date for Determining Time for Completion) of the Form of Contract Agreement. In this case, the Effective Date will be date on which the Contract Agreement will be signed between the Parties.

“Time for Completion” means the period within which Completion of the Facilities as a whole shall be attained in accordance with the stipulations in the RFP and the relevant provisions of the Contract. The time schedule for completion of Facilities of Solar System including BESSwill be 12(twelve) months from the date of execution of Contract Agreement. Further, the Bidder shall provide comprehensive Operation and Maintenance (O&M) of solar PV plant including BESS for a period of 12 (twelve) years from the date of Operational Acceptance of the Facilities.

“Completion” means that the Facilities (or a specific part thereof where specific parts are specified in the RFP) have been completed operationally and structurally and put in a tight and clean condition and that all work in respect of Pre-commissioning of the Facilities has been completed and Commissioning has been attained as per Technical Specifications.

“Pre-commissioning” means the testing, checking and other requirements specified in the Technical Specifications that are to be carried out by the Contractor in preparation for Commissioning as provided in TCC Clause 3.5.8 (Commissioning and Completion of Facilities) hereof.

“Commissioning” means the synchronization and operation of the Facilities or any part thereof by the Contractor, which is to be carried out by the Contractor

as provided in TCC Clause 3.5.8 (Commissioning and Completion of Facilities) hereof, for the purpose of carrying out Guarantee Test(s).

“Guarantee Test(s)” means the test(s) specified in the Technical Specifications to be carried out to ascertain whether the Facilities or a specified part thereof is able to attain the Technical Specification specified in the Technical Specifications in accordance with the provisions of TCC Sub-Clause 3.5.9.1 (Guarantee Test) hereof.

“Operational Acceptance” means the acceptance by KREDL of the Facilities, which certifies the Contractor’s fulfillment of the Contract in respect of Technical Specification of the Facilities (or the relevant part thereof) and shall include deemed acceptance in accordance with TCC Clause 3.5.9 (Guarantee Tests and Operational Acceptance) hereof.

“Defect Liability Period” means the period of validity of the warranties given by the Contractor commencing at Operational Acceptance of the Facilities, during which the Contractor is responsible for correcting the defects with respect to the operation of Facilities as provided in TCC Clause 3.6.2 (Defect Liability) hereof.

“Warranties” means the period of validity **for twelve (12) years from the date of Operational Acceptance** of the required warranties given by the Original Equipment Manufacturers (OEMs) or the Contractor (on the same terms and conditions provided by the OEMs) commencing at Operational Acceptance of the Facilities as provided below: Notwithstanding anything to the contrary contained in this Contract, the **minimum** warranties provided by the OEMs in respect of the Facility shall be:

- Solar photovoltaic modules: Performance warranty with guarantee 90% (ninety percent) production at the end of 10<sup>th</sup> year and 80% (eighty percent) at 25<sup>th</sup> year. Product warranty for a period of 25 (twenty five) years;
- PV Inverter – Product warranty period of 12 (Twelve) ;
- Module Mounting Structures – Product Warranty period of 22 (twenty Two);
- Battery Energy Storage System – Product Warranty period of 5 (Five) years;
- All other balance equipment (power and inverter duty transformers, string combiner box (SMB)/ DC/ AC Cable etc.) – Product warranty period of 2 (Two) years.
- The above warranties shall be backed by third party insurance.

### 3.1.2. **Contract Documents**

- 3.1.2.1. Subject to Article 1.2 (Order of Precedence) of the Contract Agreement, all documents forming part of the Contract (and all parts thereof) are intended to be correlative, complementary and mutually explanatory. The Contract shall be read as a whole.

3.1.2.2. The Contractor, at its own cost, shall provide 03 (three) original document of the Contract. The Contract shall be signed by the Parties in 03 (three) original documents and the Contractor shall be provided with 01 (one) signed original and the remaining 02 (two) will be retained by KREDL.

3.1.2.3. The Contractor shall provide, free of cost to KREDL, all the engineering data, drawing and descriptive materials, within the prescribed timelines, for KREDL's usage only for this project, in at least six (6) copies to form a part of the Contract.

**3.1.3. Interpretation**

**3.1.3.1. Language**

3.1.3.1.1. Unless the Contractor is a national of KREDL's country and Parties agree to use the local language, all Contract Documents, all correspondence and communications to be given, and all other documentation to be prepared and supplied under the Contract shall be written in English, and the Contract shall be construed and interpreted in accordance with that language.

3.1.3.1.2. If any of the Contract Documents, correspondence or communications are prepared in any language other than the governing language under TCC Sub-Clause 3.1.3.1.1 above, the English translation of such documents, correspondence or communications shall prevail in matters of interpretation.

3.1.3.1.3. The English translation of the documents shall be carried out by professional translators and the translator shall certify that the person is proficient in both languages in order to translate the document and that the translation complete and accurate. Further, translation shall be authenticated by the Indian Consulate located in Country where the documents have been issued or the Embassy of that Country in India.

3.1.3.1.4. All such translation related costs and expenses shall be to the account of the Contractor.

**3.1.3.2. Singular and Plural**

The singular shall include the plural and the plural shall include singular, except where the context otherwise requires.

**3.1.3.3. Headings**

The headings and marginal notes in the Terms and Conditions of Contract are included for ease of reference, and shall neither constitute a part of the Contract nor affect its interpretation.

**3.1.3.4. Persons**

Words importing persons or parties shall include any person, firms, corporations and government entities.

**3.1.3.5. Construction of the Contract**

**3.1.3.5.1. KREDL will sign one (01) EPC Contract with the Contractor for providing all the requirements as mentioned in the RFP.**

**3.1.3.6. Entire Agreement**

Subject to TCC Sub-Clause 3.4.2.4 hereof, the Contract constitutes the entire agreement between KREDL and Contractor with respect to the subject matter of Contract and supersedes all communications, negotiations and agreements (whether written or oral) of Parties with respect thereto made prior to the date of Contract.

**3.1.3.7. Amendment**

No amendment or other variation of the Contract shall be made effective unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorized representative of each Party hereto.

**3.1.3.8. Independent Contractor**

The Contractor shall be an independent contractor performing the Contract. The Contract does not create any agency, partnership, joint venture or other joint relationship between the Parties hereto. Subject to the provisions of the Contract, the Contractor shall be solely responsible for the manner in which the Contract is performed. All employees, representatives or Subcontractors engaged by the Contractor in connection with the performance of the Contract shall be under the complete control of the Contractor and shall not be deemed to be employees of KREDL, and nothing contained in the Contract or in any subcontract awarded by the Contractor shall be construed to create any contractual relationship between any such employees, representatives or Subcontractors and KREDL.

**3.1.3.9. Consortium**

A consortium is allowed for a maximum of **two (2)** members including the lead Bidder, and such members are allowed jointly to fulfill the technical and financial eligibility criteria. In case of a consortium, all such firms shall be jointly and severally bound to KREDL for the fulfillment of the obligations under the Contract and shall designate 01 (one) of such firms to act as a lead member with authority to bind the consortium. The composition or the constitution of the consortium shall not be altered without the prior consent of KREDL.

**3.1.3.10. Non-Waiver**

**3.1.3.10.1.** Subject to TCC Sub-Clause 3.1.3.10.2 below, no relaxation, forbearance, delay or indulgence by either Party in enforcing any of the terms and conditions of the Contract or the granting of time by either Party to the other shall prejudice, affect or restrict the rights of that Party under the Contract, nor shall any waiver by either Party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

**3.1.3.10.2.** Any waiver of a Party's rights, powers or remedies under the Contract must be in writing and acceptance by the other Party, must be dated and signed by an authorized representative of the Party granting such waiver, and must specify the right and the extent to which it is being waived.

### **3.1.3.11. Severability**

If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.

### **3.1.3.12. Country of Origin**

“Origin” means the place where the Plants and Equipment and other supplies for the Facilities are mined, grown, produced or manufactured and from which the services are provided.

## **3.1.4. Notices**

**3.1.4.1.** Unless otherwise stated in the Contract, all notices to be given under the Contract shall be in writing, and shall be sent by personal delivery, special courier, post, email or telefax followed by post confirmation to the address of the relevant Party set out in the Contract Coordination Procedure to be finalized pursuant to TCC Sub-Clause 3.5.1.2.4, with the following provisions:

**3.1.4.1.1.** Any notice sent by cable, telegraph, facsimile shall be confirmed within 02 (two) Days after despatch by notice sent by post confirmation, except as otherwise specified in the Contract.

**3.1.4.1.2.** Any notice sent by email, airmail post or special courier shall be deemed (in the absence of evidence of earlier receipt) to have been delivered 10 (ten) Days after despatch. In proving the fact of despatch, it shall be sufficient to show that the envelope containing such notice was properly addressed, stamped and conveyed to the postal authorities or courier service for transmission by airmail or special courier.

**3.1.4.1.3.** Any notice delivered personally or sent by telegraph, facsimile, email or EDI shall be deemed to have been delivered on date of its despatch.

**3.1.4.1.4.** Either Party may change its postal address, telefax number, email id, and addressee for receipt of such notices by 10 (ten) Days' notice to the other Party in writing.

**3.1.4.2.** Notices shall be deemed to include any approvals, consents, instructions, orders and certificates to be given under the Contract.

## **3.1.5. Governing Laws**

**3.1.5.1.** The Contract shall be governed by and interpreted in accordance with laws in force in India. The Courts of Bengaluru shall have exclusive jurisdiction in all matters arising under the Contract.

## **3.1.6. Settlement of Disputes**

### **3.1.6.1. Mutual Consultation**

If any dispute of any kind whatsoever shall arise between KREDL and the Contractor in connection with or arising out of the Contract, including without

prejudice to the generality of the foregoing, any question regarding its existence, validity or termination, or the execution of the Facilities, whether during the progress of the Facilities or after their completion and whether before or after the termination, abandonment or breach of the Contract, the Parties shall seek to resolve any such dispute or difference by mutual consultation. If the Parties fail to resolve such a dispute or difference by mutual consultation, then the dispute maybe settled through Expert Settlement Council/Arbitration.

### **3.1.6.2. Resolution of Dispute through Conciliation**

Where the disputed amount is within INR 50 (fifty) crores (to be arrived at considering the claim and counter claim of the Parties to the dispute) and in case the Parties fail to resolve such a dispute or difference by mutual consultation, the dispute may be referred to Conciliation.

#### **3.1.6.2.1. Invitation for Conciliation**

- 3.1.6.2.1.1. A Party shall notify the other Party in writing about such a dispute it wishes to refer for conciliation within a period of 30 (thirty) Days from the date of failure to resolve the dispute through mutual consultation. Such invitation for conciliation shall contain sufficient information as to the dispute to enable the other Party to be fully informed as to the nature of the dispute, amount of the monetary claim, if any, and apparent cause of action.
- 3.1.6.2.1.2. Upon acceptance of the invitation to conciliate, the other Party shall submit its counter claim, if any, within a period of 30 (thirty) days from the date of the invitation to conciliate. If the other Party rejects the invitation or if disputed amount exceeds INR 50 (fifty) crores, there will be no conciliation proceedings.
- 3.1.6.2.1.3. If the Party initiating conciliation does not receive a reply within 30 (thirty) days from the date it sends the invitation, or within such other period of time as specified in the invitation, it shall treat this as a rejection of the invitation to conciliate from the other Party.

#### **3.1.6.2.2. Conciliation**

- 3.1.6.2.2.1. Where Invitation for conciliation has been furnished under TCC sub clause 4.1.6.2.1, the Parties shall attempt to settle such dispute through Expert Settlement Council (ESC), which shall be constituted by the Chairman as Additional Chief Secretary to Government, Energy Department.
- 3.1.6.2.2.2. ESC will be formed from experts comprising 03 (three) members from the panel of conciliators maintained by KREDL. However, there will be single member ESC for disputes involving claim and counter claim (if any) up to INR 01 Crore. Chairman will have authority to reconstitute an ESC to fill any vacancy.

3.1.6.2.2.3. The eligible persons for consideration for empanelment in the panel of conciliators shall be amongst Retired Civil Servants of Govt. of India/ Karnataka not below the rank of Additional Secretary, Retired Judges, Retired Directors/ Chairman of any department in Government of Karnataka/ Government of India and Independent experts in their respective fields preferably registered with the Indian Council of Arbitration or Arbitration Centre-Karnataka (Domestic & International) or Federation of Indian Chambers of Commerce and Industry or SCOPE Forum of Conciliation and Arbitration.

**3.1.6.2.3. Proceedings before ESC:**

3.1.6.2.3.1. The claimant shall submit its statement of claims along with relevant documents to ESC members, and to the Party(s) indicated in the appointment letter within 30 (thirty) Days of the issue of the appointment letter. The respondent shall file its reply and counter claim (if any) within 30 (thirty) Days of the receipt of the statement of claims. Parties may file their rejoinder/additional documents, if any in support of their claim/counterclaim within next 15 (fifteen) Days. No documents shall be allowed thereafter, except with the permission of ESC.

3.1.6.2.3.2. The Parties shall file their claim and counterclaim in the following format

- a. Chronology of dispute
- b. Brief of the contract
- c. Brief history of the dispute
- d. Issues

Sl.No	Description of Claims/Counter Claims	Amount (in INR)	Relevant Contract Clause

- e. Details of Claim(s)/Counter Claim(s)
- f. Basis/Ground of claim(s)/counter claim(s) along with relevant clause of contract

3.1.6.2.3.3. In case of 03 (three) members ESC, 02 (two) members will constitute a valid quorum and the meeting can take place to proceed in the matter after seeking consent from the member who is not available. However, ESC recommendations will be signed by all the members.

- 3.1.6.2.3.4. The Parties shall be represented by their inhouse employees. No Party shall be allowed to bring any advocate or outside consultant/advisor/agent to contest on their behalf. Ex-officers of KREDL who have handled the disputed matter in any capacity shall not be allowed to attend and present the case before ESC on behalf of Contractor. However, ex-employees of Parties may represent their respective organizations. Parties shall not claim any interest on claims/counter-claims from the date of notice invoking conciliation until execution of settlement agreement, if so arrived. In case, Parties are unable to reach a settlement, no interest shall be claimed by either Party for the period from the date of notice invoking conciliation until the date of ESC recommendations and 30 (thirty) Days thereafter in any further proceeding.
- 3.1.6.2.3.5. ESC will conclude its proceedings in maximum 10 (ten) meetings, and give its recommendations within 90 (ninety) Days of its first meeting. ESC will give its recommendations to both the Parties recommending possible terms of settlement. Chairman may extend the time/ number of meetings, in exceptional cases, if ESC requests for the same with sufficient reasons.
- 3.1.6.2.3.6. ESC members and the Parties shall meet at the venue Bengaluru, Karnataka. All the expenditure incurred in ESC proceedings shall be shared by the Parties in equal proportion initially and later as per the instructions received from the ESC.
- 3.1.6.2.3.7. If decision of KREDL is acceptable to the Contractor, a Settlement Agreement under section 73 of the Arbitration and Conciliation Act 1996 will be signed within 15 (fifteen) Days of Contractor's acceptance and same shall be authenticated by all the ESC members. Parties are free to terminate conciliation proceedings at any stage as provided under the Arbitration and Conciliation Act 1996.
- 3.1.6.2.3.8. The Parties shall keep confidential all matters relating to the conciliation proceedings. Parties shall not rely upon them as evidence in arbitration proceedings or court proceedings.

### 3.1.6.3. Arbitration

- 3.1.6.3.1. In case the Parties fail to settle the dispute through the process of mutual consultation and/or conciliation as per TCC Sub-Clause 3.1.6.1&3.1.6.2 above, either Party may give a notice to the other Party, of its intention to commence arbitration, as hereinafter provided, as to the matter in dispute, and no arbitration in respect of this matter may be commenced unless such notice is given. Such notice of intention to commence arbitration shall be given within a period of 30 (thirty) Days from the date of failure to settle the matter

through mutual consultation or 30 (thirty) Days from the date of termination of ESC proceedings (applicable only in case where ESC has been constituted).

- 3.1.6.3.2. Any dispute in respect of which a notice of intention to commence arbitration has been given, in accordance with Sub-Clause 3.1.6.3.1 above, shall be finally settled by arbitration. Arbitration may be commenced prior to or after completion of the Facilities.
- 3.1.6.3.3. Any dispute submitted by a Party to arbitration shall be heard by an arbitration panel composed of 03 (three) arbitrators, in accordance with the provisions set forth below.
- 3.1.6.3.4. KREDL and the Contractor shall each appoint 01 (one) arbitrator, and these 02 (two) arbitrators shall jointly appoint a third arbitrator, who shall chair the arbitration panel. If the 02 (two) arbitrators do not succeed in appointing a third arbitrator within twenty-eight (28) Days after the latter of the 02 (two) arbitrators has been appointed, the third arbitrator shall, at the request of either Party, be appointed by the Appointing Authority for arbitrator designated in the Contract.
- 3.1.6.3.5. If one Party fails to appoint its arbitrator within forty-two (42) Days after the other Party has named its arbitrator, the Party which has named an arbitrator may request the Appointing Authority to appoint the second arbitrator.
- 3.1.6.3.6. If for any reason an arbitrator is unable to perform its function, the mandate of the Arbitrator shall terminate in accordance with the provisions of applicable laws as mentioned in TCC Clause 3.1.5 (Governing Law) and a substitute shall be appointed in the same manner as the original arbitrator.
- 3.1.6.3.7. Arbitration proceedings shall be conducted (i) in accordance with the rules of procedure designated in the Contract, (ii) in the place designated in the Contract, and (iii) in the language in which this Contract has been executed. The Place for Arbitration shall be Bengaluru, Karnataka of India.
- 3.1.6.3.8. The decision of a majority of the arbitrators (or of the third arbitrator chairing the arbitration, if there is no such majority) shall be final and binding and shall be enforceable in any court of competent jurisdiction as decree of the court. The Parties thereby waive any objections to or claims of immunity from such enforcement.
- 3.1.6.3.9. The arbitrator(s) shall give reasoned award.
- 3.1.6.4. Notwithstanding any reference to the Conciliation or Arbitration herein,
  - 3.1.6.4.1. the Parties shall continue to perform their respective obligations under the Contract unless they otherwise agree.
  - 3.1.6.4.2. KREDL shall pay the Contractor any monies due to the Contractor.

### **3.2. Subject Matter of Contract**

#### **3.2.1. Scope of Facilities**

- 3.2.1.1. Unless otherwise expressly limited in the Technical Specifications, the Contractor's obligations cover the provision of all Plant and Equipment including Mandatory Spares and the performance of all Installation and Services required for the design, engineering, the manufacture (including procurement, quality assurance, construction, installation, associated civil, structural and other construction works, Pre-commissioning and delivery) of the Plant and Equipment along with Installation Service, Commissioning, testing, completion of the Facilities and carrying out Guaranteed Tests for completing the Facilities in accordance with the plans, procedures, specifications, drawings, codes and any other documents as specified in the Technical Specifications. Such Technical Specifications include, but are not limited to, the provision of supervision and engineering services; the supply of labour, materials, equipment, spare parts and accessories; Contractor's Equipment; construction utilities and supplies; temporary materials, structures and facilities; transportation (including, without limitation, unloading and hauling to, from and at the Site), insurance and safe keeping and storage, except for those supplies, works and services that will be provided or performed by KREDL, as set forth in Appendix 6 (Scope of Works and Supply by KREDL) to the Contract Agreement.
- 3.2.1.2. The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining completion of the Facilities as if such work and/or items and materials were expressly mentioned in the Contract.
- 3.2.1.3. The Contractor agrees that the Mandatory Spares recommended by them for twelve (12) Years of operation are quoted in Price Bid and shall be maintained by them at the same terms and conditions as are otherwise applicable to this Contract.
- 3.2.1.4. All the Mandatory Spares for the Plant and Equipment under the Contract will strictly conform to the Technical Specification and other relevant documents and will be identical to the corresponding main Plant and Equipment including the materials and components supplied under the Contract and shall be fully interchangeable.
- 3.2.1.4.1.1. All the Mandatory Spares covered under the Contract shall be produced along with the main Plant and Equipment as a continuous operation and the delivery of the Mandatory Spares will be effected along with the Plant and Equipment in a phased manner and the delivery would be completed by the respective dates for the various categories of Plant and Equipment as per the agreed network. In case of Mandatory Spares, the above shall be applicable provided the order for the Mandatory Spares have been placed with the Contractor prior to commencement of manufacture of the Plant and Equipment.
- 3.2.1.4.1.2. The Contractor shall provide KREDL with the manufacturing drawings, catalogues, assembly drawings and any other document required by KREDL so as to enable KREDL to identify the Mandatory Spares.

- 3.2.1.4.1.3. The quality plan and the inspection requirement finalized for the main Plant and Equipment shall also be applicable to the corresponding Mandatory Spares.
- 3.2.1.4.1.4. The Contractor shall provide KREDL with all the addresses and particulars of his Subcontractors while placing the order on Subcontractor for items/materials/components/Equipment covered under the Contract and shall further ensure with its Subcontractors that KREDL, if so desires, shall have the right to place order for spares directly on them on mutually agreed terms based on offers of such Subcontractors.
- 3.2.1.4.1.5. The Contractor shall warrant that all Mandatory Spares supplied shall be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.
- 3.2.1.4.1.6. The scope of work also includes comprehensive Operation and Maintenance (O&M) of solar PV plant with BESS for a period of twelve (12) years from the date of Operational Acceptance of the Facilities.

### **3.2.2. Time for Commencement and Completion**

- 3.2.2.1. The Contractor shall commence work on the Facilities from the date of **signing of Contract Agreement** and without prejudice to TCC SubClause 3.6.1.1.2 hereof.
- 3.2.2.2. The Contractor shall attain completion of the Facilities as specified in the Contract within the time stated in the Contract or within such extended time to which the Contractor shall be entitled under TCC Clause 3.8.1 (Extension of Time for Completion) hereof.
- 3.2.2.3. The time schedule for completion of Facilities for the Bidder shall be as defined in definition of Section-III Terms and Conditions of Contract. Further, the Bidder shall provide comprehensive Operation and Maintenance (O&M) of solar PV plant with BESS for a period of twelve (12) years from the date of Operational Acceptance of the Facilities.

### **3.2.3. Contractor's Responsibilities**

- 3.2.3.1. The Contractor shall execute the scope of work as per NIT clause 1.2.2 or any other provisions mentioned in the RFP.
- 3.2.3.2. The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities provided by KREDL, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site (if access thereto was available) and of other data readily available to it relating to the Facilities as at the date ten (10) Days prior to Price Bid submission. The Contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve its responsibility for properly estimating the difficulty or cost of successfully performing the Facilities.

- 3.2.3.3. The Contractor shall acquire in its name all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located that are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall also acquire all other permits, approvals and/ or licenses that are not the responsibility of KREDL hereof and that are necessary for the performance of the Contract. However, the Bidder shall be responsible for facilitation, providing necessary documents as required by various authorities and further follow up for obtaining all the permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings on behalf of KREDL in the country where the Site is located, as mentioned in the RFP.
- 3.2.3.4. KREDL shall only provide the documents for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located, which such authorities or undertakings require KREDL to obtain them in the KREDL's name are necessary for the execution of the Contract (they include those required for the performance by both the Contractor and KREDL of their respective obligations under the Contract), including those specified in Appendix 6 (Scope of Works and Supply by KREDL) to the Contract Agreement. In such case, all such payments shall be made by Contractor.
- 3.2.3.5. The Contractor shall comply with all laws in force in the country where the Facilities are installed and where the Installation Services are carried out. The laws will include all national, provincial, municipal, local or other laws that affect the performance of the Contract and bind upon the Contractor. The Contractor shall indemnify and hold harmless KREDL from and against any and all liabilities, damages, claims, fines, penalties and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to TCC Sub-Clause 3.2.4.1 hereof.
- 3.2.3.6. Any Plant and Equipment along with Installation Services that will be incorporated in or be required for the Facilities and other supplies shall have their origin as specified under TCC Clause 3.1.3.12 (Country of Origin).
- 3.2.4. KREDL's Responsibilities**
- 3.2.4.1. KREDL shall ensure the accuracy of all information and/or data to be supplied by KREDL as described in Appendix-6 (Scope of Works and Supply by KREDL) to the Contract, except when otherwise expressly stated in the Contract.
- 3.2.4.2. KREDL shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in Appendix 6 (Scope of Works and Supply by KREDL) to the Contract Agreement. KREDL shall give full possession of and accord all rights of access thereto on or before the date(s) specified in Appendix 6 (Scope of Works and Supply by KREDL).

- 3.2.4.3. If requested by the Contractor, KREDL shall use its best endeavors to assist the Contractor in obtaining in a timely and expeditious manner all permits, approvals and/or licenses necessary for the execution of the Contract from all local, state or national government authorities or public service undertakings that such authorities or undertakings require the Contractor or Subcontractors or the personnel of the Contractor or Subcontractors, as the case may be, to obtain.
- 3.2.4.4. KREDL shall be responsible for the continued operation of the Facilities after completion of Operations and Maintenance Period, in accordance with TCC Sub-Clause 3.5.9.2 (Operational Acceptance), and shall be responsible for certifying the Guarantee Test(s) for the Facilities, in accordance with TCC Sub-Clause 3.5.9.2 (Operational Acceptance).
- 3.2.4.5. All costs and expenses involved in the performance of the obligations under this TCC Clause 3.2.4 (KREDL's Responsibilities) shall be the responsibility of KREDL, save those to be incurred by the Contractor with respect to the performance of Guarantee Tests, in accordance with TCC 3.5.9.2 (Operational Acceptance).

### **3.3. Payment**

#### **3.3.1. Contract Price**

- 3.3.1.1. The Contract Price shall be as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement.
- 3.3.1.2. Subject to TCC Sub-Clauses 3.2.3.2, 3.2.4.1 and 3.7.5 (Unforeseen Conditions) hereof, the Contractor shall be deemed to have satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract.

#### **3.3.2. Terms of Payment**

- 3.3.2.1. The Contract Price shall be paid as specified in Appendix-1 (Terms and Procedures of Payment) to the Contract Agreement. The procedures to be followed in making application for and processing payments shall be those outlined in the same Appendix-1 (Terms and Procedures of Payment). **The following clause provided in TERMS OF PAYMENT of this RFP.**
- 3.3.2.2. No payment made by KREDL herein shall be deemed to constitute acceptance by KREDL of the Facilities or any part(s) thereof.
- 3.3.2.3. The currency or currencies in which payments are made to the Contractor under this Contract shall be specified in Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, subject to the general principle that payments will be made in the currency or currencies in which the Contract Price has been stated in the Contractor's bid.

#### **3.3.3. Securities**

##### **3.3.3.1. Issuance of Securities**

The Contractor shall provide the Securities specified below in favor of Managing Director, KREDL at the times, and in the amount, manner and form specified below.

### 3.3.3.2. Contract Performance Security

- 3.3.3.2.1. The Contractor shall, within thirty (30) Days of the Letter of Award, provide Contract Performance Security for due performance of the Contracts for Five percent (5%) of the Contract. Price of all the Contracts, with an initial validity up to **thirty (30) Days beyond the expiry of the respective PBGs as mentioned in Clause 2.6.5.1 of Volume I of the RFP**. However, in case of delay in completion of the Facility, the validity of all the Contract Performance Security shall be extended by the period of such delay. Prior to the expiry of initial validity period of the Contract Performance Security, the Contractor Performance Security shall be extended up to ninety (90) Days beyond the end of O&M Period of twelve (12) Years from the date of Operational Acceptance.

### 3.3.4. Taxes and Duties

- 3.3.4.1. Except as otherwise specifically provided in the Contract, the Contractor shall bear and pay all taxes, duties, levies and charges assessed on the Contractor, its Subcontractor or their employees by all Municipal, State or National Government Authorities in connection with the completion of the Facilities till Operational Acceptance and during the O&M Period, in and outside of the Country where the Site is located.
- 3.3.4.2. KREDL will issue the GST certificate post incorporation of the Site address as additional place of business, requisite waybill or road permit required for transportation of Plant and Equipment. Further, in case of all Plant and Equipment identified by the Contractor and KREDL to be despatched directly from the Sub-contractor's work to Site in a state different from the State wherein Subcontractor's works are located, the Contractor will effect sale in transit. For effecting the sale in transit, the Contractor shall ensure that his Sub-contractor raises invoices in Contractor's name (and not in the name of KREDL) and obtains Goods Receipt (GR)/ Lorry Receipt (LR)/Railway Receipt (RR)/ Bill of Lading (BL)/ Air Way Bill (AWB) in the name of Contractor (and not in the name of KREDL). The Contractor shall further ensure that he endorses the GR/LR/RR/BL/BL/AWB in the name of KREDL during transit of the Plant and Equipment just before the delivery of Plant and Equipment is taken by KREDL.
- 3.3.4.3. If any tax exemptions, reductions, allowances or privileges are available to the Contractor in the Country where the Site is located, KREDL shall use its best endeavors to enable the Contractor to benefit from any such tax savings to the maximum allowable extent.
- 3.3.4.4. For the purpose of the Contract, it is agreed that the Contract Price specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes, duties, levies and charges prevailing on the day of submission of Price Bid in the country where the Site is located (hereinafter called "Tax" in this TCC Sub-Clause 3.3.4).
- 3.3.4.5. Notwithstanding TCC Sub-Clauses above, KREDL shall reimburse all taxes and duties as quoted by the Bidder in the Price Bid or in actuals supported by all documentation, whichever is minimum. However, in case of any increase in the taxes and duties due to wrong estimation or non-inclusion of some or all of the

taxes and duties quoted by the the Contractor in their Price Bid for the taxes and duties already existing at the time of submission of Techno-Commercial Bid and Price Bid, the same shall be to the account of the Contractor. If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation or application of any Tax occurs in the course of the performance of Contract by Government or court of law, which was or will be assessed on the Contractor in connection with performance of the Contract, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition to the Contract Price or deduction therefrom, as the case may be, in accordance with TCC Clause 3.7.6 (Change in Laws and Regulations) hereof. However, these adjustments would be restricted to direct transactions between KREDL and the Contractor. These adjustments shall not be applicable on procurement of raw materials, intermediary components etc. by the Contractor and also not applicable on the bought out items despatched directly from Sub-contractor's works to Site.

### **3.4. Intellectual Property**

#### **3.4.1. Copyright**

- 3.4.1.1. The copyright in all drawings, documents and other materials containing data and information furnished to KREDL by the Contractor herein shall remain vested in the Contractor or, if they are furnished to KREDL directly or through the Contractor by any third Party, including suppliers of materials, the copyright in such materials shall remain invested in such third Party. KREDL shall however be free to reproduce all drawings, documents and other material furnished to KREDL for the purpose of the contract including, if required, for operation and maintenance of the Facilities.

#### **3.4.2. Confidential Information**

- 3.4.2.1. KREDL and the Contractor shall keep confidential and shall not, without the written consent of the other Party hereto, divulge to any third Party any documents, data or other information furnished directly or indirectly by the other Party hereto in connection with the Contract, whether such information has been furnished prior to, during or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Sub-Contractor(s) such documents, data and other information it receives from KREDL to the extent required for the Sub-contractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Sub-Contractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this TCC Clause 3.4.2 (Confidential Information).

- 3.4.2.2. KREDL shall not use such documents, data and other information received from the Contractor for any purpose other than execution of the Contract and operation and maintenance of this Facilities. Similarly, the Contractor shall not use such documents, data and other information received from KREDL for any purpose other than the design, procurement of Plant and Equipment, construction or such other work and services as are required for the performance of the Contract.

- 3.4.2.3. The obligation of a Party under TCC Sub-Clauses 3.4.2.1 and TCC Sub-Clauses 3.4.2.2 above, however, shall not apply to that information which

- (a) Now or hereafter enters the public domain through no fault of that Party

- (b) Can be proven to have been possessed by that Party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other Party hereto
- (c) Otherwise lawfully becomes available to that Party from a third Party that has no obligation of confidentiality.

- 3.4.2.4. The above provisions of this TCC Clause 3.4.2 (Confidential Information) shall not in any way modify any undertaking of confidentiality given by either of the Parties hereto prior to the date of the Contract in respect of the Facilities or any part thereof.
- 3.4.2.5. The provisions of this TCC Clause 3.4.2 (Confidential Information) shall survive termination, for whatever reason, of the Contract.

### **3.5. Work Execution**

#### **3.5.1. Representatives**

##### **3.5.1.1. Facilities Manager**

If the Facilities Manager is not named in the Contract, then within fourteen (14) Days of the Effective Date, KREDL shall appoint and notify the Contractor in writing of the name of the Facilities Manager. KREDL may from time to time appoint some other person as the Facilities Manager in place of the person previously so appointed, and shall give a notice of the name of such other person to the Contractor without delay. KREDL shall take reasonable care to see that no such appointment is made at such a time or in such a manner as to impede the progress of work on the Facilities. The Facilities Manager shall represent and act for KREDL at all times during the currency of the Contract.

All notices, instructions, orders, certificates, approvals and all other communications under the Contract shall be given by the Facilities Manager, except as herein otherwise provided. All notices, instructions, information and other communications given by the Contractor to KREDL under the Contract shall be given to the Facilities Manager, except as herein otherwise provided.

##### **3.5.1.2. Contractor's Representative and Construction Manager**

3.5.1.2.1. If the Contractor's Representative is not named in the Contract, then within fourteen (14) Days of the Effective Date, the Contractor shall appoint the Contractor's Representative and shall request KREDL in writing to approve the person so appointed. If KREDL makes no objection to the appointment within fourteen (14) Days, the Contractor's Representative shall be deemed to have been approved. If KREDL objects to the appointment within fourteen (14) Days giving the reason therefor, then the Contractor shall appoint a replacement within fourteen (14) Days of such objection, and the foregoing provisions of this TCC Sub-Clause herewith shall apply thereto.

3.5.1.2.2. The Contractor's Representative shall represent and act for the Contractor at all times during the currency of the Contract and shall give to the Facilities Manager all the Contractor's notices, instructions, information and all other communications under the Contract. All notices, instructions, information and all other

communications given by KREDL or the Facilities Manager to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided. The Contractor shall not revoke the appointment of the Contractor's Representative without KREDL's prior written consent, which shall not be unreasonably withheld. If KREDL consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the procedure set out in TCC Sub-Clause 3.5.1.2.1.

- 3.5.1.2.3. The Contractor's Representative may, subject to the approval of KREDL (which shall not be unreasonably withheld), at any time delegate to any person any of the powers, functions and authorities vested in him or her. Any such delegation may be revoked at any time. Any such delegation or revocation shall be subject to a prior notice signed by the Contractor's Representative, and shall specify the powers, functions and authorities thereby delegated or revoked. No such delegation or revocation shall take effect unless and until a copy thereof has been delivered to KREDL and the Facilities Manager. Any act or exercise by any person of powers, functions and authorities so delegated to him or her in accordance with this TCC Sub-Clause 3.5.1.2.3 shall be deemed to be an act or exercise by the Contractor's Representative.
- 3.5.1.2.4. Notwithstanding anything stated in TCC Sub-Clause 3.5.1.1 (Facilities Manager) and TCC Sub-Clause 3.5.1.2.1 above, for the purpose of execution of Contract, KREDL and the Contractor shall finalize and agree to a Contract Co-ordination Procedure and all the communication under the Contract shall be in accordance with such Contract Co-ordination Procedure.
- 3.5.1.2.5. From the commencement of Installation of the Facilities at the Site until Operational Acceptance, the Contractor's Representative shall appoint a suitable person as the construction manager (hereinafter referred to as "the Construction Manager"). The Construction Manager shall supervise all work done at the Site by the Contractor and shall be present at the Site throughout normal working hours except when on leave, sick or absent for reasons connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, a suitable person shall be appointed to act as his or her deputy.
- 3.5.1.2.6. KREDL may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of KREDL, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided under TCC Sub-Clause 3.5.6.3. KREDL shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.
- 3.5.1.2.7. If any representative or person employed by the Contractor is removed in accordance with TCC Sub-Clause 3.5.1.2.6, the Contractor shall, where required, promptly appoint a replacement.

### **3.5.2. Work Program**

#### **3.5.2.1. Contractor's Organization**

The Contractor shall supply to KREDL and the Facilities Manager a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities. The chart shall include the identities of the key personnel together with the curricula vitae of such key personnel to be employed within twenty one (21) Days of the Effective Date. The Contractor shall promptly inform KREDL and the Facilities Manager in writing of any revision or alteration of such an organization chart.

#### **3.5.2.2. Program of Performance**

Within fifteen (15) Days after the date of Letter of Award of Contract, the Contractor shall prepare and submit to the Facilities Manager a detailed program of performance of the Contract, made in the form of PERT network with L1, L2, L3 and up to L4 schedule and showing the sequence in which it proposes to design, manufacture, transport, assemble, install & commission the Facilities and deliver the Mandatory Spares at Site as well as the date(s) by which the Contractor reasonably requires that KREDL shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve Completion and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in Appendix 4 (Time Schedule) to the Contract Agreement and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Facilities Manager, but without modification in the Times for Completion and any extension granted in accordance with TCC Clause 3.8.1 (Extension of Time for Completion), and shall submit all such revisions to the Facilities Manager.

#### **3.5.2.3. Progress Report**

The Contractor shall monitor progress of all the activities specified in the program referred to in TCC Sub-Clause 3.5.2.2 (Program of Performance) above, and supply a progress report, **supported by photographs and videos or any other document as required by KREDL**, to the Facilities Manager **on a weekly/ fortnightly/ monthly basis as required by KREDL from time to time**. The progress report shall be in a form acceptable to the Facilities Manager and shall also indicate: (a) percentage completion achieved compared with the planned percentage completion for each activity; and (b) where any activity is behind the program, giving comments and likely consequences and stating the corrective action being taken.

#### **3.5.2.4. Progress of Performance**

If at any time the Contractor's actual progress falls behind the program referred to in TCC Sub-Clause 3.5.2.2 (Program of Performance), or it becomes apparent that it will so fall behind, the Contractor shall, at the request of KREDL or the Facilities Manager, prepare and submit to the Facilities Manager a revised program, taking into account the prevailing circumstances, and shall notify the Facilities Manager of the steps being taken to expedite progress so as to attain Completion of the Facilities within the Time for Completion under TCC Sub-Clause 0 (Time for Commencement and Completion), any extension thereof entitled under TCC Sub-Clause

3.8.1.1 (Extension of Time for Completion), or any extended period as may otherwise be agreed upon between KREDL and the Contractor.

### **3.5.2.5. Work Procedures**

The Contract shall be executed in accordance with the Contract Documents and the procedures given in the section on Forms and Procedures of the Contract Documents. If agreed between KREDL and the Contractor, the Contractor may execute the Contract in accordance with its own standard project execution plans and procedures to the extent that they do not conflict with the provisions contained in the Contract.

### **3.5.3. Sub-Contracting**

3.5.3.1. Appendix 5 (List of Approved Subcontractors) to the Contract Agreement specifies major items of supply or services and a list of approved Subcontractors against each item, including suppliers and vendors. Insofar as no Subcontractors are listed against any such item, the Contractor shall prepare a list of Subcontractors for such item for inclusion in such list. The Contractor may from time to time propose any addition to or deletion from any such list. The Contractor shall submit any such list or any modification thereto to KREDL for its approval in sufficient time so as not to impede the progress of work on the Facilities. Such approval by KREDL for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties or responsibilities under the Contract.

3.5.3.2. The Contractor shall select and employ its Subcontractors for such major items from those listed in the lists referred to in TCC Sub-Clause 3.5.3.1.

3.5.3.3. For items or parts of the Facilities not specified in Appendix 5 (List of Approved Subcontractors) to the Contract Agreement, the Contractor may employ such Subcontractors as it may select, at its discretion.

### **3.5.4. Design and Engineering**

#### **3.5.4.1. Specifications and Drawings**

3.5.4.1.1. The Contractor shall execute the basic and detailed design and the engineering work in compliance with the provisions of the Contract, or where not so specified, in accordance with good engineering practice.

3.5.4.1.2. The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Facilities Manager or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of KREDL.

3.5.4.1.3. The Contractor shall be entitled to disclaim responsibility for any design, data, drawing, specification or other document, or any modification thereof provided or designated by or on behalf of KREDL, by giving a notice of such disclaimer to the Facilities Manager.

### **3.5.4.2. Codes and Standards**

- 3.5.4.2.1. Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date on the date of Bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied after approval by KREDL.

### **3.5.4.3. Approval/Review of Technical Documents by Facilities Manager**

- 3.5.4.3.1. The Contractor shall prepare (or cause its Subcontractors to prepare) and furnish to the Facilities Manager the documents listed in Appendix 7 (List of Documents for Approval or Review) to the Contract Agreement for its approval or review as specified and as in accordance with the requirements of TCC Sub-Clause 3.5.2.2 (Program of Performance).
- 3.5.4.3.2. Any part of the Facilities covered by or related to the documents to be approved by the Facilities Manager shall be executed only after the Facilities Manager's approval thereof.
- 3.5.4.3.3. TCC Sub-Clauses 3.5.4.3.4 through 3.5.4.3.9 shall apply to those documents requiring the Facilities Manager's approval, but not to those furnished to the Facilities Manager for its review only.
- 3.5.4.3.4. Within twenty one (21) Days after receipt by the Facilities Manager of any document requiring the Facilities Manager's approval in accordance with TCC Sub-Clause 3.5.4.3.1, the Facilities Manager shall either return one copy thereof to the Contractor with its approval endorsed thereon or shall notify the Contractor in writing of its disapproval thereof and the reasons therefor and the modifications that the Facilities Manager proposes.
- 3.5.4.3.5. The Facilities Manager shall not disapprove any document, except on the grounds that the document does not comply with some specified provision of the Contract or that it is contrary to good engineering practice.
- 3.5.4.3.6. If the Facilities Manager disapproves the document, the Contractor shall modify the document and resubmit it for the Facilities Manager's approval in accordance with TCC Sub-Clause 3.5.4.3.4. If the Facilities Manager approves the document subject to modification(s), the Contractor shall make the required modification(s), and upon resubmission with the required modifications the document shall be deemed to have been approved. The procedure for submission of the documents by the Contractor and their approval by the Facilities Manager shall be discussed and finalized with the Contractor.
- 3.5.4.3.7. If any dispute or difference occurs between KREDL and the Contractor in connection with or arising out of the disapproval by the Facilities Manager of any document and/or any modification(s) thereto that cannot be settled between the Parties within a reasonable period, then such dispute or difference may be referred

to an Adjudicator for determination in accordance with TCC Sub-Clause 3.1.6.1 (Adjudicator) hereof. If such dispute or difference is referred to an Adjudicator, the Facilities Manager shall give instructions as to whether and if so, how, performance of the Contract is to proceed. The Contractor shall proceed with the Contract in accordance with the Facilities Manager's instructions, provided that if the Adjudicator upholds the Contractor's view on the dispute and if KREDL has not given notice under TCC Sub-Clause 3.1.6.1 hereof, then the Contractor shall be reimbursed by KREDL for any additional costs incurred by reason of such instructions and shall be relieved of such responsibility or liability in connection with the dispute and the execution of the instructions as the Adjudicator shall decide, and the Time for Completion shall be extended accordingly.

- 3.5.4.3.8. The Facilities Manager's approval, with or without modification of the document furnished by the Contractor, shall not relieve the Contractor of any responsibility or liability imposed upon it by any provisions of the Contract except to the extent that any subsequent failure results from modifications required by the Facilities Manager.
- 3.5.4.3.9. The Contractor shall not depart from any approved document unless the Contractor has first submitted to the Facilities Manager an amended document and obtained the Facilities Manager's approval thereof, pursuant to the provisions of this TCC Sub-Clause 3.5.4.3.

### **3.5.5. Procurement**

#### **3.5.5.1. Plant and Equipment**

The Contractor shall procure and transport all the Plant and Equipment in an expeditious and orderly manner to the Site for completion of the Facilities.

#### **3.5.5.2. Transportation**

- 3.5.5.2.1. The Contractor shall at its own risk and expense transport all the Plant and Equipment and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances.
- 3.5.5.2.2. Unless otherwise provided in the Contract, the Contractor shall be entitled to select any safe mode of transport operated by any person to carry the Plant and Equipment and the Contractor's Equipment.
- 3.5.5.2.3. Upon despatch of each shipment of the Plant and Equipment and the Contractor's Equipment, the Contractor shall notify KREDL by courier, post or by email followed by post confirmation of the description of the Plant and Equipment and of the Contractor's Equipment, the point and means of dispatch, and the estimated time and point of arrival in the country where the Site is located, if applicable, and at the Site. The Contractor shall furnish KREDL with relevant shipping documents to be agreed upon between the Parties.

3.5.5.2.4. The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the Plant and Equipment and the Contractor's Equipment to the Site. KREDL shall use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless KREDL from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the Plant and Equipment and the Contractor's Equipment to the Site.

### 3.5.5.3. **Customs Clearance**

The Contractor shall, at its own expense, handle all imported Plant and Equipment including Spares and Contractor's Equipment at the point(s) of import and shall handle any formalities for customs clearance, including liability for port charges etc., provided that if applicable laws or regulations require any application or act to be made by or in the name of KREDL, KREDL shall take all necessary steps to comply with such laws or regulations.

## 3.5.6. **Installation**

### 3.5.6.1. **Setting Out/Supervision/Labor**

3.5.6.1.1. **Bench Mark:** The Contractor shall be responsible for the true and proper setting out of the Facilities in relation to Bench Marks, reference marks and lines provided to it in writing by or on behalf of KREDL. If, at any time during the progress of installation of the Facilities, any error shall appear in the position, level or alignment of the Facilities, the Contractor shall forthwith notify the Facilities Manager of such error and, at its own expense, immediately rectify such error to the reasonable satisfaction of the Facilities Manager. If such error is based on incorrect data provided in writing by or on behalf of KREDL, the expense of rectifying the same shall be borne by KREDL.

3.5.6.1.2. **Contractor's Supervision:** The Contractor shall give or provide all necessary superintendence during the installation of the Facilities, and the Construction Manager or its deputy shall be constantly on the Site to provide full-time superintendence of the installation. The Contractor shall provide and employ only technical personnel who are skilled and experienced in their respective callings and supervisory staff who are competent to adequately supervise the work at hand.

#### 3.5.6.1.3. Labour:

(a) The Contractor shall provide and employ on the Site in the Installation of the Facilities such skilled, semiskilled and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills.

(b) Unless otherwise provided in the Contract, the Contractor shall be responsible for the recruitment, transportation,

accommodation and catering of all labor, local or expatriate, required for the execution of the Contract and for all payments in connection therewith.

(c) The Contractor shall be responsible for obtaining all necessary permit(s) and/or visa(s) from the appropriate authorities for the entry of all labor and personnel to be employed on the Site into the country where the Site is located.

(d) The Contractor shall at its own expense provide the means of repatriation to all of its and its Subcontractor's personnel employed on the Contract at the Site to their various home countries. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure.

In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, KREDL may provide the same to such personnel and recover the cost of doing so from the Contractor.

(e) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst its employees and the labor of its Subcontractors.

(f) The Contractor shall, in all dealings with its labor and the labor of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious or other customs and all local laws and regulations pertaining to the employment of labor.

### **3.5.6.2. Contractor's Equipment**

3.5.6.2.1. All Contractor's Equipment brought by the Contractor onto the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Facilities Manager's consent that such Contractor's Equipment is no longer required for the execution of the Contract.

3.5.6.2.2. Unless otherwise specified in the Contract, upon completion of the Facilities, the Contractor shall remove from the Site all Equipment brought by the Contractor onto the Site and any surplus materials remaining thereon.

3.5.6.2.3. KREDL will, if requested, use its best endeavors to assist the Contractor in obtaining any local, state or national government permission required by the Contractor for the export of the Contractor's Equipment imported by the Contractor for use in the execution of the Contract that is no longer required for the execution of the Contract.

### **3.5.6.3. Site Regulations and Safety**

KREDL and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall

comply therewith. The Contractor shall prepare and submit to KREDL, with a copy to the Facilities Manager, proposed Site regulations for KREDL's approval, which approval shall not be unreasonably withheld.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Facilities, gate control, sanitation, medical care, and fire prevention.

#### **3.5.6.4. Opportunities for Other Contractors**

- 3.5.6.4.1. The Contractor shall, upon written request from KREDL or the Facilities Manager, give all reasonable opportunities for carrying out the work to any other contractors employed by KREDL on or near the Site.
- 3.5.6.4.2. If the Contractor, upon written request from KREDL or the Facilities Manager, makes available to other contractors any roads or ways the maintenance for which the Contractor is responsible, permits the use by such other contractors of the Contractor's Equipment, or provides any other service of whatsoever nature for such other contractors, KREDL shall fully compensate the Contractor for any loss or damage caused or occasioned by such other contractors in respect of any such use or service, and shall pay to the Contractor reasonable remuneration for the use of such equipment or the provision of such services.
- 3.5.6.4.3. The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Facilities Manager shall determine the resolution of any difference or conflict that may arise between the Contractor and other contractors and the workers of KREDL in regard to their work.
- 3.5.6.4.4. The Contractor shall notify the Facilities Manager promptly of any defects in the other Contractors' work that come to its notice, and that could affect the Contractor's work. The Facilities Manager shall determine the corrective measures, if any, required to rectify the situation after inspection of the Facilities. Decisions made by the Facilities Manager shall be binding on the Contractor.

#### **3.5.6.5. Emergency Work**

If, by reason of an emergency arising in connection with and during the execution of the Contract, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Facilities, the Contractor shall immediately carry out such work.

#### **3.5.6.6. Site Clearance**

- 3.5.6.6.1. Site Clearance in Course of Performance: In the course of carrying out the Contract, the Contractor shall keep the Site

reasonably free from all unnecessary obstruction, store or remove any surplus materials, clear away any wreckage, rubbish or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.

- 3.5.6.6.2. Clearance of Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site and Facilities clean and safe.

#### **3.5.6.7. Watching and Lighting**

The Contractor shall provide and maintain at its own expense all lighting, fencing, compound boundary wall, watch towers and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.

#### **3.5.6.8. Work at Night and on Holidays**

- 3.5.6.8.1. Unless otherwise provided in the Contract, no work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of KREDL, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property or loss in generation due to shut down of the Facilities, when the Contractor shall immediately advise the Facilities Manager, provided that provisions of this TCC Sub-Clause 3.5.6.8.1 shall not apply to any work which is customarily carried out by rotary or double-shifts.
- 3.5.6.8.2. Notwithstanding TCC Sub-Clause 3.5.6.8.1 or 3.5.6.1.3, if and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests KREDL's consent thereto, KREDL shall not unreasonably withhold such consent.

#### **3.5.7. Test and Inspection**

- 3.5.7.1. The Contractor shall at its own expense carry out at the place of manufacture and/or on the Site all such tests and/or inspections of the Plant and Equipment and any part of the Facilities as are specified in the Contract.
- 3.5.7.2. The Facilities Manager or their designated representatives shall be entitled to attend the aforesaid Test and Inspection, provided that Contractor shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all traveling and boarding & lodging expenses.
- 3.5.7.3. Whenever the Contractor is ready to carry out any such Test and Inspection, the Contractor shall give a reasonable advance notice of such Test and Inspection and of the place and time thereof to the Facilities Manager. The Contractor shall obtain from any relevant third Party or manufacturer any necessary permission or consent to enable KREDL and the Facilities Manager (or their designated representatives) to attend the Test and Inspection.

- 3.5.7.4. The Contractor shall provide the Facilities Manager with a certified report of the results of any such Test and Inspection. If KREDL or Facilities Manager (or their designated representatives) fails to attend the Test and Inspection, or if it is agreed between the Parties that such persons shall not do so, then the Contractor may proceed with the Test and Inspection in the absence of such persons, and shall provide the Facilities Manager with a certified report of the results thereof.
  - 3.5.7.5. If any Plant and Equipment or any part of the Facilities fails to pass any Test and Inspection, the Contractor shall either rectify or replace such Plant and Equipment or part of the Facilities and shall repeat the Test and Inspection upon giving a notice under TCC Sub-Clause 3.5.7.3.
  - 3.5.7.6. If any dispute or difference of opinion shall arise between the Parties in connection with or arising out of the test and/ or inspection of the Plant and Equipment or part of the Facilities that cannot be settled between the Parties within a reasonable period of time, it may be referred to the Adjudicator for determination in accordance with TCC Sub- Clause 3.1.6.1 (Adjudicator).
  - 3.5.7.7. The Contractor agrees that neither the execution of a Test and Inspection of Plant and Equipment or any part of the Facilities, nor the attendance by KREDL or the Facilities Manager, nor the issue of any test certificate pursuant to TCC Sub-Clause 3.5.7.4, shall release the Contractor from any other responsibilities under the Contract.
  - 3.5.7.8. No part of the Facilities or foundations shall be covered up on the Site without the Contractor carrying out any Test and Inspection required under the Contract. The Contractor shall give a reasonable notice to the Facilities Manager whenever any such part of the Facilities or foundations are ready or about to be ready for Test and Inspection; such Test and Inspection and notice thereof shall be subject to the requirements of the Contract.
  - 3.5.7.9. The Contractor shall uncover any part of the Facilities or foundations, or shall make openings in or through the same as the Facilities Manager may from time to time require at the Site, and shall reinstate and make good such part or parts.
  - 3.5.7.10. If any part of the Facilities or foundations have been covered up at the Site after compliance with the requirement of TCC Sub- Clause 3.5.7.8 and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating, and making good the same shall be borne by KREDL, and the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been delayed or impeded in the performance of any of its obligations under the Contract.
- 3.5.8. Commissioning and Completion of the Facilities**
- 3.5.8.1. As soon as Installation of the Facilities or any part thereof has, in the opinion of the Contractor, been completed operationally and structurally and put in a tight and clean condition as specified in the Technical Specifications, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify KREDL in writing.

- 3.5.8.2. Within seven (7) Days after receipt of the notice from the Contractor under TCC Sub-Clause 3.5.8.1, KREDL shall nominate Facilities Manager to witness the pre commissioning tests of the facilities or any part thereof.
  - 3.5.8.3. As soon as reasonably practicable after the Facilities Manager has been nominated by KREDL, the Contractor shall commence Pre-commissioning of the Facilities or the relevant part thereof in preparation for Commissioning.
  - 3.5.8.4. As soon as all works in respect of Pre-commissioning are completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall commence Commissioning of the Facilities. As soon as Commissioning is satisfactorily completed, the Contractor shall so notify the Facilities Manager in writing.
  - 3.5.8.5. Commissioning of the Facilities or any part thereof shall be completed by the Contractor as per procedures detailed in the Technical Specifications.
  - 3.5.8.6. The Facilities Manager shall, within seven (7) Days after receipt of the Contractor's notice under TCC Sub-Clause 3.5.8.4, either issue a Completion Certificate in the form specified in Section-VI (Forms and Procedures) of the RFP, stating that the Facilities have reached Completion as at the date of the Contractor's notice under TCC Sub-Clause 3.5.8.4, or notify the Contractor in writing of any defects and/or deficiencies.
  - 3.5.8.7. If the Facilities Manager notifies the Contractor of any defects and/or deficiencies, the Contractor shall then correct such defects and/or deficiencies, and shall repeat the procedure described in TCC Sub-Clause 3.5.8.4.
  - 3.5.8.8. If the Facilities Manager is satisfied that the Facilities or that part thereof have reached Completion, the Facilities Manager shall, within seven (7) Days after receipt of the Contractor's repeated notice, issue a Completion Certificate stating that the Facilities have reached Completion as at the date of the Contractor's repeated notice.
  - 3.5.8.9. If the Facilities Manager is not so satisfied, then he shall notify the Contractor in writing of any defects and/or deficiencies within seven (7) Days after receipt of the Contractor's repeated notice, and the above procedure shall be repeated until the correction of such defects and/or deficiencies.
  - 3.5.8.10. As soon as possible after Completion, the Contractor shall complete all outstanding minor items so that the Facilities are fully in accordance with the requirements of the Contract, failing which KREDL will undertake such completion and deduct the costs thereof from any monies owing to the Contractor.
  - 3.5.8.11. Upon Completion of O and M period, KREDL shall be responsible for the care and custody of the Facilities or the relevant part thereof. Prior to completion of O and M period, the Contractor shall be responsible for the care and custody of the Facilities or the relevant part thereof together with the risk of loss or damage thereto.
- 3.5.9. Guarantee Tests and Operational Acceptance**
- 3.5.9.1. Guarantee Test**

- 3.5.9.1.1. The Guarantee Test (and repeats thereof) shall be conducted by the Contractor after completion of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can attain the Technical Specification specified in the Contract Documents. The Contractor's and Facilities Manager's personnel shall attend the Guarantee Test. KREDL shall promptly provide the Contractor with such information as the Contractor may reasonably require in relation to the conduct and results of the Guarantee Test (and any repeats thereof).
- 3.5.9.1.2. If for reasons attributable to KREDL, the Guarantee Test of the Facilities cannot be successfully completed within the period from the date of Completion of the respective Facilities or any other period agreed upon by KREDL and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Technical Specification, and TCC Sub-Clauses 3.6.3.3 shall not apply.
- 3.5.9.1.3. The Guaranteed Tests or Pre-Commissioning Tests are covered in Vol II of this RFP.

### **3.5.9.2. Operational Acceptance**

- 3.5.9.2.1. Operational Acceptance shall occur in respect of the Facilities or when
  - (a) the Plant is providing Generation corresponding to the CUF for the Month to be calculated on pro rata basis, for a continuous period of fifteen (15) Days from the date of Commissioning of Facilities. In this regard, the Bidder shall demonstrate and prove the Generation corresponding to the CUF for the Month, for a continuous period of fifteen (15) Days from the date of Commissioning of Facilities.
  - (b) the Guarantee Test has been successfully completed and the Technical Specification are met; or
  - (c) the Guarantee Test has not been successfully completed or has not been carried out for reasons attributable to KREDL within the period from the date of Completion or any other agreed upon period as specified in TCC Sub Clause above, but successful Completion of the Facilities has been achieved; or
  - (d) the Contractor has paid the liquidated damages specified in TCC Sub-Clause 3.6.3.3 hereof; and
  - (e) any minor items mentioned in TCC Sub-Clause 3.5.8.10 hereof relevant to the Facilities have been completed.
- 3.5.9.2.2. At any time after any of the events set out in TCC Sub-Clause 3.5.9.2.1 have occurred, the Contractor may give a notice to the Facilities Manager requesting for issue of an Operational Acceptance Certificate in the form provided in the RFP or in another form acceptable to KREDL in respect of the Facilities specified in such notice as at the date of such notice.
- 3.5.9.2.3. The Facilities Manager shall, after consultation with KREDL, and within fifteen (15) Days after receipt of the Contractor's notice, issue an Operational Acceptance Certificate.

3.5.9.2.4. Mere issue of Operational Acceptance certificate by KREDL will not relieve the contractor in executing and performing the O and M related activities until completion of twelve (12) years from the date of Operational Acceptance at his cost and risk.

### **3.6. Guarantees and Liabilities**

#### **3.6.1. Completion Time Guarantee**

- 3.6.1.1.1. The Contractor guarantees that it shall attain Completion of the Facilities within the Time for Completion specified pursuant to TCC Sub-Clause 3.2.2.2 or within such extended time to which the Contractor shall be entitled under TCC Clause 3.8.1 (Extension of Time for Completion) hereof.
- 3.6.1.1.2. If the Contractor fails to attain successful Completion of the Facilities within the Time for Completion or any extension thereof under TCC Clause 3.8.1 (Extension of Time for Completion), the Contractor shall pay to KREDL Liquidated Damages in the amount computed as per the provisions set out below:

#### **Delay Liquidated Damages:**

If the Contractor is unable to achieve Operational Acceptance within a time stipulated in definition of Section-III Terms and Conditions of Contract from the Effective Date, the Contractor shall pay to KREDL, Liquidated Damages for the delay in achieving Operational Acceptance as per the following:

- For the delay up to one (1) month an amount equivalent to 20% (twenty percent) of the Performance Security.
- For the delay of more than one (1) month and upto two (2) months an amount equivalent to 40% (forty percent) of the total Performance Security.
- For the delay of more than two and upto three (3) months an amount equivalent to 40% (forty percent) of the Performance Security.

For avoidance of doubt, in the event of failure to pay the above-mentioned damages by the Contractor entitles KREDL to encash the Performance Security.

In case the Contractor delays the achievement of Operational Acceptance beyond 3 (three) months, the Contractor shall pay to KREDL, the Liquidated Damages at rate of INR 50,000/- (Rupees Fifty Thousand only) per MW per day (for both Solar PV and BESS) of delay for the delay in achieving such Operational Acceptance. Provided that the Contractor shall be required to make such payments to KREDL in advance on a week to week basis for the period of delay.

The maximum time period allowed for achievement of Operational Acceptance with payment of Liquidated Damages shall be limited to 17(seventeen) Months from the Effective Date. In case, the achievement of Operational Acceptance is delayed beyond 17(seventeen) Months from the Effective Date, it shall be considered as a Contractor's Event of Default and the Contract may be terminated.

The maximum liability of the Bidder under Delay Liquidated Damages will be limited to 10% (ten percent) of the total Contract Price, agreed in the Final Price Bid.

In case the Bidder fails to execute the Facility within a maximum timeline of 12 (twelve) Months from the Effective Date, then the Bidder may get an extension in the timelines as approved and allowed by KERC. Further, in case the Bidder fails to execute the Facility within the extended timelines then the Bidder shall be blacklisted/debarred/ suspended from providing any further services to KREDL along with a notice circulated to the power utilities of Karnataka, Energy Department and Government of Karnataka.

**Performance Liquidated Damage:**

Post Operational Acceptance and until the expiry of O&M Period, the Bidder shall meet the generation equivalent to minimum AC CUF for 21% (Twenty One percent). In case Bidder is not able meet the minimum AC CUF of 21% (Twenty One percent), then the Bidder shall be liable to pay a liquidated damage to compensate for the energy loss during the yearly O&M Period ("Performance Liquidated Damages").

**Performance Liquidated Damages = Loss in Energy during O&M Period for a year as per CUF target of 21.0% (Twenty One percent) x22 INR per kWh**

The maximum liability of the Bidder under Performance Liquidated Damages will be limited to 10% (ten percent) of the total Contract Price, agreed in the Final Price Bid for the first 2 (two) years and then the maximum liability of the Bidders under Performance Liquidated Damages will be limited to 100% (one hundred percent) of the corresponding annual O&M Price until the expiry of the O&M Period of 12 (twelve) years from the date of Operational Acceptance.

The Parties agree that the Delay Liquidated Damages and Performance Liquidated Damages are a genuine pre-estimate of damages and losses to be suffered by the Owner. The amount of Delay Liquidated Damages and Performance Liquidated Damages specified herein represent the projected commercial losses and damages that shall be suffered by the Owner and are fair and reasonable and are not penalties.

- 3.6.1.1.3. Such payment shall completely satisfy the Contractor's obligation to attain Completion of the Facilities within the Time for Completion or any extension thereof under TCC Clause 3.8.1 (Extension of Time for Completion). The Contractor shall have no further liability whatsoever to KREDL in respect thereof.
- 3.6.1.1.4. However, the payment of liquidated damages shall not in any way relieve the Contractor from any of its obligations to complete the Facilities and liabilities of the Contractor under the Contract.
- 3.6.1.1.5. Save for liquidated damages payable under this TCC Sub-Clause 3.6.1.1.2, the failure by Contractor to attain any milestone or other act, matter or thing by any date specified in Appendix 4 (Time Schedule) to the Contract Agreement and/or other program of work prepared pursuant to TCC Clause 3.5.2 (Program of Performance) shall not

render the Contractor liable for any loss or damage thereby suffered by KREDL.

- 3.6.1.1.6. No bonus will be given for earlier completion of the Facilities.

### 3.6.2.

#### **Defect Liability**

- 3.6.2.1.1. The Contractor warrants that the Facilities shall be free from defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed.
- 3.6.2.1.2. The Defect Liability Period shall be **twelve (12) Years** from the date of Operational Acceptance of the Facilities
- 3.6.2.1.3. KREDL shall give the Contractor a notice stating the nature of any such defect together with all available evidence thereof, promptly following the discovery thereof.
- 3.6.2.1.4. The Contractor may, with the consent of KREDL, remove from the Site any Plant and Equipment or any part of the Facilities that are defective, if the nature of the defect and/or any damage to the Facilities caused by the defect is such that repairs cannot be expeditiously carried out at the Site.
- 3.6.2.1.5. If the repair, replacement or making good is of such a nature that it may affect the efficiency of the Facilities, KREDL may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests.
- 3.6.2.1.6. If such part fails the tests, the Contractor shall carry out further repair, replacement or making good (as the case may be) until that part of the Facilities passes such tests. The tests, in character, shall in any case be not inferior to what has already been agreed upon by KREDL and the Contractor for the original Equipment/part of the Facilities.
- 3.6.2.1.7. If the Contractor fails to commence and complete the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time of 48 (forty-eight) hours or may be extended based on the justification provided by the Contractor and at the discretion of KREDL. In case if the contractor fails to rectify the defect within said period of 48 hours, the contractor shall be penalized @ Rs.25,000/per day per MW subject to maximum of 1 month beyond which, the contractor is liable of penalty payment of Rs.1,25,000/- per MW Per day..  
  
If the Facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities shall be extended by a period equal to the period during which the Facilities cannot be used by KREDL because of any of the aforesaid reasons. Upon correction of the defects in the Facilities by repair/replacement, such repair/replacement **shall be also covered under Defect Liability Period**
- 3.6.2.1.8. At the end of the Defect Liability Period, the Contractor liability ceases except for latent defects. The Contractor's liability for latent defects

warranty for the Plant and Equipment including Spares shall be limited to a period of twelve (12) Years from the date of Operational Acceptance. For the purpose of this clause, the latent defects shall be the defects inherently lying within the material or arising out of design deficiency which do not manifest themselves during the Defect Liability Period as defined in this TCC Clause 3.6.2, but later during O&M Period.

- 3.6.2.1.9. Except as provided in TCC Clauses 3.6.2 and 3.7.3 (Loss of or Damage to Property / Accident or Injury to Workers/ Indemnification), the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities, the Plant and Equipment, design or engineering or work executed that appear after Completion of the Facilities, except where such defects are the result of the gross negligence, fraud, criminal or wilful action of the Contractor.
- 3.6.2.1.10. In addition, the Contractor shall also provide an extended warranty for any such component of the Facilities. Such obligation shall be in addition to the defect liability specified under TCC Sub-Clause 3.6.2.1.2.

### 3.6.3.

#### **Technical Specification**

- 3.6.3.1. The Contractor guarantees that during the Guarantee Test, the Facilities and all parts thereof shall attain the Technical Specification specified in Appendix 8 (Technical Specification) to the Contract Agreement, subject to and upon the conditions therein specified.
- 3.6.3.2. If, for reasons attributable to the Contractor, the guaranteed level of the Technical Specification specified in Appendix 8 (Technical Specification) to the Contract Agreement are not met either in whole or in part, the Contractor shall, within a mutually agreed time, at its cost and expense make such changes, modifications and/or additions to the Plant or any part thereof as may be necessary to meet such Guarantees. The Contractor shall notify KREDL upon completion of the necessary changes, modifications and/or additions, and shall seek KREDL's consent to repeat the Guarantee Test. If the specified Technical Specification are not established even during the repeat of the Guarantee Test, KREDL may at its option, either
  - (a) Reject the Equipment and recover the payments already made, or
  - (b) Terminate the Contract pursuant to TCC Sub-Clause 3.8.3.2.2 and recover the payments already made, or
  - (c) Accept the Plant and Equipment after levy of liquidated damages in accordance with the provisions specified in Appendix-8 (Technical Specification) to the contract agreement.
- 3.6.3.3. In case KREDL exercises its option to accept the Plant and Equipment after levy of liquidated damages, the payment of liquidated damages under TCC Sub-Clause 3.6.3.2, up to the limitation of liability specified, shall completely satisfy the Contractor's guarantees under TCC Sub-Clause 3.6.3.2 and the Contractor shall have no further liability whatsoever to KREDL in respect thereof. Upon the payment of such

liquidated damages by the Contractor, the Facilities Manager shall issue the Operational Acceptance Certificate for the Facilities in respect of which the liquidated damages have been so paid.

#### **3.6.4. Patent Indemnity**

- 3.6.4.1.1. The Contractor shall, subject to KREDL's compliance with TCC Sub-Clause 3.6.4.1.2, indemnify and hold harmless KREDL and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which KREDL may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facilities by the Contractor or the use of the Facilities in the country where the Site is located; and (b) the sale of the products produced by the Facilities in any country. Such indemnity shall not cover any use of the Facilities or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract, any infringement resulting from the use of the Facilities or any part thereof, or any products produced thereby in association or combination with any other equipment, plant or materials not supplied by the Contractor, pursuant to the Contract Agreement.
- 3.6.4.1.2. If any proceedings are brought or any claim is made against KREDL arising out of the matters referred to in TCC Sub-Clause 3.6.4.1.1, KREDL shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in KREDL's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Contractor fails to notify KREDL within twenty eight (28) Days after receipt of such notice that it intends to conduct any such proceedings or claim, then KREDL shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify KREDL within the twenty eight (28) Day period, KREDL shall make no admission that may be prejudicial to the defense of any such proceedings or claim. KREDL shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.
- 3.6.4.1.3. KREDL shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of KREDL.

#### **3.6.5. Limitation of Liability**

- 3.6.5.1. Except in cases of criminal negligence or willful misconduct,

(a) the Contractor shall not be liable to KREDL, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss

of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to KREDL, and

(b) the aggregate liability of the Contractor to KREDL, whether under the Contract, in tort or otherwise, shall not exceed the total Contract Price, provided that this limitation shall not apply to any obligation of the Contractor to indemnify KREDL with respect to patent infringement.

### **3.7. Risk Distribution**

#### **3.7.1. Transfer of Ownership**

- 3.7.1.1. Ownership of the Plant and Equipment (including Mandatory Spares) to be imported into the country where the Site is located shall be transferred to KREDL upon loading on to the mode of transport to be used to convey the Plant and Equipment (including Spares) from the country of origin to that country and upon endorsement of the despatch documents in favour of KREDL.
- 3.7.1.2. Ownership of the Plant and Equipment (including Spares) procured in the country where the Site is located shall be transferred to KREDL when the Plant and Equipment (including spare parts) are loaded on to the mode of transport to be used to convey the Plant and Equipment (including Spares) from the works to the site and upon endorsement of the despatch documents in favour of KREDL.
- 3.7.1.3. Ownership of the Contractor's Equipment used by the Contractor and its Subcontractors in connection with the Contract shall remain with the Contractor or its Subcontractors.
- 3.7.1.4. Ownership of any Plant and Equipment in excess of the requirements for the Facilities shall revert to the Contractor upon Completion of the Facilities or at such earlier time when KREDL and the Contractor agree that the Plant and Equipment in question are no longer required for the Facilities, provided quantity of any Plant and Equipment specifically stipulated in the Contract shall be the property of KREDL whether or not incorporated in the Facilities.
- 3.7.1.5. Notwithstanding the transfer of ownership of the Plant and Equipment, the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor pursuant to TCC Clause 3.7.2 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant and Equipment are incorporated.
- 3.7.1.6. In case of two/three Contracts entered into between KREDL and the Contractor as per TCC Sub-Clause 3.1.3.5 or where KREDL hands over its Equipment to the Contractor for executing the Contract, then the Contractor shall, at the time of taking delivery of the Equipment through Bill of Lading or other dispatch documents, furnish Trust Receipt for Plant, Equipment and Materials and also execute an Indemnity Bond in favour of KREDL for keeping the equipment in safe custody and to utilize the same exclusively for the purpose of the said Contract. The Trust Receipt and Indemnity Bond shall be furnished as per proforma enclosed in Section IV (Forms and Procedures). KREDL shall also issue a separate Authorization Letter to the Contractor to enable him to take physical

delivery of plant, equipment and materials from KREDL as per proforma enclosed under Section-VII (Forms and Procedures).

### 3.7.2.

#### **Care of Facilities**

- 3.7.2.1. The Contractor shall be responsible for the care and custody of the Facilities until the date of Operational Acceptance of the Facilities pursuant to TCC Clause 3.5.9.2 (Operational Acceptance) and subsequently until the expiry of the O&M Period of 12 (twelve) Years from the date of Operational Acceptance and shall make good at its own cost any loss or damage that may occur to the Facilities from any cause whatsoever during such period. The Contractor shall also be responsible for any loss or damage to the Facilities caused by the Contractor or its Subcontractors in the course of any work carried out pursuant to TCC Clause 3.6.2 (Defect Liability). Notwithstanding the foregoing, the Contractor shall not be liable for any loss or damage to the Facilities or that part thereof caused by reason of any of the matters specified or referred to in paragraphs (a), (b) and (c) of TCC Sub-Clauses 3.7.2.2 and 3.7.8.1.
- 3.7.2.2. If any loss or damage occurs to the Facilities or to the Contractor's temporary facilities by reason of
  - (a) (insofar as they relate to the country where the Site is located) nuclear reaction, nuclear radiation, radioactive contamination, pressure wave caused by aircraft or other aerial objects, or any other occurrences that an experienced contractor could not reasonably foresee, or if reasonably foreseeable could not reasonably make provision for or insure against, insofar as such risks are not normally insurable in the insurance market and are mentioned in the general exclusions of the policy of insurance, including War Risks and Political Risks, taken out under TCC Clause 3.7.4 (Insurance) hereof
  - (b) any use or occupation by KREDL or any third Party (other than a Subcontractor) authorized by KREDL of any part of the Facilities
  - (c) any use of or reliance upon any design, data or specification provided or designated by or on behalf of KREDL, or any such matter for which the Contractor has disclaimed responsibility herein.
- 3.7.2.3. The Contractor shall be liable for any loss of or damage to any Contractor's Equipment, or any other property of the Contractor used or intended to be used for purposes of the Facilities, except (i) as mentioned in TCC Sub-Clause 3.7.2.2 (with respect to the Contractor's temporary facilities), and (ii) where such loss or damage arises by reason of any of the matters specified in TCC Sub-Clauses 3.7.2.2 (b) and (c) and 3.7.8.1
- 3.7.2.4. With respect to any loss or damage caused to the Facilities or any part thereof or to the Contractor's Equipment by reason of any of the matters specified in TCC Sub-Clause 3.7.8.1, the provisions of TCC Sub-Clause 3.7.8.3 shall apply.

### **3.7.3. Loss of Damage to Property; Accident or Injury to Workers; Indemnification**

- 3.7.3.1.** Subject to TCC Sub – Clause 3.7.3.3, the Contractor shall indemnify and hold harmless KREDL and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, in respect of the death or injury of any person or loss of or damage to any property (other than the Facilities whether accepted or not), arising in connection with the supply and installation of the Facilities and by reason of the negligence of the Contractor or its Subcontractors, or their employees, officers or agents, except any injury, death or property damage caused by the negligence of KREDL, its contractors, employees, officers or agents.
- 3.7.3.2.** If any proceedings are brought or any claim is made against KREDL that might subject the Contractor to liability under TCC Sub-Clause 3.7.3.1, KREDL shall promptly give the Contractor a notice thereof and the Contractor shall at its own expense and in KREDL's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Contractor fails to notify KREDL within twenty-eight (28) Days after receipt of such notice that it intends to conduct any such proceedings or claim, then KREDL shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify KREDL within the twenty-eight (28) day period, KREDL shall make no admission that may be prejudicial to the defense of any such proceedings or claim. KREDL shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.
- 3.7.3.3.** KREDL shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from any liability for loss of or damage to property of KREDL, other than the Facilities not yet taken over, that is caused by fire, explosion or any other perils, in excess of the amount recoverable from insurances procured under TCC Clause 3.7.4 (Insurances), provided that such fire, explosion or other perils were not caused by any act or failure of the Contractor.
- 3.7.3.4.** The Party entitled to the benefit of an indemnity under this TCC Clause 3.7.3 shall take all reasonable measures to mitigate any loss or damage which has occurred. If the Party fails to take such measures, the other Party's liabilities shall be correspondingly reduced.

### **3.7.4. Insurance**

- 3.7.4.1.** To the extent specified in Appendix 3 (Insurance Requirements) to the Contract Agreement, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified in the said Appendix. The identity of the insurers and the form of the policies shall be subject to the approval of KREDL, who should not unreasonably withhold such approval.

- (a) **Marine,Cargo Insurance During Transport:** Covering loss or damage occurring while in transit from the Contractor's or Subcontractor's works or stores until arrival at the Site, to the Plant and Equipment (including spare parts therefor) and to the Contractor's Equipment.
  - (b) **Installation All Risks Insurance:** Covering physical loss or damage to the Facilities at the Site, occurring prior to Completion of the Facilities, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the Defect Liability Period.
  - (c) **Third Party Liability Insurance:** Covering bodily injury or death suffered by third Parties (including KREDL's personnel) and loss of or damage to property occurring in connection with the supply and installation of the Facilities.
  - (d) **Automobile Liability Insurance:** Covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the execution of the Contract.
  - (e) **Workers' Compensation:** In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed.
  - (g) **Other Insurances:** Such other insurances as may be specifically agreed upon by the Parties hereto as listed in the said Appendix 3.
- 3.7.4.2. KREDL shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to TCC Sub-Clause 3.7.4.1, except for the Third Party Liability, Workers' Compensation and KREDL's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to TCC Sub-Clause 3.7.4.1 except for the Cargo Insurance During Transport, Workers' Compensation and KREDL's Liability Insurances. 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.
- 3.7.4.3. The Contractor shall, in accordance with the provisions of Appendix 3 (Insurance Requirements) to the Contract Agreement, deliver to KREDL certificates of insurance (or copies of the insurance policies) as evidence that the required policies are in full force and effect. The certificates shall provide that no less than twenty-one (21) Days' notice shall be given to KREDL by insurers prior to cancellation or material modification of a policy.
- 3.7.4.4. The Contractor shall ensure that, where applicable, its Subcontractor(s) shall take out and maintain in effect adequate insurance policies for their personnel and vehicles and for work executed by them under the Contract, unless such Subcontractors are covered by the policies taken out by the Contractor.

- 3.7.4.5. KREDL shall at its expense take out and maintain in effect during the performance of the Contract those insurances which are specified in Appendix 3 (Insurance Requirements) to the Contract Agreement.
- 3.7.4.6. If the Contractor fails to take out and/or maintain in effect the insurances referred to in TCC Sub-Clause 3.7.4.1, KREDL may take out and maintain in effect any such insurances and may from time to time deduct from any amount due to the Contractor under the Contract any premium that KREDL shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Contractor. If KREDL fails to take out and/or maintain in effect the insurances referred to in TCC 3.7.4.4, the Contractor may take out and maintain in effect any such insurances and may from time to time deduct from any amount due to KREDL under the Contract any premium that the Contractor shall have paid to the insurer, or may otherwise recover such amount as a debt due from KREDL. If the Contractor fails to or is unable to take out and maintain in effect any such insurances, the Contractor shall nevertheless have no liability or responsibility towards KREDL, and the Contractor shall have full recourse against KREDL for any and all liabilities of KREDL herein.
- 3.7.4.7. Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all and any claims made under the policies effected by it pursuant to this TCC Clause 3.7.4 and the monies payable by any insurers shall be paid to the Contractor as per the procedure outlined in TCC Sub- Clause 3.7.4.7 below. KREDL shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance claims in which KREDL's interest is involved, the Contractor shall not give any release or make any compromise with the insurer without the prior written consent of KREDL. With respect to insurance claims in which the Contractor's interest is involved, KREDL shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor.
- 3.7.4.8. (i) Wherever total damages/loss of equipment/material would occur, the Contractor will be entitled to payment of all amounts received from the underwriters except the following amounts:
- (a) The amount paid to the Contractor under the Contract in respect of equipment/material damaged/lost, excluding the pro-rata initial advance but including the entire amount of escalation, if any, already paid to the Contractor.
  - (b) Custom Duties, Excise duty and other taxes and duties which have already been paid by KREDL.
- In the event the claim money settled is less than the total of the amounts in a & b above, then the entire claim money settled will be retained by KREDL and the Contractor will forthwith pay KREDL the short fall amount between the claim money and the total of amounts as per a & b mentioned above. Subsequent payments, if any, due under the Contract shall be regulated by the relevant terms of payment.
- (ii) In case of partial damage to any equipment/material during any stage, upon rectification of the damaged equipment/material to the satisfaction

of KREDL, the Contractor shall be paid to the extent of claims settled by the underwriters.

### 3.7.5. **Unforeseen Conditions**

- 3.7.5.1. If, during the execution of the Contract, the Contractor shall encounter on the Site any physical conditions (other than climatic conditions) or artificial obstructions that could not have been reasonably foreseen prior to the date of the Contract Agreement by an experienced contractor on the basis of reasonable examination of the data relating to the Facilities (including any data as to boring tests) provided by KREDL, and on the basis of information that it could have obtained from a visual inspection of the Site (if access thereto was available) or other data readily available to it relating to the Facilities, and if the Contractor determines that it will in consequence of such conditions or obstructions incur additional cost and expense or require additional time to perform its obligations under the Contract that would not have been required if such physical conditions or artificial obstructions had not been encountered, the Contractor shall promptly, and before performing additional work or using additional Plant and Equipment or Contractor's Equipment, notify the Facilities Manager in writing of
- (a) the physical conditions or artificial obstructions on the Site that could not have been reasonably Foreseen
  - (b) the additional work and/or Plant and Equipment and/or Contractor's Equipment required, including the steps which the Contractor will or proposes to take to overcome such conditions or obstructions
  - (c) the extent of the anticipated delay
  - (d) the additional cost and expense that the Contractor is likely to incur.

On receiving any notice from the Contractor under this TCC Sub-Clause 3.7.5.1, the Facilities Manager shall promptly consult with KREDL and the Contractor and decide upon the actions to be taken to overcome the physical conditions or artificial obstructions encountered. Following such consultations, the Facilities Manager shall instruct the Contractor, with a copy to KREDL, of the actions to be taken.

- 3.7.5.2. Any reasonable additional cost and expense incurred by the Contractor in following the instructions from the Facilities Manager to overcome such physical conditions or artificial obstructions referred to in TCC Sub-Clause 3.7.5.1 shall be paid by KREDL to the Contractor as an addition to the Contract Price.
- 3.7.5.3. If the Contractor is delayed or impeded in the performance of the Contract because of any such physical conditions or artificial obstructions referred to in TCC Sub-Clause 3.7.5.1 the Time for Completion shall be extended in accordance with TCC Clause 40 (Extension of Time for Completion).

### 3.7.6. **Change in Laws and Regulations**

- 3.7.6.1. If, after the last date of Bid submission, in the country where the Site is located, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed (which shall be

deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/ or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. However, these adjustments would be restricted to direct transactions between KREDL and the Contractor. These adjustments shall not be applicable on procurement of raw materials, intermediary components etc. by the Contractor and shall also not be applicable on the bought out items despatched directly from sub-vendor's works to site. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price adjustment provisions where applicable, in accordance with Appendix 2 to the Contract Agreement.

### 3.7.7. Force Majeure

**3.7.7.1.** "Force Majeure" shall mean any event beyond the reasonable control of KREDL or of the Contractor, as the case may be, and which is unavoidable notwithstanding the reasonable care of the Party affected.

A 'Force Majeure' means any event or circumstance or combination of events those stated below that wholly or partly prevents or unavoidably delays an Affected Party in the performance of its obligations under this Agreement, but only if and to the extent that such events or circumstances are not within the reasonable control, directly or indirectly, of the Affected Party and could not have been avoided if the Affected Party had taken reasonable care or complied with prudent utility practices:

- a) Act of God, including, but not limited to lightning, drought, fire and explosion (to the extent originating from a source external to the Site), earthquake, volcanic eruption, landslide, flood, cyclone, typhoon or tornado;
- b) Any act of war (whether declared or undeclared), invasion, armed conflict or act of foreign enemy, blockade, embargo, revolution, riot, insurrection, terrorist or military action;
- c) Radioactive contamination or ionising radiation originating from a source in India or resulting from another Force Majeure Event mentioned above excluding circumstances where the source or cause of contamination or radiation is brought or has been brought into or near the Power Project by the Affected Party or those employed or engaged by the Affected Party.
- d) Any event of above Force Majeure affecting evacuation of power from the Facility to the grid.
- e) Pandemic.

Force Majeure Exclusions Force Majeure shall not include

- (i) any event or circumstance which is within the reasonable control of the Parties and
- (ii) the following conditions, except to the extent that they are consequences of an event of Force Majeure:

- a) Unavailability, late delivery, or changes in cost of the plant, machinery, equipment, materials, spare parts or consumables for the Power Project;
  - b) Delay in the performance of by contractor, Sub -contractor or their agents;
  - c) Non -performance resulting from normal wear and tear typically experienced in power generation materials and equipment;
  - d) Strikes at the Facilities of the Affected Party;
  - e) Insufficiency of finances or funds or the agreement becoming onerous to perform; and
  - f) Non-performance caused by, or connected with, the Affected Party's:
    - (i) Negligent or intentional acts, errors or omissions;
    - (ii) Failure to comply with an Indian Law; or
    - (iii) Breach of, or default under this Contract Agreement.
- 3.7.7.2. If either Party is prevented, hindered or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within fourteen (14) Days after the occurrence of such event.
- 3.7.7.3. The Party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such Party's performance is prevented, hindered or delayed. The Time for Completion shall be extended in accordance with TCC Clause 40 (Extension of Time for Completion).
- 3.7.7.4. The Party or Parties affected by the event of Force Majeure shall use reasonable efforts to mitigate the effect thereof upon its or their performance of the Contract and to fulfill its or their obligations under the Contract, but without prejudice to either Party's right to terminate the Contract under TCC Sub-Clauses 3.7.7.6 and 3.7.7.7.
- 3.7.7.5. Delay or nonperformance by either Party hereto caused by the occurrence of any event of Force Majeure shall not
- (a) constitute a default or breach of the Contract
  - (b) (subject to TCC Sub-Clauses 3.7.2.2, 3.7.8.3 and 3.7.8.4) give rise to any claim for damages or additional cost or expense occasioned thereby if and to the extent that such delay or nonperformance is caused by the occurrence of an event of Force Majeure.
- 3.7.7.6. If the performance of the Contract is substantially prevented, hindered or delayed for a single period of more than sixty (60) Days or an aggregate period of more than one hundred and twenty (120) Days on account of one or more events of Force Majeure during the currency of the Contract, the Parties will attempt to develop a mutually satisfactory solution, failing which the dispute shall be resolved in accordance with TCC Clause 3.1.6.
- 3.7.7.7. Notwithstanding TCC Sub-Clause 3.7.7.5, Force Majeure shall not apply to any obligation of KREDL to make payments to the Contractor herein.

3.7.8. **War Risks**

3.7.8.1. "War Risks" shall mean any of the following events occurring or existing in or near the country (or countries) where the Site is located :

- (a) war, hostilities or warlike operations (whether a state of war is declared or not), invasion, act of foreign enemy and civil war
- (b) rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion and terrorist acts, and
- (c) any explosion or impact of any mine, bomb, shell, grenade or other projectile, missile, munitions or explosive of war.

3.7.8.2. Notwithstanding anything contained in the Contract, the Contractor shall have no liability whatsoever for or with respect to

- (a) destruction of or damage to Facilities, Plant & Equipment, or any part thereof
- (b) destruction of or damage to property of KREDL or any third Party
- (c) injury or loss of life if such destruction, damage, injury or loss of life is caused by any War Risks, and KREDL shall indemnify and hold the Contractor harmless from and against any and all claims, liabilities, actions, lawsuits, damages, costs, charges or expenses arising in consequence of or in connection with the same.

3.7.8.3. If the Facilities or any Plant and Equipment or Contractor's Equipment or any other property of the Contractor used or intended to be used for the purposes of the Facilities shall sustain destruction or damage by reason of any War Risks, KREDL shall pay the Contractor for

- (a) any part of the Facilities or the Plant and Equipment so destroyed or damaged (to the extent not already paid for by KREDL)
- (b) replacing or making good any Contractor's Equipment or other property of the Contractor so destroyed or damaged so far as may be required by KREDL, and as may be necessary for completion of the Facilities,
- (c) replacing or making good any such destruction or damage to the Facilities or the Plant and Equipment or any part thereof.

3.7.8.4. Notwithstanding anything contained in the Contract, KREDL shall pay the Contractor for any increased costs or incidentals to the execution of the Contract that are in any way attributable to, consequent on, resulting from, or in any way connected with any War Risks, provided that the Contractor shall as soon as practicable notify KREDL in writing of any such increased cost.

3.7.8.5. If during the performance of the Contract any War Risks shall occur that financially or otherwise materially affect the execution of the Contract by the Contractor, the Contractor shall use its reasonable efforts to execute the Contract with due and proper consideration given to the safety of its

and its Subcontractors' personnel engaged in the work on the Facilities, provided, however, that if the execution of the work on the Facilities becomes impossible or is substantially prevented for a single period of more than sixty (60) Days or an aggregate period of more than one hundred and twenty (120) Days on account of any War Risks, the Parties will attempt to develop a mutually satisfactory solution, failing which the dispute will be resolved in accordance with TCC Clause 3.1.6.

- 3.7.8.6. In the event of termination pursuant to TCC Sub-Clauses 3.7.8.3, the rights and obligations of KREDL and the Contractor shall be as specified in TCC Sub-Clauses 3.8.3.1.2 and 3.8.3.1.3, except that the Contractor shall have no entitlement to profit under paragraph (e) of TCC Sub-Clause 3.8.3.1.3 in respect of any unexecuted Facilities as of the date of termination.

## **3.8. Change in Contract Elements**

### **3.8.1. Extension of Time for Completion**

- 3.8.1.1. The Time(s) for Completion specified in the RFP shall be extended, if the Contractor is delayed or impeded in the performance of any of its obligations under the Contract by reason of any of the following:

- (a) any occurrence of Force Majeure as provided in TCC Clause 3.7.7 (Force Majeure), unforeseen conditions as provided in TCC Clause 3.7.5 (Unforeseen Conditions)/
- (c) any suspension order given by KREDL under TCC 3.8.2 Clause (Suspension) hereof or reduction in the rate of progress pursuant to TCC Sub-Clause 3.8.2.2 or
- (d) any changes in laws and regulations as provided in TCC Clause 3.7.6 (Change in Laws and Regulations) or

- 3.8.1.2. Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Facilities Manager a notice of a claim for an extension of the Time for Completion, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim, KREDL and the Contractor shall agree upon the period of such extension. In the event that the Contractor does not accept KREDL's estimate of a fair and reasonable time extension, the Contractor shall be entitled to refer the matter to the Adjudicator, pursuant to TCC Sub-Clause 3.1.6.1 (Adjudicator).

- 3.8.1.3. The Contractor shall at all times use its reasonable efforts to minimize any delay in the performance of its obligations under the Contract.

### **3.8.2. Suspension**

- 3.8.2.1. KREDL/ Facilities Manager may, by notice to the Contractor, order the Contractor to suspend performance of any or all of its obligations under the Contract. Such notice shall specify the obligation of which performance is to be suspended, the effective date of the suspension and

the reasons therefor. The Contractor shall thereupon suspend performance of such obligation (except those obligations necessary for the care or preservation of the Facilities) until ordered in writing to resume such performance by the Facilities Manager/ KREDL.

If, by virtue of a suspension order given by the Facilities Manager/KREDL, other than by reason of the Contractor's default or breach of the Contract, the Contractor's performance of any of its obligations is suspended for an aggregate period of more than ninety (90) Days, then at any time thereafter and provided that at that time such performance is still suspended, the Contractor may give a notice to the Facilities Manager requiring that KREDL shall, within twenty-eight (28) Days of receipt of the notice, excluding the performance of the suspended obligations from the Contract.

**3.8.2.2. If**

(a) KREDL has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to KREDL that requires payment of such sum, requires approval of such invoice or supporting documents, or specifies the breach and requires KREDL to remedy the same, as the case may be. If KREDL fails to pay such sum, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, or fails to remedy the breach or take steps to remedy the breach within fourteen (14) Days after receipt of the Contractor's notice or

(b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to KREDL, including but not limited to KREDL's failure to provide possession of or access to the Site or other areas in accordance with TCC Sub-Clause 3.2.4.2, or failure to obtain any governmental permit necessary for the execution and/ or completion of the Facilities; then the Contractor may by fourteen (14) Days' notice to KREDL suspend performance of all or any of its obligations under the Contract, or reduce the rate of progress.

**3.8.2.3. If the Contractor's performance of its obligations is suspended or the rate of progress is reduced pursuant to this TCC Clause 3.8.2, then the Time for Completion shall be extended in accordance with TCC Sub-Clause 3.8.1.1, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction shall be paid by KREDL to the Contractor in addition to the Contract Price, except in the case of suspension order or reduction in the rate of progress by reason of the Contractor's default or breach of the Contract.**

**3.8.2.4. During the period of suspension, the Contractor shall not remove from the Site any Plant and Equipment, any part of the Facilities or any Contractor's Equipment, without the prior written consent of KREDL.**

**3.8.3. **Termination****

**3.8.3.1. **Termination for KREDL's Convenience****

**3.8.3.1.1. KREDL may at any time terminate the Contract for any reason by giving the Contractor a notice of termination that refers to this TCC Sub-Clause 3.8.3.1.**

3.8.3.1.2. Upon receipt of the notice of termination under TCC Sub- Clause 3.8.3.1.1, the Contractor shall either immediately or upon the date specified in the notice of termination

(a) cease all further work, except for such work as KREDL may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to KREDL pursuant to paragraph (d)(ii) below

(c) remove all Contractor's Equipment from the Site, repatriate the Contractor's and its Subcontractors' personnel from the Site, remove from the Site any wreckage, rubbish and debris of any kind, and leave the whole of the Site in a clean and safe condition

(d) In addition, the Contractor, subject to the payment specified in TCC Sub-Clause 3.8.3.1.3, shall

(i) deliver to KREDL the parts of the Facilities executed by the Contractor up to the date of termination

(ii) to the extent legally possible, assign to KREDL all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as at the date of termination, and, as may be required by KREDL, in any subcontracts concluded between the Contractor and its Subcontractors

(iii) deliver to KREDL all non-proprietary drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities.

3.8.3.1.3. In the event of termination of the Contract under TCC Sub-Clause 3.8.3.1.1, KREDL shall pay to the Contractor the following amounts:

(a) the Contract Price, properly attributable to the parts of the Facilities executed by the Contractor as of the date of termination

(b) the costs reasonably incurred by the Contractor in the removal of the Contractor's Equipment from the Site and in the repatriation of the Contractor's and its Subcontractors' personnel

(c) any amounts to be paid by the Contractor to its Subcontractors in connection with the termination of any subcontracts, including any cancellation charges

(d) costs incurred by the Contractor in protecting the Facilities and leaving the Site in a clean and safe condition pursuant to paragraph (a) of TCC Sub-Clause 3.8.3.1.2

(e) the cost of satisfying all other obligations, commitments and claims that the Contractor may in good faith have undertaken with third Parties in connection with the Contract and that are not covered by paragraphs (a) through (d) above.

### 3.8.3.2. Termination for Contractor's Default

3.8.3.2.1. KREDL, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefor to the Contractor, referring to this TCC Sub-Clause 3.8.3.2.:

(a) if the Contractor becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, if the Contractor is a corporation, a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Contractor takes or suffers any other analogous action in consequence of debt

(b) if the Contractor assigns or transfers the Contract or any right or interest therein in violation of the provision of TCC Clause 3.8.4(Assignment).

(c) if the Contractor, in the judgement of KREDL has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this Sub-Clause:

"corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution.

"fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of KREDL and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive KREDL of the benefits of free and open competition.

### 3.8.3.2.2. If the Contractor

(a) has abandoned or repudiated the Contract

(b) has without valid reason failed to commence work on the Facilities promptly or has suspended (other than pursuant to TCC Sub-Clause 3.8.3.1) the progress of Contract performance for more than twenty-eight (28) Days after receiving a written instruction from KREDL to proceed

(c) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause

(d) refuses or is unable to provide sufficient materials, services or labor to execute and complete the Facilities in the manner specified in the program furnished under TCC Clause 18 (Program of Performance) at rates of progress that give reasonable assurance to KREDL that the Contractor can attain Completion of the Facilities by the Time for Completion as extended then KREDL may, without prejudice to any other rights it may possess under the Contract, give a notice to the Contractor stating the nature of the default and requiring the Contractor to remedy the same. If the Contractor fails to remedy or to take steps to remedy the same within fourteen (14) Days of its receipt of such notice, then KREDL may terminate the Contract forthwith by giving a notice of termination to the Contractor that refers to this TCC Sub-Clause 3.8.3.2.

- 3.8.3.2.3. Upon receipt of the notice of termination under TCC Sub- Clauses 3.8.3.2.1 or 3.8.3.2.2, the Contractor shall, either immediately or upon such date as is specified in the notice of termination,

(a) cease all further work, except for such work as KREDL may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to KREDL pursuant to paragraph (d) below

(c) deliver to KREDL the parts of the Facilities executed by the Contractor up to the date of termination

(d) to the extent legally possible, assign to KREDL all right, title and benefit of the Contractor to the Works and to the Plant and Equipment as at the date of termination, and, as may be required by KREDL, in any subcontracts concluded between the Contractor and its Sub-Contractors

(e) deliver to KREDL all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities.

- 3.8.3.2.4. KREDL may enter upon the Site, expel the Contractor, and complete the Facilities itself or by employing any third Party. KREDL may, to the exclusion of any right of the Contractor over the same, take over and use with the payment of a fair rental rate to the Contractor, with all the maintenance costs to the account of KREDL and with an indemnification by KREDL for all liability including damage or injury to persons arising out of KREDL's use of such equipment, any Contractor's Equipment owned by the Contractor and on the Site in connection with the Facilities for such reasonable period as KREDL considers expedient for the supply and installation of the Facilities.

- 3.8.3.2.5. Upon completion of the Facilities or at such earlier date as KREDL thinks appropriate, KREDL shall give notice to the Contractor that such Contractor's Equipment will be returned to the Contractor at or near the Site and shall return such Contractor's Equipment to the Contractor in accordance with such notice. The Contractor shall thereafter without delay and at its cost remove or arrange removal of the same from the Site.
- 3.8.3.2.6. Subject to TCC Sub-Clause 3.8.3.2.7, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as at the date of termination, the value of any unused or partially used Plant and Equipment on the Site, and the costs, if any, incurred in protecting the Facilities and in leaving the Site in a clean and safe condition pursuant to paragraph (a) of TCC Sub-Clause 3.8.3.2.3. Any sums due to KREDL from the Contractor accruing prior to the date of termination shall be deducted from the amount to be paid to the Contractor under this Contract.
- 3.8.3.2.7. If KREDL completes the Facilities, the cost of completing the Facilities by KREDL shall be determined. If the sum that the Contractor is entitled to be paid, pursuant to TCC Sub-Clause 3.8.3.2.6, plus the reasonable costs incurred by KREDL in completing the Facilities, exceeds the Contract Price, the Contractor shall be liable for such excess.
- 3.8.3.2.8. If such excess is greater than the sums due to the Contractor under TCC Sub-Clause 3.8.3.2.6 the Contractor shall pay the balance to KREDL, and if such excess is less than the sums due to the Contractor under TCC Sub- Clause 3.8.3.2.6, KREDL shall pay the balance to the Contractor.
- 3.8.3.2.9. KREDL and the Contractor shall agree, in writing, on the computation described above and the manner in which any sums shall be paid.

#### 3.8.4.

#### **Assignment**

- 3.8.4.1. The Contractor shall not, without the express prior written consent of KREDL, assign to any third Party the Contract or any part thereof, or any right, benefit, obligation or interest therein or thereunder, except that the Contractor shall be entitled to assign either absolutely or by way of charge any monies due and payable to it or that may become due and payable to it under the Contract.

#### 3.8.5.

#### **Bankruptcy**

- 3.8.5.1. If the Contractor shall become bankrupt or have a receiving order made against him or compound with his creditors, or being a corporation commence to be wound up, not being a voluntary winding up for the purpose only of amalgamation / reconstruction, or carry on its business under a receiver for the benefit of its creditors or any of them, the Owner will be at liberty:

(a) to terminate the contract forthwith by notice in writing to the liquidator or receiver or to any person in whom the

contract may become vested & to act in the manner provided in TCC clause 3.8.3 entitled "Termination" as though the last mentioned notice has been the notice referred to in such clause and the equipment and materials have been taken out of the contractor's hands.

(b) to give such liquidator, receiver or other person, the option of carrying out the contract subject to his providing a guarantee, for the due and faithful performance of the contract up to an amount to be determined by the Owner.

**4. Section IV: Forms and Procedures**

**BID FORM (ENVELOPE-I)  
(TECHNO-COMMERCIAL BID)  
(Part 1 of 3)**

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System (excluding all variants of lead acid batteries) Facilities having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

RFP No \_\_\_\_\_

**Attachment 1:**

**COVERING LETTER**  
(To be submitted online along with the Techno-Commercial Bid)

Date:

**NAME OF RFP:** RFP for selection of Engineering, Procurement and Construction (EPC) Contractor for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning and O&M of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System having 12 years Plant O&M at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka.

To,

Managing Director  
Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

Dear Sir/ Madam,

1. Having examined the RFP No. \_\_\_\_\_, including subsequent amendments and clarifications if any, the receipt of which is hereby acknowledged, we the undersigned, offer to perform the scope of work to create the Facility under the above named RFP in full conformity with the said RFP as per all the terms and conditions in the RFP, hereby furnish our Techno-Commercial Bid.
2. We, [Single Bidder/ Lead Member of the Consortium] are participating as a [Single Bidder/ Consortium]. [In case of Consortium, please mention the name of the consortium partners and the ratio of shareholding.]
3. We have submitted our Techno-Commercial Bid as per the requirement in this RFP and submitted in all respect. In case we have not submitted such documents, then our Bids will be rejected.
4. We have furnished our compliance to the provisions of the RFP and its subsequent Amendment(s)/Clarification(s)/Addenda/Errata.
5. We have read all the provision of the RFP and confirm that notwithstanding anything stated elsewhere in our Bid to the contrary, the provisions of the RFP are acceptable to us and we further confirm that we have not taken any deviation to provision of the RFP anywhere in our Bid.

Acceptance of above attribute shall be considered as our confirmation that any deviation, variation or additional condition etc. or any mention, contrary to the provisions of RFP and its subsequent Amendment(s)/ Clarification(s) /Addenda/Errata (if any) found anywhere in our bid proposal implicit or explicit shall stand unconditionally withdrawn, without any cost implication whatsoever to KREDL.

6. We further declare that additional conditions, variations, deviations to the provisions of RFP and its subsequent Amendments/Clarifications/Addenda/Errata, if any, found in our Bid, shall not be given effect to.
7. We have furnished our compliance on “Qualifying Requirements” of KREDL.

8. We further confirm that no change or substitution in respect of reference Plants, as specified in our bid, by new/additional plant for meeting the specified Qualifying Requirement (QR) shall be offered by us.
9. We undertake, if our Bid is accepted, to commence work on the Facilities immediately upon signing of Contract Agreement until the Operational Acceptance of the Facility.
10. We confirm that there is no ongoing litigation or litigation pending or, to the best of such Party's knowledge, threatened to which it or any of its Group Business Entities is a party that presently affects or which would have a material adverse effect on the financial condition or prospects or business of such Party in the fulfilment of its obligations under this Agreement .
11. We do not have any Conflict of Interest in accordance the provisions of the RFP.
12. If our Bid is accepted, we undertake to provide Contract Performance Securities as specified in the RFP and our offer for battery system is excluding all variants of lead acid batteries for subject scope of work,
13. We agree to abide by our Techno-Commercial Bid and Price Bid during the period of its original validity for a period one hundred and Eighty (180) Days from the last date of submission of Techno-Commercial Bids and Price Bids as stipulated in the RFP, unless extended by us on your request pursuant to ITB Clause 2.3.7 and it shall remain binding upon us and may be accepted by you at any time before expiration of that said period.
14. We understand that you are not bound to accept the lowest or any other Bid you may receive.
15. We, hereby, declare that only the persons or firms interested in this proposal as principals are named here and that no other persons or firms other than those mentioned herein have any interest in this proposal or in the Contract to be entered into, if the award is made on us, that this proposal is made without any connection with any other person, firm or Party likewise submitting a proposal, is in all respects for and in good faith, without collusion or fraud.
16. We acknowledge the right of KREDL to reject our Bid without assigning any reason or otherwise and hereby waive, to the fullest extent permitted by applicable law, our right to challenge the same on any account whatsoever.

Dated this \_\_\_ day of \_\_\_ 2022

Thanking you, we remain,

Yours Faithfully,

Date

Authorized Signatory

Place

Designation

Business Address

Country of Incorporation (Province also to be indicated)

Fax No.

Phone No.

E-mail ID

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System (excluding all variants of lead acid batteries) Facilities having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP NO. : \_\_\_\_\_

**Attachment 2:**

**COST OF RFP**

(To be submitted online and offline along with the Techno-Commercial Bid)

BIDDER TO FURNISH PROOF TOWARDS COST OF RFP IN LINE WITH ITB CLAUSE 2.3.5 (COST OF RFP)

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP NO. : \_\_\_\_\_

**Attachment 3:**

**BID SECURITY**

(To be submitted online and offline along with the Techno-Commercial Bid)

**BIDDER TO FURNISH BID SECURITY IN LINE WITH ITB CLAUSE 2.3.6 (BID SECURITY) AND AS PER FORMAT GIVEN AT SECTION-VII (FORMS & PROCEDURES)**

**Bank Guarantee**

(To be on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution)

Bank Guarantee No.

Date

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

Dear Sirs,

In accordance with Invitation for Bids under your RFP No. \_\_\_\_\_, M/s \_\_\_\_\_ having its registered office at \_\_\_\_\_ (Hereinafter called the Bidder) wish to participate in the bid for selection of Engineering, Procurement and Construction (EPC) Contractor for design, engineering, procurement, supply, construction, erection, testing and commissioning of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System with associated transmission system and comprehensive Operation & Maintenance (O&M) for 12 (twelve) years at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka.

We, the \_\_\_\_\_ [Name & address of bank] \_\_\_\_\_ having our head office at \_\_\_\_\_ guarantee and undertake to pay immediately on demand by \_\_\_\_\_ [Name of KREDL] \_\_\_\_\_ (hereinafter called KREDL) for this Bid Security in the form an unconditional Bank Guarantee for the amount of INR \_\_\_\_\_ (Indian Rupees in words) without any reservation, protest, demand and recourse. Any such demand made by the 'KREDL' shall be conclusive and binding on us irrespective of any dispute or difference raised by the Bidder.

Notwithstanding anything contained herein above our liability under this guarantee is restricted to \_\_\_\_\_ and it shall remain with a expiry date up to \_\_\_\_\_ with a claim date up to \_\_\_\_\_ and shall be extended from time to time for such period, as may be desired by M/s. \_\_\_\_\_ whose behalf this guarantee has been given.

In witness where of the Bank, through its authorized officer, has set its hand and stamp on this \_\_\_\_\_ day of \_\_\_\_\_ at \_\_\_\_\_.

**WITNESS:**

1. Signature

Name

Official Address

2. Signature

Name

Official Address

**Note:**

1. The Bank Guarantee shall be from a Bank as per relevant provisions RFP.
2. The BG should be on Non-Judicial stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG is executed, whichever is higher. The Stamp Paper shall be purchased in the name of Bidder/Bank issuing the guarantee.

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP NO. : \_\_\_\_\_

**Attachment 4:**

**POWER OF ATTORNEY**

(To be submitted online and offline along with the Techno-Commercial Bid)

**BIDDER TO ATTACH THE POWER OF ATTORNEY**

**IN ACCORDANCE WITH ITB CLAUSE 2.3.2.2.1 (4)**

**(BOARD RESOLUTION IN FAVOUR OF AUTHORIZED SIGNATORY ALSO ENCLOSED)**

(To be on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution)

Power of Attorney provided by the Bidder in favor of its representative as evidence of authorized signatory's authority.

Know all men by these presents, we ..... do hereby constitute, appoint and authorize ..... presently residing at ..... who is presently employed with us and holding the position of ..... as our true and lawful attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to submission of our Bid for selection of Engineering, Procurement and Construction (EPC) Contractor for design, engineering, procurement, supply, construction, erection, testing and commissioning of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System with associated transmission system and comprehensive Operation & Maintenance (O&M) for 12 years at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka.

The aforesaid Authorized employee, in response to the RFP [ ] issued by Karnataka Renewable Energy Development Limited ("KREDL"), including signing and submission of the Bid and all other documents related to the Bid, including but not limited to undertakings, letters, certificates, acceptances, clarifications, guarantees or any other document which KREDL may require us to submit. The aforesaid Attorney is further authorized for making representations to KREDL, and providing information / responses to KREDL, representing us in all matters before KREDL, and generally dealing with KREDL in all matters in connection with our Bid till the completion of the Bidding Process as per the terms of the RFP.

We hereby agree to ratify all acts, deeds and things done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall be binding on us and shall always be deemed to have been done by us.

All the terms used herein but not defined shall have the meaning ascribed to such terms under the RFP.

Signed by the within named

**Organization Name:**

Through the hand of

**Name of Authorizer:**

Duly authorized by the Board to issue such Power of Attorney  
Dated this

Signature of Attorney

Name:

Designation:

Address of the Attorney:

Attested

Signature of the executant

Name:

Designation:

Address of the executant:

Signature and stamp of Notary of the place of execution

Common seal of ..... has been affixed in my/our presence pursuant to Board of Director's

Resolution dated .....

**WITNESS**

1

Signature

Name:

Designation:

2.

Signature

Name:

Designation:

Notes:

The mode of execution of the power of attorney shall be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and the same shall be under common seal of the executant affixed in accordance with the applicable procedure. Further, the person whose signatures are to be provided on the power of attorney shall be duly authorized by the executant(s) in this regard.

The person authorized under this Power of Attorney shall be a person holding the responsible post & designation in the company.

For a Power of Attorney executed and issued overseas, the document will also have to be legalised by the Indian Embassy and notarised in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have signed the Hague Legislation Convention 1961 are not required to be legalised by the Indian Embassy if it carries a conforming Apostille certificate.

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

RFP NO. : \_\_\_\_\_

**Attachment 5 (a):**

**Bidder on its letter head**

(Details Pertaining to Technical Qualification of the Bidder)

As per Detailed NIT Clause 1.2.6 and ITB Clause 2.3.2.2.3 (5))

(To be submitted online along with the Techno-Commercial Bid)

Name of the Bidder:

Address of the Bidder:

Corporate Identification Number (CIN):

**A. FOR BIDDERS SEEKING QUALIFICATIONS AS PER Detailed NIT Clause 1.2.6 and ITB Clause 2.3.2.2.3 (5)**

In support of Qualifying Requirements of Detailed NIT Clause 1.2.6 and ITB Clause 2.3.2.2.3 (5), we confirm that

**BESS QR**

The Bidder should have manufactured or supplied batteries for battery energy storage system(s) of cumulative installed capacity of 5MWh with dispatchable capacity of 4.5MWh or higher out of which atleast one battery energy storage system should be of 3MWh capacity or higher. The reference battery energy storage system of 3MWh or higher capacity must have been in successful operation for atleast 12 months prior to the date of techno commercial bid submission.

OR

The Bidder should have consortium agreement/MOU with technical partner who has manufactured or supplied and installed batteries for energy storage system(s) of cumulative installed capacity of 5MWh with dispatchable capacity of 4.5MWh or higher out of which atleast one battery energy storage system should be of 3MWh capacity or higher. The reference battery energy storage system of 3MWh or higher capacity must have been in successful operation for atleast 12 months prior to the date of techno commercial bid submission. The bidder should upload the consortium agreement/MOU and submit the hard copy of the original MOU before the bid opening date.

**Solar QR**

The Bidder should have consortium agreement/MOU with an EPC contractor and should have designed, supplied, erected/ supervised erection and commissioned solar PV based grid connected power plant(s) of cumulative installed capacity of not less than 2MW<sub>AC</sub>, out of which one project should be a minimum of 1.5MW or above at single location for public or /Government or private client. The reference plant(s) of at least 1.5 MW<sub>AC</sub>, through which the Bidder is meeting this Technical Eligibility Criteria, must have been in successful operation for at least twelve (12) months prior to the date of Techno-Commercial Bid submission.

OR

The Bidder either as a EPC contractor or as a developer should have designed, supplied, erected/ supervised erection and commissioned solar PV based grid connected power plant(s) of cumulative installed capacity of not less than 2 MW<sub>AC</sub>, out of which one project should be a minimum of 1.5MW or above at single location for public or /Government or private client. The reference plant(s) of at least 1.5 MW<sub>AC</sub>, through which the Bidder is meeting this Technical Eligibility Criteria, must have been in successful operation for at least twelve (12) months prior to the date of Techno-Commercial Bid submission.

### **Transmission substation QR**

The bidder or his consortium partner should be a government approved Super Grade License/Class I license and have executed at least one (1) Electrical Sub-station of minimum 33kV voltage level, consisting of equipments such as 33kV or above voltage level circuit breakers and power transformer, either as developer or as Contractor. In addition, the bidder/contractor should have required QMS certifications like ISO 9001:2015 and ISO 14001:2015.

The bidders have to meet all the eligibility criteria's like BESS QR, Solar QR and **Transmission substation QR along with all other requirements.**

In this regard, we have verified the documents required under Detailed NIT Clause 1.2.6.2:

(I) The details pertaining to the reference plants are given below:

#### **Cumulative installed capacity of Grid connected power plant in MW<sub>AC</sub>**

Sr.No.	Item Description	Reference Plant 1 (2 MW <sub>AC</sub> & above)	Reference Plant 2	Reference Plant ...	Cumulative
1	Description of work (Capacity – AC/DC)				
2	Name of Client with full address				
3	Name of ultimate user of energy				
4	Project arrangement (Captive/ third party/ Government Bidding/ Any other – please specify)				
5	Name of the power plant with its location (GPS coordinate, Village, Taluk, District, State, Country)				
6	Name & designation of the responsible person in Clients organization				
7	Contract No. & date				
8	Whether this is a SPV based grid connected power plant	Yes*/No*	Yes*/No*	Yes*/No*	Yes*/No*
	Connected voltage level with				

Sr.No.	Item Description	Reference Plant 1 (2 MW <sub>AC</sub> & above)	Reference Plant 2	Reference Plant ...	Cumulative
	grid				
9	Capacity of the plant in AC				
	Whether scope of work includes (a) Design (b) Supply (c) Erected (d) Commissioned (e) Supervised Commissioning Or Whether scope of work includes (a) Build (b) Own (c) Operate				
10	Date of Commercial Operations Date of the above plant				
11	energy generation in units (kWh) for a continuous period of at least twelve (12) months prior to the date of Techno-Commercial Bid submission.				
12	Copies of authentic purchase orders certificate from Clients, Agreements in support of details/ data of Sl. No. 1 to 11 enclosed as annex as required in the RFP. <ul style="list-style-type: none"><li>• Letter of award/ work order/ purchase order (as applicable)</li><li>• Detailed contract agreement along with any amendment, if any.</li><li>• certificate received from any Government entity, Central/ State utilities</li><li>• Certificate from the owner of the solar PV plant OR submission of latest Joint Meter Reading report issued by the power utilities certifying the successful operation of the solar PV Plant for</li></ul>				

Sr.No.	Item Description	Reference Plant 1 (2 MW <sub>AC</sub> & above)	Reference Plant 2	Reference Plant ...	Cumulative
	continuous period of at least twelve (12) months prior to the date of Techno-Commercial Bid submission				

Date:

**Name of the Bidder**

Name of authorized signatory

Signature:

Seal:

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

Attachment 5 (b):

**CERTIFICATE FROM CHARTERED ACCOUNTANT**

**(Financial Data pertaining to Financial Qualification of the Bidder as per Detailed NIT Clause 1.2.6.3)**

(To be submitted online along with the Techno-Commercial Bid)

**To satisfy the above requirements, we give below the following details:**

In terms of **Detailed NIT Clause 1.2.6.3**, we confirm that the average annual turnover of the Bidder, is not be less than “**Rs.96/- Crores (Indian Rupees Ninety Six only)**” during any two (2) FYs out of the preceding five (5) FYs viz. from FY 2017-18 until FY 2021-22.

\*For domestic Bidders,

Sl. No:	Financial Year	Amount in INR (In Crores)
1	FY 2021-22	
2	FY 2020 – 21	
3	FY 2019 – 20	
4	FY 2018 – 19	
5	FY 2017 – 18	
6	Average Annual Turnover during any two (2 FYs out of the preceding five (5) FYs viz. from FY 2017-18 until FY 2021-22, or as applicable under the RFP	
7	We have enclosed Audited Financial Statements for preceding five (5) Financial Years	Yes*/No*

Note: \*Strike off the part which are not applicable

Date:

Name of the Chartered Accountant

Name of authorized signatory

Signature:

Seal:

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

**Attachment 5 (c):**

**CERTIFICATE FROM CHARTERED ACCOUNTANT**

**(Financial Data pertaining to Financial Qualification of the Bidder as per Detailed NIT Clause 1.2.6.3)**

(To be submitted online along with the Techno-Commercial Bid)

We hereby confirm that net worth of our company as on the last day of the preceding Financial Year/ Calendar Year FY 2021-22 is not less than 100% (one hundred percent) of its paid-up share capital, subject to a minimum of INR 14 Crores per annum.

The Details of the entity [name of the entity through which the Financial Qualification criteria is being met] are as under:

Sr. No.	Description	As on last day of the preceding Financial Year/ Calendar Year (in INR Crores)
1	Paid-up Share Capital	
2	Net Worth (as per Detailed NIT Clause 1.2.6.3.5)	
3	%age of Net worth to Paid-up Share Capital	
4	Documentary evidence required under Detailed NIT Clause 1.2.6.3 of the RFP.	

Note: Strike off the part, which are not applicable

Date:

Name of the Chartered Accountant

Name of authorized signatory

Signature:

Seal:

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

**Attachment 5 (d):**

**PROFORMA OF CERTIFICATE FROM THE CEO/CFO OF THE HOLDING COMPANY IN ACCORDANCE  
DETAILED NIT CLAUSE 1.2.6.3, If applicable**

(To be submitted online by Bidder along with the Techno-Commercial Bid)

Ref. : \_\_\_\_\_

Date: \_\_\_\_\_

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

Dear Sirs,

1. I, Mr. \_\_\_\_\_ (CEO of the Company / CFO of the Company)\* declare that M/s. \_\_\_\_\_ (Name of the Holding Company) is the Holding Company of M/s \_\_\_\_\_ (Name of the Bidder).
2. I hereby confirm and undertake that the unaudited unconsolidated/ consolidated financial statements submitted in respect of the Bidder as part of the bid reference no. \_\_\_\_\_ dated \_\_\_\_\_ have been considered for the purposes of the finalization of Consolidated Financial Statements of the Holding Company as part of the Annual Accounts.
3. I further, certify that the figures in the unaudited unconsolidated/ consolidated financial statements are true and correct and same have been duly reflected in the audited unconsolidated/ consolidated financial statements and / or Annual Accounts of the Holding Company.

Yours faithfully

(Signature)

Date : \_\_\_\_\_ (Name & Designation) .....

Place : \_\_\_\_\_ (Name of the Holding Company) .....

(Seal of Holding Company) .....

**Note:** \*Strike off whichever is not applicable.

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. :

Attachment 5 (e):

**PROFORMA OF LETTER OF UNDERTAKING, If applicable  
(TO BE FURNISHED ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)**

**(To be executed by the Holding Company Supported by  
Board Resolution and submitted by the Bidder along with the Techno-Commercial Bid,  
Applicable to the Bidder for meeting the stipulated Financial Qualifying  
Requirement as per Detailed NIT Clause 1.2.6.3)**

(To be submitted online by Bidder along with the Techno-Commercial Bid)

Ref. :

Date:

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

**Dear Sirs,**

1. We, M/s \_\_\_\_\_ declare that we are the holding company of M/s \_\_\_\_\_ (Name of the Bidder) and have controlling interest therein.

M/s \_\_\_\_\_ (Name of the Bidder) proposes to submit the bid for the package \_\_\_\_\_ (Name of the package) for \_\_\_\_\_ (Name of the Facilities) under bid reference no. \_\_\_\_\_ dated \_\_\_\_\_ and have sought financial strength and support from us for meeting the stipulated Financial Qualifying Requirement as per Detailed NIT Clause 1.2.6.3.

2. We hereby undertake that we hereby pledge our unconditional & irrevocable financial support for the execution of the said package to M/s. \_\_\_\_\_ (Name of the Bidder), in case they are awarded the Contract for the said package, at the end of the bidding process. We further agree that this undertaking shall be without prejudice to the various liabilities that M/s \_\_\_\_\_ (Name of Bidder) would be required to undertake in terms of the Contract including the Performance Security as well as other obligations of the Bidder/Contractor.
3. This undertaking is irrevocable and unconditional, and shall remain in force till the successful execution and performance of the entire contract and/or till it is discharged by KREDL.
4. We are herewith enclosing a copy of the Board Resolution in support of this undertaking.

Yours Faithfully

Signature of the Authorized Signatory on

behalf of the holding company

Witness:

1. ( Name& Designation)
2. (Name of the holding company)
3. Seal of the holding company

Date:

Place:

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

**Attachment 5 (f):**

**PROFORMA OF CERTIFICATE FROM THE CEO/CFO, If applicable  
IN ACCORDANCE WITH ITEM as per Detailed NIT Clause 1.2.7.3**

(To be submitted online by Bidder along with the Techno-Commercial Bid)

Ref. : \_\_\_\_\_

Date: \_\_\_\_\_

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10<sup>th</sup> Block, 2<sup>nd</sup> Stage,  
Nagarbhavi, Bangalore – 560072.

Karnataka

Dear Sirs,

I, Mr. \_\_\_\_\_ (CEO/CFO of the Company) of \_\_\_\_\_ (Name of the Company) \_\_\_\_\_ declare that the financial results of M/s. \_\_\_\_\_ (Name of the Bidder) are under audit as on \_\_\_\_\_ (Date of Techno-Commercial Bid opening) and the Certificate from the practicing Chartered Accountant certifying the financial parameters is also not available.

Yours faithfully

(Signature)

Date: \_\_\_\_\_ (Name & Designation).....

Place: \_\_\_\_\_ (Name of the Company) .....

..... (Seal of Company) .....

\*Strike off if not applicable.

**Note:**

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

**Attachment 6:**

**(DECLARATION OF BLACKLISTING)**

(To be submitted online by Bidder along with the Techno-Commercial Bid)

I, M/s. ..... (Single Business Entity / Lead Member/ Other Member /s), (the names and addresses of the registered office) hereby certify and confirm that we or any of our promoter/s / director/s are not barred by Karnataka Renewable Energy Development Ltd. (KREDL) / any other entity of Government of Karnataka or blacklisted by any state government or central government / department / agency in India from participating in Facilities/s, either individually or as member of a Consortium as on the \_\_\_\_\_(Bid Due Date).

We hereby certify and confirm that in the preparation and submission of our Bid for the Development of Solar Power Projects in the State of Karnataka, we have not acted in concert or in collusion with any other Bidder or other person(s) and also not done any act, deed or thing which is or could be regarded as anti-competitive.

We further confirm that we are aware that our Bid for the Facilities would be liable for rejection in case any material misrepresentation is made or discovered with regard to the requirements of this RFP at any stage of the Bidding Process or thereafter during the agreement period.

Dated this .....Day of ....., 20....

Name of the Bidder

Signature of the Authorized person

Name of the Authorized Person

Seal:

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

**Attachment 7:**

**SIGNING OF BID**

(To be submitted online by Bidder along with the Techno-Commercial Bid)

I hereby signing and accepting the terms and conditions and providing the copy of RFP, any amendments/ addenda/ corrigenda/ errata/ clarification to the RFP issued by KREDL duly signed on each pages as token of unequivocal acceptance to such documents.

Dated this ..... Day of ....., 20....

Name of the Bidder

Signature of the Authorized person

Name of the Authorized Person

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&Mat Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

**Attachment 8:**

**(NO DEVIATION CERTIFICATE)**

(To be submitted online by Bidder along with the Techno-Commercial Bid)

I/ We, M/s. ..... (Single Business Entity and/or Group Business Entity and/or Lead Member and/or Other Members – as applicable), (the names and addresses of the registered office) hereby certify and confirm that we have read the clauses and provisions of the RFP, amendments, addendums & clarifications issued thereafter and the stipulation of all clauses and provisions are acceptable to us, and we have not taken any technical or commercial deviations whatsoever to any of the clauses and provisions in the RFP.

\*In case the Bidder has taken any deviation, then the same shall be mentioned here. [\*strike-off, if not applicable]

We further confirm that we are aware that our Bid would be liable for rejection in case any material misrepresentation is made or discovered with regard to the requirements of this RFP at any stage of the Bidding Process or thereafter during the agreement period.

Dated this .....Day of ....., 20....

Name of the Bidder

Signature of the Authorised person

Name of the Authorised Person

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

RFP NO. : \_\_\_\_\_

**Attachment 9:**

Consortium Agreement/MOU  
(To be submitted online and offline along with the Techno-Commercial Bid)

BIDDER TO FURNISH CONSORTIUM AGREEMENT/MOU IN LINE WITH ITB PROVISION

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

**Attachment 10:**

**(NO DEVIATION CERTIFICATE WITH RESPECT TO TARGET SOLAR AND BESS GENERATION)**

(To be submitted online by Bidder along with the Techno-Commercial Bid)

I/ We, M/s. ..... (Single Business Entity and/or Group Business Entity and/or Lead Member and/or Other Members – as applicable), (the names and addresses of the registered office) hereby certify and confirm that we have read the clauses and provisions of the RFP, amendments, addendums & clarifications issued thereafter and the stipulation of all clauses and provisions are acceptable to us, and we have not taken any technical or commercial deviations including the target generation details with respect to solar and BESS generation whatsoever to any of the clauses and provisions in the RFP.

\*In case the Bidder has taken any deviation, then the same shall be mentioned here. [\*strike-off, if not applicable]

We further confirm that we are aware that our Bid would be liable for rejection in case any material misrepresentation is made or discovered with regard to the requirements of this RFP at any stage of the Bidding Process or thereafter during the agreement period.

<b>Target Generation from Solar and BESS system</b>				
<b>Year of operation</b>	<b>Generation (Solar) in MU</b>	<b>Generation (BESS) - Discharge</b>	<b>Generation (BESS) - Charge</b>	<b>Total generation in MU</b>
1st	3.67234	1.61897	(2.14853)	3.14278
2nd	3.65214	1.57040	(2.08407)	3.13847
3rd	3.63206	1.52329	(2.02155)	3.13379
4th	3.61208	1.47759	(1.96090)	3.12877
5th	3.59221	1.45543	(1.93149)	3.11615
6th	3.57246	1.43360	(1.90252)	3.10353
7th	3.55281	1.61897	(2.14853)	3.02325
8th	3.53327	1.59469	(2.11630)	3.01165
9th	3.51383	1.57077	(2.08456)	3.00004
10th	3.49451	1.54720	(2.05329)	2.98842
11th	3.47529	1.52400	(2.02249)	2.97680
12th	3.45617	1.50114	(1.99215)	2.96516
13th	3.43717	1.47862	(1.96227)	2.95351
14th	3.41826	1.45644	(1.93284)	2.94187
15th	3.39946	1.43459	(1.90384)	2.93021
16th	3.38076	1.41307	(1.87529)	2.91855
17th	3.36217	1.39188	(1.84716)	2.90689
18th	3.34368	1.37100	(1.81945)	2.89523
19th	3.32529	1.35044	(1.79216)	2.88357
20th	3.30700	1.33018	(1.76527)	2.87190

--	--	--	--	--

Dated this ..... Day of ....., 20....

Name of the Bidder

Signature of the Authorised person

Name of the Authorised Person

**Bidding documents for development of 2MW  
(AC) Solar PV Power Plant (2.2 MWp DC)  
with 4.5 MWh Battery Energy Storage  
System Facilities having 12 years Plant O&M  
at Pavagada Ultra Mega Solar Park in  
Karnataka**

**Part 2 of 3  
Bid form (Price Bid)**

The Price Bid will be submitted as per the format file named as “Price Bid”.

**Bidding documents for development of 2MW  
(AC) Solar PV Power Plant (2.2 MWp DC)  
with 4.5 MWh Battery Energy Storage  
System Facilities having 12 years Plant O&M  
at Pavagada Ultra Mega Solar Park in  
Karnataka**

**Part 3 of 3**

<b>Sr. No:</b>	<b>Description</b>
1.	Form of Notification of Award
2.	Form of Contract Agreement
3.	Performance Security Forms
4.	Form of Completion Certificate
5.	Form of Operational Acceptance Certificate
6.	Form of Authorization Letter
7.	Form of Consortium Agreement
8.	Form of indemnity bond the removal/ disposal of scrap/ disposal of surplus material
9.	Bank guarantee form for operation & maintenance (O&M) period

## 1. FORM OF 'NOTIFICATION OF AWARD'

FOR SUPPLY OF PLANT AND EQUIPMENT ALONG WITH INSTALLATION SERVICES TO DEVELOP  
THE FACILITY AND COMPREHENSIVE O&M

(This form shall apply mutatis-mutandis for the EPC Contract)

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities (excluding all variants of lead acid batteries) having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

RFP No. : \_\_\_\_\_

*Note: Instructions indicated in italics in this notification of award are to be taken care of by the issuing authority.*

Ref. No. \_\_\_\_\_

Date:

Contractor's Name & Address

Attn: Mr \_\_\_\_\_

**Sub:** Notification of Award of Contract for **Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System Facilities having 12 years Plant O&M at Pavagada Ultra Mega Solar Park in Karnataka**

as per RFP No. \_\_\_\_\_

Dear Sir,

1. This has reference to the following:

- i. Our Invitation for Bids (NIT) No. \_\_\_\_\_ dated \_\_\_\_\_
- ii. RFP for the subject package issued to you vide RFP no. \_\_\_\_\_ dated \_\_\_\_\_ comprising the following:
  - RFP containing Volume I, Volume II and Volume III
  - Reference of Addendum, if any
- iii. Clarifications furnished to you on the RFP vide our letter no. \_\_\_\_\_ dated \_\_\_\_\_ based on the query raised by you/one of the prospective Bidders (Use as applicable)

**(Applicable only if any clarification to the RFP has been issued subsequently)**

**(INCLUDE AS FURTHER SUB-PARAGRAPHS ANY OTHER CORRESPONDENCE MADE TO THE BIDDER AFTER ISSUANCE OF BIDDING DOCUMENTS UP TO THE DATE OF BID OPENING)**

- iv. Your Techno-Commercial Bid, Price Bid and Final Price Bid for the RFP submitted vide your letter no. \_\_\_\_\_ dated \_\_\_\_\_ and its modification vide letter no. \_\_\_\_\_ dated \_\_\_\_\_  
(Delete if not applicable)

- v. Our letter No \_\_\_\_\_ dated \_\_\_\_\_ regarding extension of validity of the Bank Guarantee towards Bid Security.

**(Applicable only if any extension has been sought subsequently)**

**(INCLUDE AS FURTHER SUB-PARAGRAPHS ANY OTHER CORRESPONDENCE MADE TO OR BY THE BIDDER AFTER BID OPENING)**

- vi. Our letter No \_\_\_\_\_ dated \_\_\_\_\_ inviting you for post bid discussions.
- vii. Post bid discussions and meetings we had with you from \_\_\_\_\_ to \_\_\_\_\_ resulting into the following Minutes of Meeting enclosed herein with this Notification of Award :
- Minutes of Meeting regarding Commercial issues (APPENDIX - \_\_\_\_\_)
  - Minutes of Meeting on Technical issues (APPENDIX - \_\_\_\_\_)
  - Minutes of Meeting regarding Work Schedule (APPENDIX - \_\_\_\_\_)
  - Minutes of Meeting regarding Quality Assurance Aspects (APPENDIX- \_\_\_\_\_)
2. We confirm having accepted your Techno-Commercial Bid, Price Bid and Final Price Bid submitted vide letter no. \_\_\_\_\_ dated \_\_\_\_\_ and its modification vide letter no. \_\_\_\_\_ dated \_\_\_\_\_ (Delete if not applicable) read in conjunction with all the specifications, terms & conditions of the RFP, Your subsequent letters (Use if relevant) and agreed Minutes of Meeting referred to in para 1.0 above and award on you the Contract for the work of (Indicate brief Scope of Work) forming part of the Contract for development of the Facility and comprehensive O&M for 12 (twelve) years from the date of Operational Acceptance.
3. The total Contract Price for the entire scope of work under the Contract shall be \_\_\_\_\_ (Specify the amount and currency) \_\_\_\_\_ as per the following break up :

Item	Description	Unit	Quantity	Currency	Lumpsum cost for delivery at Site - FOR (destination at Site)	Applicable Taxes and Duties	Total cost

Item	Description	Unit	Quantity	Currency			
	<b>TOTAL PRICE (A+B+C+D+E+F)</b>	LUMPSUM		INR	-	-	-
	<b>TOTAL PRICE (A+B+C+D+E+F))</b>	LUMPSUM		INR	[in words] only	[in words] only	[in words] only

**Discount rate (%)**                   **8.61%**

4. You shall prepare and finalize the Contract for signing of the formal Contract Agreement and shall enter into the Contract Agreement with us, as per the proforma enclosed with the RFP, on non-judicial stamp paper of appropriate value within 30 (thirty Days from the date of this Notification of Award.
5. This Notification of Award is being issued to you in duplicate. We request you to return its duplicate copy duly signed and stamped on each page including all the enclosed Appendices, by the authorized signatory of your company as a proof of your acknowledgement and confirmation.

Please take the necessary action to commence the work and confirm action.

Yours Faithfully,  
For and behalf of

(Name of KREDL)

(Authorized Signatory)

Encl.: As above

## 2. Form of Contract Agreement

This Contract is made the \_\_\_\_\_ day of 20\_\_\_\_.

BETWEEN

[Name of KREDL], a corporation incorporated under the laws of [country of KREDL] and having its principal place of business at [address of KREDL] (hereinafter called "KREDL"), and (2) [name of Contractor], a corporation incorporated under the laws of [country of Contractor] and having its principal place of business at [address of Contractor] (hereinafter called "the Contractor")

WHEREAS KREDL desires to engage the Contractor to design, engineering, procurement, supply, insurance, packing, forwarding, loading, transportation, unloading, storage, construction, installation, erection, testing, commissioning and operational acceptance of the Facilities having all Plant and Equipment and their Installation Services along with its associated auxiliaries including all solar photovoltaic modules, inverters, module mounting structures, string combiner boxes, inverter transformers, HT panels, metering infrastructure, auxiliary transformer, control room, gantry tower, potential transformer, current transformer, vacuum circuit breaker, lightening arrestor etc., single circuit 33 kV underground cables including provision of any cable tray support structures along the road side from the solar plant to the 220/ 33 kV KSPDCL pooling substation for KREDL battery energy storage system (BESS) at 220/33kV sub-station No. 04, AC components, DC components, tools/ tackles and all the other assets, buildings, structures, machinery, facilities and related assets thereof ("Facilities") and the Contractor have agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

### Article1. Contract Documents

1.1 The following documents shall constitute the Contract between KREDL and the Contractor, and each shall be read and construed as an integral part of the Contract:

- a) This Contract Agreement and the Appendices hereto
- b) Notification of Award
- c) Any Corrigendum and Addendum issued.
- d) RFP containing VOLUME I, VOLUME II and VOLUME III

1.2 In the event of any ambiguity or conflict between the Contract Documents listed above, the order of precedence shall be the order in which the Contract Documents are listed in Article 1.1 (Contract Documents) above.

### 1.3 Definitions (Reference TCC Clause 1)

Capitalized words and phrases used herein shall have the same meanings as are ascribed to them in the Terms and Conditions of Contract.

### Article2. Contract price & terms of payment

#### 2.1 Contract Price (Reference TCC Clause 3.3.1)

KREDL hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations hereunder. The Contract Price shall be paid in INR (Indian Rupees) only with a total amount *[amount of in*

*[words], [amount in figures]*, or such other sums as may be determined in accordance with the terms and conditions of the Contract. The Contract Price is definitive as indicated in the Final Price Bid and the Contractor shall not be entitled to any increase or variation in Contract Price, except initiated by KREDL as per the provisions of the Contract.

2.2

**Terms of Payment** (Reference TCC Clause 3.3.2)

The terms and procedures of payment according to which KREDL will reimburse the Contractor are given in Appendix 1 (Terms and Procedures of Payment) hereto.

Article 3. Effective date for determining time for completion

3.1

**Effective Date** (Reference TCC Clause 3)

The Time of Completion of the Facilities shall be determined from the date of signing of Contract Agreement provided all of the following conditions have been fulfilled within a period of 30 (thirty) Days from the date of said Notification of Award:

- a) This Contract Agreement has been duly executed for and on behalf of KREDL and the Contractor;
- b) The Contractor has submitted to KREDL the required Performance Security required in this Contract.

Each Party shall use its best efforts to fulfill the above conditions for which it is responsible as soon as practicable.

3.2

If the conditions listed under 3.1 are not fulfilled within 30 (thirty) Days from the date of Notification of Award, the Bid submitted by the Bidder will be rejected and the Bid Security will be forfeited, subject to the decision of KREDL.

Article 4.

4

It is expressly understood and agreed by and between the Contractor and KREDL that KREDL is entering into this Agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood and agreed that the Government of India is not a Party to this Agreement and has no liabilities, obligations or rights hereunder. It is expressly understood and agreed that KREDL is an Independent legal entity with power and authority to enter into Contracts solely on its own behalf under the applicable laws of India and the general principles of Contract Law. The Contractor expressly agrees, acknowledges and understands that KREDL is not an Agent, Representative or Delegate of the Govt. of India. It is further understood and agreed that the Government of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the Contract. Accordingly, the Contractor expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Government of India arising out of this Contract and covenants not to sue the Government of India as to any manner, claim, cause of action or thing whatsoever arising of or under this Agreement.

Article 5: Appendices

5

The Appendices listed in the attached list of Appendices shall be deemed to form an integral part of this Contract Agreement.

Reference in the Contract to any Appendix shall mean the Appendices attached hereto, and the Contract shall be read and construed accordingly.

IN WITNESS WHEREOF KREDL and the Contractor have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.

Signed by for and on behalf of the KREDL

(Signature)

(Title)

in the presence of \_\_\_\_\_

Signed by for and on behalf of the Contractor

(Signature)

(Title)

in the presence of \_\_\_\_\_

#### CONTRACT AGREEMENT

dated \_\_\_\_\_ the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_

BETWEEN

KREDL

And

\_\_\_\_\_ (the Contractor)

#### APPENDICES:

Appendix 1 Terms and Procedures of Payment

Appendix 2 Insurance Requirements

Appendix 3 Time Schedule

Appendix 4 List of Approved Subcontractors

Appendix 5 Scope of Works and Supply by KREDL

Appendix 6 List of Documents for Approval or Review

Appendix 7 Functional Guarantees

## TERMS AND PROCEDURES OF PAYMENT

### TERMS OF PAYMENT:

#### A **Plant and Equipment (Module, BESS, Inverter, Balance of Plant and Equipment) and Mandatory Spares**

In respect of Plant and Equipment along with Mandatory Spares supplied, the following payments shall be made:

<b>Payment milestone</b>	<b>Payment Terms</b>
On receipt of material at Site as a part of the Plant and Equipment subject to inspection and certification by the Facilities Manager/ Third Party consultant appointed by KREDL	50% (fifty percent) of Basic Price of the material(Part A+ Part B+ Part C of SOR-1(Price) ) + 100% of the Tax
On achievement of Installation Services and Pre-Commissioning Testing of Plant and Equipment of relevant MW certified and witnessed by KREDL KPTCL, KSPDCL or any other applicable authority (as applicable)	30% (thirty percent) of Basic Price of the material (Part A+ Part B+ Part C of SOR-1(Price))
On Operational Acceptance by KREDL and issuance of Operational Acceptance certificate provided by KREDL, KPTCL, KSPDCL (as applicable)	10% (ten percent) of Basic Price of the material(Part A+ Part B+ Part C of SOR-1(Price))
One (1) Year after the date of Operational Acceptance	10% (ten percent) of Basic Price of the material(Part A+ Part B+ Part C of SOR-1(Price))
Payment of Mandatory Spares after Commissioning and prior Operational Acceptance by KREDL supported by the certification from KREDL/ Third Party consultant appointed by KREDL (as applicable)	100% (one hundred percent) of Basic Price of the material (Part A+ Part B+ Part C of SOR-1(Price)) + 100% of the Tax for the receipt of material at Site as a part of Mandatory Spares

#### B **Installation Services**

In respect of Installation Services for Services and Civil Works, the following payments shall be made:

<b>Payment milestone</b>	<b>Payment Terms</b>
On achievement of Installation Services and Testing of Plant and Equipment of relevant MW certified by KREDL	60% (sixty percent) of Basic Price (Part D+ Part E+ Part F of SOR-1 (Price)) of the completed works as a part of Installation Services (Services and Civil) + 100% of the Tax for the completed the works as a part of Installation Services (Services and Civil)
On Operational Acceptance by KREDL and issuance of Operational Acceptance certificate provided by KREDL, KPTCL, KSPDCL (as applicable)	20% (twenty percent) of Basic Price (Part D+ Part E+ Part F of SOR-1 (Price)) of the completed works as a part of Installation Services (Services and Civil)

One (1) Year after the date of Operational Acceptance	20% (twenty percent) of Basic Price (Part D+ Part E+ Part F of SOR-1(Price)) of the completed works as a part of Installation Services (Services and Civil)
---	---

**C O&M**

On quarterly basis for the Basic Price (SOR-2 (O&M)) along with applicable Taxes for the quarter, for the O&M Period, subject to any early termination.

## PAYMENT PROCEDURE

The Procedures to be followed in making application for, certifying and making payments shall be as follows:

### **1. Payment Schedule/Price Break-up for Payments**

1.1 Any payment under the Contract shall be made only after the Contractor's price break-up provided in Final Contract Price is approved by KREDL, submitted as a part of Letter of Award.

### **2. Currency of Payment**

2.1 The Contract Price shall be paid in one currency INR (Indian Rupees) only.

### **3. Application for Payment**

3.1 The Contractor shall submit application to the Facilities Manager for the payment in the proforma enclosed.

3.2 Each such application shall state the amount claimed and shall set forth in details, the order of the Payment Schedule, particulars of the Facilities including the Facilities executed at Site.

3.3 Every invoice shall be supported with a completion certificate signed by the Facilities Manager, without which the invoice will not be considered for further processing.

### **4. Due Dates for Payment**

4.1 KREDL will make payment within 45 (forty five) Days from the date of receipt of invoice in complete respect.

### **5. Mode of Payment**

5.1 The payment will be made through either demand draft or electronic transfer of funds.

### **6. For payments related to supply of Plant and Equipment, Mandatory Spares, Installation Service for Civil Works and Services**

6.1 The Contractor shall maintain a account with a Scheduled Bank at Site for the purpose of receiving all the payments under the Contract(s) and for utilization of payments received from KREDL for disbursement to subcontractors, sub-vendors, PRW's etc., of the Contractor. The Contractor shall maintain separate books of accounts for all payments under this Contract.

6.2 In case the Contractor violates the above provisions, KREDL will have the right to give suitable instructions to the Bank to regulate/freeze the account.

### **FORM OF APPLICATION FOR PAYMENTS**

Facilities:	Date:
Plant and Equipment and Mandatory Spares/ Installation Services:	Contract No.:
Name and Address of Contractor: GST no.:	Contract Name:
Contract Value:	Application serial no.
Unit Reference:	

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10th Block, 2nd Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

Dear Sir,

#### **Application for Payment**

1. Pursuant to the above referred Contract Agreement dated \_\_\_\_\_ the undersigned hereby applies for payment of the sum of \_\_\_\_\_ (Specify amount).
2. The above amount is on account of: (Insert the payment milestone as mentioned under Terms of Payment)

Others (specify)

Final payment (Schedule \*\*) as detailed in the attached schedule(s) which form an integral part of this application.

3. The payment claimed is as per item(s) No (s) \_\_\_\_\_ of the payment schedule annexed to the above mentioned Contract.
4. The application consists of this page, a summary of claim statement (Schedule \*\*), and the following signed schedules

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

The following document are also enclosed:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Signature of the Contractor/ Authorized Signatory

\*Application for payment will be made to 'Facilities Manager' as to be designated for this purpose at the time of Notification of Award.

\*\*Proforma for the Schedules will be mutually discussed and agreed to during the finalization of the Contract Agreement.

Facilities:	Client:
Package:	Contractor:
Title: Billing breakup for mandatory spares	
NOA Ref: CS _____	
Billing breakup (BBU) No. :	

Sl. No.	Description	Quantity	Unit	Unit Price	Total Price	Equipment Make	Equipment Model	Drawing/ Document/ Data sheet No.	Part No.	Remarks

## **Insurance Requirement**

### **I. Insurance to be taken by the Contractor**

In accordance with the provisions of TCC Clause 3.7.4, the Contractor shall at his expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified herein. The identity of the insurers and the form of the policies shall be subject to the approval of KREDL, such approval not to be unreasonably withheld.

Note:

1. KREDL shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to TCC Clause 3.7.4 except for Third Party Liability, Workman's Compensation and KREDL's Liability Insurances and the Contractor's Sub-Contractors shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to TCC Clause 3.7.4, except for the Cargo insurance during transport, Workman's Compensation and KREDL's Liability Insurances. All insurers 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
2. Notwithstanding the insurance requirements mentioned above, it would be the Contractor's responsibility to take adequate insurance cover as may be pertinent to protect his interest and interest of KREDL. If at any point of time during execution of the Contract, the insurance policies are found to be inadequate, the Contractor shall take fresh insurance policies meeting aforesaid requirements. KREDL reserves the right to make suitable recovery from the Contractor, if any.

Upon grant of extension of time for completion by KREDL; the Contractor shall promptly furnish documentary evidence to Facilities Manager towards extension of insurance policies for the period of time extension.

3. Any loss or damage to the plant and equipment during handling, transportation, storage, installation, commissioning, and all activities to be performed until the "Completion of O & M period of the Facilities" shall be to the account of the contractor. The contractor shall be responsible for preference of all claims and make good the damages or loss by way of repairs and/or replacement of plant and equipment damaged or lost. Notwithstanding the extent of insurances cover and the amount of claim available from the underwriter, the contractor shall be liable to make good the full replacement/rectification of all the equipment/materials and to ensure their availability as per project requirement without additional financial liability to KREDL.

The insurance should be in freely convertible currency and insurance policy to be taken should be on replacement value basis and/or incorporating appropriate insurance clause.

The Contractor shall follow local acts and laws as may be prevalent for insurance.

### **Time Schedule**

1. The program of furnishing, installing, commissioning, completion of facilities and FOR site delivery of all Plant and Equipment, Mandatory Spares and Installation Services identifying the key phases in various areas of work like design, procurement, manufacture and field activities including erection works, Planning, Design & Engineering, civil works (including structural steel works), allied works etc. shall be as per Master network enclosed as Annexure-I to this Appendix-4 (The master network submitted by the Bidder as per Attachment-13 to Bid and as mutually discussed and agreed to before Notification of Award shall be enclosed as Annexure-I to Appendix-4 of Contract Agreement). As per this master network, the key milestones are as under. The period is commencing from the date of signing of Contract Agreement.

Further we confirm to carry out comprehensive Operation & Maintenance (O&M) of Solar Photo Voltaic Plant including BESS for 12 (twelve) Years from the date of Facility Acceptance as specified in the Technical Specifications.

2. After the Notification of Award, the Contractor shall plan the sequence of work of manufacture and erection to meet the above stated dates of successful completion of facilities and shall ensure all work, manufacture, shop testing, inspection and shipment of the equipment in accordance with the required construction/erection sequence.
3. Within 30 (thirty) Days of the Notification of Award, the Contractor shall submit to KREDL for his review and approval two copies (one reproducible and one print) of detailed PERT Network schedules with master network activities further exploded based on the Master Network mutually agreed by KREDL and contractor, showing the logic and duration of the activities from the Effective date until the date of Operational Acceptance as per the Completion Time provided in the RFP. The L1, L2, L3 and L4 Schedules and Milestones shall be mentioned clearly in the PERT chart.

#### **4. Pre-Erection Activity Programme**

The erection network will be supported by detailed Pre-erection activity programme covering the following:

- A. Manpower deployment
- B. T&P mobilization
- C. Detailed site mobilization plan
5. Within (1) one week of approval of the network schedule, the Contractor shall forward to the Facilities Manager, copies of the Computer Initial run-Data. The type of outputs and number of copies of each type to be supplied by the Contractor shall be determined by the Facilities Manager.
6. All the networks shall be updated every month or at a frequency mutually agreed upon. Within (7) seven days following the Monthly Review, a progress meeting shall be held, whenever possible at the works, wherein the major items of the plant or equipment are being produced. The meeting will be attended by the Facilities Manager and responsible representative of Contractor that the Facilities Manager consider necessary for the meeting.
7. Access to the Contractor's and Sub-Contractor's work shall be granted to the Facilities Manager at all reasonable times for the purpose of ascertaining the progress.

### **Master Network**

*Access to the Contractor's and Sub-Contractor's work shall be granted to the Facilities Manager at all reasonable times for the purpose of ascertaining the progress.*

### List of Subcontractors

Part-1	<p><b>Nominated subcontractors</b></p> <p>In the event that KREDL wishes to nominate any particular Sub Contractors for the undertaking of any part or parts of the Works, these shall be identified and named by KREDL in the following schedule prior to the issue of the RFP.</p> <p>Full details shall be given of the part of the Works to be executed, and the names and addresses of the Sub-Contractors to whom the part of the Works is to be subcontracted by the Bidder. Where more than one name is given for any part of the Work, the Bidder shall be free to select any of the named Sub-Contractors for that part.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Item of work</th><th style="width: 50%;">Nominated subcontractor</th></tr> </thead> <tbody> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </tbody> </table>	Item of work	Nominated subcontractor										
Item of work	Nominated subcontractor												
Part-2	<p><b>Approved subcontractor</b></p> <p>(Prior to award of Contract the following details shall be completed indicating those Subcontractors proposed by the Bidder by Attachment to his Bid which are approved by KREDL for engagement by the Contractor during the performance of the Works).</p> <p>The following Sub-Contractors are approved for carrying out the item of work indicated. Where more than one Subcontractor is listed, the Contractor is free to choose between them but he must notify KREDL of his choice in good time prior to appointing any selected Sub-Contractor. In accordance with Clause TCC 2.5.1, the Contractor is free to submit proposals for additional Sub-Contractors from time to time. No Sub-Contracts shall be placed with any such additional Sub-Contractors until they have been approved in writing by KREDL and their names added to this list of Approved Sub-Contractors.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Item of work</th><th style="width: 25%;">Nominated subcontractor</th><th style="width: 25%;">Approved Subcontractor</th><th style="width: 25%;">Nationality</th></tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Item of work	Nominated subcontractor	Approved Subcontractor	Nationality								
Item of work	Nominated subcontractor	Approved Subcontractor	Nationality										

### **Scope of works & supply by KREDL**

The following facilities, works, supplies and personnel will be provided / supplied by KREDL and the provisions of the RFP shall apply.

All facilities, works and supplies as described herein will be provided by KREDL in good time so as not to delay the performance of the Contractor, in accordance with the approved Time Schedule and Programme of Performance pursuant to the RFP.

Facilities, works, supplies and personnel will be provided to the Contractor as identified hereunder:

Sr. No.	Facilities	Charges to Contractor

#### **Scope of Work and obligations as covered in the RFP**

**Refer Technical Specification in VOLUME II**

#### **List of Documents for review & approval**

##### **A. Approval**

1. \_\_\_\_
2. \_\_\_\_
3. \_\_\_\_

##### **B. Review**

1. \_\_\_\_
2. \_\_\_\_
3. \_\_\_\_

### **Functional Guarantees**

#### **Guarantees, Liquidated Damages and Performance**

1. The Bidder shall guarantee that the Plant and Equipment along with Facility offered shall meet the rating and performance requirements stipulated for various equipment covered in this specification. The Bidder shall also furnish a declaration in the manner prescribed and included in the relevant schedule of Bid Form & procedures i.e. Annexure G for guarantees which shall attract levy of liquidated damages for non-performance. Refer relevant provisions of Technical Specification in this regard.

### 3. Performance Security Form

#### **Bank Guarantee for Operational Acceptance and during O&M Period**

(To be on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution)

Bank Guarantee No.

Date

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10th Block, 2nd Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

Dear Sirs,

In accordance with Invitation for Bids under your RFP No. \_\_\_\_\_, M/s \_\_\_\_\_ having its registered office at \_\_\_\_\_ (Hereinafter called the Bidder) wish to participate in the bid for selection of Engineering, Procurement and Construction (EPC) Contractor for design, engineering, procurement, supply, construction, erection, testing and commissioning of 2MW (AC) Solar PV Power Plant (2.2MWp DC)with 4.5 MWh Battery Energy Storage System with associated transmission system and comprehensive Operation & Maintenance (O&M) for 12 (twelve) years at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka.

We, the \_\_\_\_\_ [Name & address of bank] \_\_\_\_\_ having our head office at \_\_\_\_\_ guarantee and undertake to pay immediately on demand by \_\_\_\_\_ [Name of KREDL] \_\_\_\_\_ (hereinafter called KREDL) for this Performance Security for Operational Acceptance along with performance during O&M Period of 12 (twelve) years from the date of Operational Acceptance in the form an unconditional Bank Guarantee for the amount of INR \_\_\_\_\_ (Indian Rupees in words) without any reservation, protest, demand and recourse. Any such demand made by the 'KREDL' shall be conclusive and binding on us irrespective of any dispute or difference raised by the Bidder.

Notwithstanding anything contained herein above our liability under this guarantee is restricted to \_\_\_\_\_ and it shall remain with a expiry date up to \_\_\_\_\_ with a claim date up to \_\_\_\_\_ and shall be extended from time to time for such period, as may be desired by M/s. \_\_\_\_\_ whose behalf this guarantee has been given.

In witness where of the Bank, through its authorized officer, has set its hand and stamp on this \_\_\_\_\_ day of \_\_\_\_\_ at \_\_\_\_\_.

#### **WITNESS:**

1. Signature

Name

Official Address

2. Signature

Name

Official Address

**Note:**

1. The Bank Guarantee shall be from a Bank as per relevant provisions RFP.
2. The BG should be on Non-Judicial stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG is executed, whichever is higher. The Stamp Paper shall be purchased in the name of Bidder/Bank issuing the guarantee.

**4. Form of completion certificate**

Date: \_\_\_\_\_

Credit No. \_\_\_\_\_

NIT No. \_\_\_\_\_

(Name of contract)

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10th Block, 2nd Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

Dear Sirs,

Pursuant to TCC Clause 3.5.8 (Commissioning and Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and KREDL dated [date], relating to the [*brief description of the facilities*], we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below.

1. Description of the Facilities or part thereof: [description]
2. Date of Completion: [date]

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities including O & M period and Guarantee Test(s) in accordance with the Contract nor of your obligations during the Defects Liability Period.

Very truly yours,

Title

(Facilities Manager)

**5. Form of operational acceptance certificate**

Date: \_\_\_\_\_  
Loan/credit No. \_\_\_\_\_  
NIT No. \_\_\_\_\_

(Name of contract)

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10th Block, 2nd Stage,  
Nagarbhavi, Bangalore – 560072.  
Karnataka

Dear Sirs,

Pursuant to TCC Sub-Clause 3.5.9.2.1 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and KREDL dated [date], relating to the [brief description of the facilities], we hereby notify you that the Functional Guarantees of the following part(s) of the Facilities were satisfactorily attained on the date specified below.

1. Description of the Facilities or part thereof: [description]
2. Date of Completion: [date]

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during O & M period and the Defects Liability Period.

Very truly yours,

Title

(Facilities Manager)

**6. Form for authorization letter**

(Name of KREDL)  
(Facilities \_\_\_\_\_)

Ref No.  
Date:

To,

M/s (Contractor's Name)

Ref: Contract No. \_\_\_\_\_ dated \_\_\_\_\_ for \_\_\_\_\_ awarded by (*Name of employer*)

Dear Sirs,

Kindly refer to Contract No. \_\_\_\_\_ dated \_\_\_\_ for \_\_\_\_\_ (Contract Name) You are hereby authorized on behalf of \_\_\_\_\_ (Name of KREDL) having its registered office at \_\_\_\_\_ and its Facilities at \_\_\_\_\_ to take physical delivery of materials/equipment covered under dispatch Document/ Consignment Note no. \_\_\_\_\_ dated \_\_\_\_\_ and as detailed in the enclosed Schedule for the sole purpose of successful performance of the aforesaid contract and for no other purposes, whatsoever.

(Signature of the Facilities Authority)

(Designation: \_\_\_\_\_)  
Date: \_\_\_\_\_

Encl: As above

\*Mention LR/RR/ Bill of Landing/ AWB No.

Sr. No.	Contract No.	NOA No./ Contract Agreement No.	Description of Materials/ Equipment	Spec. Quantity No.	Value	Remarks

Signature of the Facilities Authority

(Designation)

(Date)

**7. Form for authorization letter**

(On Non-Judicial stamp of appropriate value)

## Form of Consortium Agreement

Between

M/s \_\_\_\_\_ &amp; M/s \_\_\_\_\_

For Successful performance of the contract for development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System with 12 years O&M at Pavagada Ultra Mega Solar Park in Karnataka

Bidding Document No. \_\_\_\_\_

This Consortium Agreement executed on this \_\_\_\_\_ day of \_\_\_\_\_ Two thousand \_\_\_\_\_ between \_\_\_\_\_ M/s \_\_\_\_\_ a Company incorporated under the law of \_\_\_\_\_ and having its Registered Office at \_\_\_\_\_ (hereinafter called the "Partner-1," which expression shall include its successors, administrators, executors and permitted assigns) and M/s \_\_\_\_\_ a Company incorporated under the laws of \_\_\_\_\_ and having its Registered Office at \_\_\_\_\_ (hereinafter called the "Partner-2", which expression shall include its successors, administrators, executors and permitted assigns) for the purpose of making a bid and entering into the Contract (in case of award) against Bidding Document No. \_\_\_\_\_ for development of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5MWh Battery Energy Storage System with 12 years O&M at Pavagada Ultra Mega Solar Park in Karnataka for \_\_\_\_\_.

WHEREAS, KREDL invited Bids for development of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5MWh Battery Energy Storage System with 12 years O&M at Pavagada Ultra Mega Solar Park in Karnataka vide its notification for bid no. \_\_\_\_\_.

AND WHEREAS the bid has been submitted to KREDL vide proposal no. \_\_\_\_\_ dated \_\_\_\_\_ based on the Consortium Agreement being these presents and the bid in accordance with the requirement of QR have been signed jointly by both the partners and submitted to the KREDL / KREDL.

NOW THEREFORE, THIS UNDERTAKING WITNESSETH AS UNDER:

1. That in consideration of the Award of the Contract by KREDL to the Consortium, we the partners to the Consortium Agreement do hereby agree that Partner-1 (M/s \_\_\_\_\_), shall act as the Lead Partner for self and formed on behalf of Partner-2 and further declare and confirm that we shall be jointly and severally be bound unto KREDL for the execution of the contract in accordance with the Contract Terms and shall be jointly and severally liable to KREDL to perform all the Technical and Contractual obligations. Further, the lead partner is authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the Consortium and the entire execution of the Contract including payment shall be done exclusively with the Lead Partner.

We the partners of the Consortium confirm that in case of award of Contract, each Partners of the Consortium shall execute the work for which we claim to have specific experience and based on which we meet the Qualifying Criteria.

2. Notwithstanding anything contained herein, the other partners do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of the contract and undertake to carry out all the obligations and responsibilities under this Consortium Agreement in order to discharge the obligations and responsibilities stipulated in the contract. Further, if KREDL sustains any loss or damage on account of any breach of the contract, we the Consortium partners jointly and severally undertake to promptly indemnify, and pay such loss/ damages, caused to KREDL on its written demand without any demur, reservation, contest or protest in any manner whatsoever.

This is without prejudice to any rights of KREDL against the Lead Member under the Contract and / or guarantees. It shall not be necessary or obligatory for KREDL to first proceed against the Partner-1 to these presents before proceeding against Partner-2.

3. We, the Consortium partners do hereby undertake and confirm that the Undertaking shall be irrevocable and shall not be revoked till the expiry of Defect Liability Period of the "Works" under the Contract, and further stipulate that the Undertaking herein contained shall terminate upon satisfactory completion of such Defect Liability Period. We further, agree that this Agreement shall be without any prejudice to the various liabilities of the Consortium partners including the Security Deposit as well as other obligations of Consortium partners in terms of the Contract.
4. The Consortium partners will be fully responsible for the quality of all the works and their upon replacement if necessary and timely execution thereof to meet the completion schedule under the Contract.
5. This agreement shall be construed and interpreted in accordance with the Laws of India and the Courts of Delhi shall have exclusive jurisdiction.
6. We, the Consortium partners agree that this Agreement shall be irrevocable and shall form an integral part of the Contract. We further agree that this Agreement shall continue to be enforceable till the successful completion of Contract and till KREDL discharges it.
7. That this Agreement shall be operative from effective date of the Contract.

IN WITNESS WHEREOF, the Consortium partners through their authorized representatives, executed these present and affixed common seals of their respective companies, on the day, month and year first mentioned above.

Witness:

Common seal of M/s \_\_\_\_\_ has been affixed in my/our presence pursuant to Board of Resolution dated \_\_\_\_\_

Signature

Name

Designation

For M/s \_\_\_\_\_ (Consortium Partner-1)

Signature of the Authorized representative

Name

Designation

Common seal of the Company

Witness:

Common seal of M/s \_\_\_\_\_ has been affixed in my/our presence pursuant to Board of Resolution dated \_\_\_\_\_

Signature

Name

Designation

For M/s \_\_\_\_\_ (Consortium Partner-1)

Signature of the Authorized representative

Name

Designation

Common seal of the Company

**8. Form of indemnity bond the removal/ disposal of scrap/ disposal of surplus material**

(To be executed on stamp paper of appropriate value)

**Indemnity Bond**

This indemnity bond executed this \_\_\_\_ day of \_\_\_\_ 20\_\_\_\_ by \_\_\_\_ (Name of Company), a Company registered under the Companies Act, 1956/ Partnership Firm/ Proprietary Concern and having its registered office(s) at \_\_\_\_ (Office Address) hereinafter called the Indemnifier(s)/Contractor(s) (which expression shall, unless excluded by or repugnant to the context, be deemed to mean and include its successors, administrators, executors and permitted assigns).

In favor of

KREDL \_\_\_\_

1. KREDL has awarded the Contractor(s), contract for execution of work ("Scope of Work") as mentioned in the contract agreement no \_\_\_\_ dated \_\_\_\_, entered into between KREDL and Contractor(s), relating to \_\_\_\_\_ (Name & Address of Facilities/Station) (hereinafter called 'the Facilities').
2. The Indemnifier(s) for the purpose of execution of its Scope of Work had from time to time procured and stored \_\_\_\_\_ (Details of material) at the project site.
3. After completion of the Scope of Work by Indemnifier(s), it has been identified that scrap \_\_\_\_\_ (Details of scrap material & its quantity) and/or surplus \_\_\_\_\_ (Details of Surplus Material & its Quantity) belonging to Indemnifier(s) is lying at the said Facilities Site.
4. Now, the scrap \_\_\_\_\_ (Details of Scrap Material & its Quantity) and/ or surplus \_\_\_\_\_ (Details of Surplus Material & its Quantity) belonging to the Indemnifier(s), requires to be removed by Indemnifier(s) from the Facilities Site

NOW THEREFORE THIS INDEMNITY BOND WITNESSETH AS UNDER:

1. That Indemnifier(s) by way of this indemnity requests KREDL to issue necessary exit gate pass(es) in favor of Indemnifier(s) for removal of scrap \_\_\_\_\_ (details of Scrap Material & its Quantity) \_\_\_\_\_ and/ or surplus \_\_\_\_\_ (details of Surplus Material & its Quantity) belonging to Indemnifier(s), from the project.
2. That as per KREDL's procedure, Indemnifier(s) shall ensure loading of trucks for clearing of its scrap \_\_\_\_\_ (details of Scrap Material & its Quantity) and/ or surplus \_\_\_\_\_ (details of Surplus Material & its Quantity) by itself, as aforesaid, under the supervision of CISF personnel.
3. That Indemnifier(s) in consideration of the premises above, for itself and its respective, executors, administrators and assigns, jointly and severally agree and undertake from time to time and at all times hereafter to indemnify KREDL and keep KREDL indemnified from and against all claims, demands, actions, liabilities and expenses which may be made or taken against or incurred by KREDL by reason of the issue of necessary gate pass(es) by KREDL and permitting Indemnifier(s) to remove scrap \_\_\_\_\_ (details of Scrap Material & its Quantity) and/ or surplus \_\_\_\_\_ (details of Surplus Material & its Quantity) belonging to Indemnifier(s), from the project.
4. That Indemnifier(s) undertakes to indemnify and keep KREDL harmless from any act of omission or negligence on the part of the Contractor in following the statutory requirements with regard to

removal/disposal of scrap and surplus belonging to Indemnifier(s), from the Facilities Site aforesaid, by the Indemnifier(s). Further, in case the laws require KREDL to take prior permission of the relevant Authorities before handing over the scrap and/or surplus to the Indemnifier, the same shall be obtained by the Indemnifier on behalf of KREDL.

INWITNESS WHEREOF, the Indemnifier(s), through its authorized representative, has executed these presents on the Day, Month and Year first mentioned above at \_\_\_\_ (Name of place).

Witness:

Indemnifier

1.

2.

(Authorized Signatory)

**9. Performance Security for operation & maintenance (O&M)**

**Bank Guarantee for Operations and Maintenance Period**

(To be on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution)

Bank Guarantee No.

Date

To,

Karnataka Renewable Energy Development Limited (KREDL),  
Head Office, #6/13/1, 10th Block, 2nd Stage,  
Nagarbhavi, Bangalore – 560072.

Karnataka

Dear Sirs,

In accordance with Invitation for Bids under your RFP No. \_\_\_\_\_, M/s \_\_\_\_\_ having its registered office at \_\_\_\_\_ (Hereinafter called the Bidder) wish to participate in the bid for selection of Engineering, Procurement and Construction (EPC) Contractor for design, engineering, procurement, supply, construction, erection, testing and commissioning of 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5MWh with associated transmission system and comprehensive Operation & Maintenance (O&M) for 12 years at Pavagada Ultra Mega Solar Park of Tumakuru District in Karnataka.

We, the \_\_\_\_\_ [Name & address of bank] \_\_\_\_\_ having our head office at \_\_\_\_\_ guarantee and undertake to pay immediately on demand by \_\_\_\_\_ [Name of KREDL] \_\_\_\_\_ (hereinafter called KREDL) for this Performance Security for Operations and Maintenance Period in the form an unconditional Bank Guarantee for the amount of INR \_\_\_\_\_ (Indian Rupees in words) without any reservation, protest, demand and recourse. Any such demand made by the 'KREDL' shall be conclusive and binding on us irrespective of any dispute or difference raised by the Bidder.

Notwithstanding anything contained herein above our liability under this guarantee is restricted to \_\_\_\_\_ and it shall remain with a expiry date up to \_\_\_\_\_ with a claim date up to \_\_\_\_\_ and shall be extended from time to time for such period, as may be desired by M/s. \_\_\_\_\_ whose behalf this guarantee has been given.

In witness where of the Bank, through its authorized officer, has set its hand and stamp on this \_\_\_\_\_ day of \_\_\_\_\_ at \_\_\_\_\_.

**WITNESS:**

1. Signature

Name

Official Address

2. Signature

Name

Official Address

**Note:**

1. The Bank Guarantee shall be from a Bank as per relevant provisions RFP.
2. The BG should be on Non-Judicial stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG is executed, whichever is higher. The Stamp Paper shall be purchased in the name of Bidder/Bank issuing the guarantee.

### **Format for Pre Bid queries**

**Development of 2MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5MWh Battery Energy Storage System along with 12 years plant comprehensive O&M at Pavagada Ultra Mega Solar Park in Karnataka**

**RFP No** \_\_\_\_\_

#### **Bidder's name and address:**

Our queries are attached herewith:

<b>Clause no.</b>	<b>Page no.</b>	<b>Bidder's query</b>	<b>Suggested modification if any</b>	<b>Rationale</b>

**Note:**

The pre bid queries shall be submitted to KREDL's email ID as mentioned in the RFP before the last date of receipt of queries

#### **General**

- KREDL shall not supply any Plant and Equipment during the development of the Facilities.

The bank details of KREDL are available in KREDL website [www.kredl.karnataka.gov.in](http://www.kredl.karnataka.gov.in) .

- All participating interested Bidders need to provide the Organization ID registered with e-portal, GoK by emailing to [kredlmd@gmail.com](mailto:kredlmd@gmail.com), [agm.sgkredl@gmail.com](mailto:agm.sgkredl@gmail.com), [tosgkredl@gmail.com](mailto:tosgkredl@gmail.com) prior to procurement of official copy of the RFP, before the last for purchase of RFP as per the timelines mentioned in the NIT or any corrigendum issued from time to time.

The scan copy of the Cost of RFP shall be submitted online in e-procurement website and the original Cost of RFP shall be submitted offline, as per the provisions provided in the NIT/RFP/ Addendum ONLY.

**Note:** The Bidder shall be solely responsible for submitting their Bid and in no case KREDL

## **VOLUME-II**

- 1. Section I: Scope of work**
- 2. Section II: Technical Specifications**
- 3. Section III: Special Technical Specifications**
- 4. Section IV: Annexures**

# Section I: Scope of Work

## Project Particulars

Design and Engineering	
Proposed AC capacity (MW)	2
Cell / Module Technology	Crystalline Module
Annual degradation factor for Solar PV module	2.5% for first year, 0.55% for balance period
Origin of manufacturer for Solar PV modules	Sourcing from Approved List of Models &Manufacturers (ALMM) as per MNRE or as per the <i>minimum technical specification for Solar PV plant asset</i> out by the MNRE as applicable.
Battery technology	<i>Any battery technology excluding all variants of lead acid batteries with characteristics suitable for operation in Pavagada Solar Park, as per the Project requirements.</i>
Minimum Cumulative Inverter Capacity (MW)	2
Minimum Cumulative Inverter Transformer Capacity (MVA)	2.5
BESS Power Rating (MW) (minimum)	2
Dispatchable BESS Energy Rating (MWh)	4.5
Minimum BESS depth of discharge (DoD)	90%
BESS round trip efficiency (%)	≥85%. Contractor shall charge the BESS exclusively with Solar PV panels only.
BESS Annual Degradation Factor (%) (Normative)	3% (for the initial period of 3 years) 1.5% (from 4 <sup>th</sup> year onwards)
BESS Energy Discharge Duration (C Rate)	C/3. i.e 1.5 Hour for the BESS package of 4.5 MWh BESS (total discharge hour is 3 hrs)
Minimum No. of cycles for BESS	4380 cycles at 25° C at the time of commissioning and/or overall with an assumption of C/3 rate of discharge per day (at 4.5 MWh package level) during the O&M period of 12 years..
Grid charging for BESS	No
O&M period	12 years
Design life of PV Power plant and BESS	25 years
Site Location and Land Details	
Site coordinates	Refer Annexure – E: Project Location
Village	Balasamudra village, Pavagada Talukat Pavagada Solar Park of KSPDCL

<b>Design and Engineering</b>	
District	Tumkur
State	Karnataka
Owner of Project	Karnataka Renewable Energy Development Limited
Land Details	About 17 acres 38 Guntas in Survey No. 83is to be utilized for the Project (i.e., only about 5 acres per MWac will be utilized). However based on the justification by the contractor additional land may be provided.
<b>Electrical Interconnection Details</b>	
Substation	<ul style="list-style-type: none"> <li>• S-4 Substation (220 kV/33 kV)</li> <li>• 33 kV line interconnecting with the 220 kV S-4 Substation, Pavagada Solar Park.</li> <li>• interconnecting with the 220 kV S-4 Substation, Pavagada Solar Park.</li> <li>• 33kV line terminal bay for KREDL battery energy storage system (BESS) interconnecting with the 220 kV S-4 Substation, Pavagada Solar Park.</li> </ul>
Distance to connecting substation (approx.)	Approx. 1.5 km
<b>Performance Parameters</b>	
Performance Ratio (PR)	82%
Proposed generation criteria for the Project	21% AC CUF
First year generation	3.67MU
BESS Availability	>95%
<b>Other Details</b>	
Construction Water	To be arranged by the EPC Contractor
Construction Power	To be arranged by the EPC Contractor

## 1. Brief Scope of Work

Scope of Supply & Work includes all design & engineering, procurement & supply of equipment and materials, testing at manufacturers works, multi – level inspections, packing and forwarding, supply, receipt, unloading and storage at site, associated civil works, services, permits, licenses, installation and incidentals, insurance at all stages, erection, testing and commissioning of a total of 2 MW (AC) Grid Interactive Solar PV Power Plant with 4.5 MWh Battery Energy Storage System (BESS) (excluding all variants of lead acid batteries) , and performance demonstration with associated equipment and materials

on turnkey basis at Pavagada Solar Park along with 12 (Twelve) years comprehensive operation and maintenance from the date of Operational Acceptance.

All works shall be executed as per Technical Specifications given in Section II (Volume II). Section III (Volume II) lays down Special Technical Specifications with reference to site specific design requirements. However, in case of any conflict in requirements between Section II and Section III, Section III (Volume II) shall have the precedence.

## **2. Design and Engineering**

- 2.1. The Contractor shall prepare the detailed design basis report (DBR) along with relevant standards (with respective clause description), PERT Chart and MDL. The Contractor shall submit a copy to Employer for review and approval prior to detail engineering.
- 2.2. All documents and drawings shall be submitted to the Employer both in soft as well as hard copies (5 nos.) for review and approval. Every drawing shall also be submitted in '\*.dwg' format and 'pdf' 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, as suitable, either soft or hard copies to the Contractor with category of approval marked thereon. 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. Re-submit for approval after incorporation of comments
  - Category-III: Not approved. Re-submit for approval after incorporation of comments
  - Category-IV: Kept for record/ reference
  - Category-IV (R): Re-submit for record/ reference after incorporation of comments

(Note: 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)

- 2.3. Submission of basic design data, design documents, drawings and engineering information including Guaranteed Technical Particulars (GTP) and test reports to Employer or its authorized representative for review and approval in hard copy and soft copy from time to time as per project schedule. The documents typically include, but not limited to, the following:
  - Solar insolation data and basis for generation
  - Detailed technical specifications (GTP) of all the equipment
  - General Arrangement (G.A.) and assembly drawings of all major equipment
  - Schematic diagram for entire electrical system (DC, AC and auxiliary systems, BESS)
  - GTP & G.A. drawings for all types of structures/ components, 66 kV or 33 kV switchgears (as applicable) & other interfacing panels
  - Test reports (for type, routine and acceptance tests)
  - Relay setting charts

- Design calculations and sheets (licensed software as well as design templates)
  - Geo technical investigation data and Topographical survey report including topographical survey data in digital format (Excel file) and Contour plan of the area.
  - GA drawings of the entire project including equipment rooms/ inverter control rooms, office cum control room, roads, storm water drainage, sewage networks, security gate, fire protection system, perimeter fencing, transformer yard fencing etc.
  - Transmission line drawings and erection plans as per STU guidelines
  - Quality assurance plans for manufacturing (MQP), Standard Operating procedure (SOP) and field activities (FQP)
  - Detailed site EHS plan, fire safety & evacuation plan and disaster management plan.
  - Detailed risk assessment and mitigation plan.
  - O&M Instruction's and maintenance manuals for major equipments.
  - As-built drawings / documents and deviation list from good for construction (GFC)
- 2.4. Estimation of the plant generation based on Solar Radiation and other climatic conditions prevailing at site.
- 2.5. Design of associated civil, structural, electrical & mechanical auxiliary systems includes preparation of single line diagrams and installation drawings, manuals, electrical layouts, erection key diagrams, electrical and physical clearance diagrams, design calculations for Earth- mat, Bus Bar & Spacers indoor and outdoor lighting/ illumination etc., GTP and GA drawings for the major equipment including transmission line, design basis & calculation sheets, and other relevant drawings and documents required for engineering of all facilities within the project periphery to be provided under this contract.
- 2.6. All drawings shall be fully corrected to match with the actual "As – Built" site conditions and submitted to Employer after commissioning of the project for record purpose. All as-built drawings must include the Good for Construction deviation list.

### **3. Procurement & Supply**

The equipment and materials for Grid Interactive Solar PV Power Plant and BESS with associated system (Typical) shall include but not limited to the transit insurance, receipt, unloading, storage, erection, testing and commissioning of all supplied material for the following:

- 3.1. Adequate capacity of Solar PV modules of suitable rating including module mounting structures, fasteners, suitable MMS foundations and module interconnections.
- 3.2. Array Junction boxes, distribution boxes and Fuse boxes with string monitoring capabilities: MCBs/ isolators, Surge Arrestors and with proper lugs, glands, ferrules, terminations and mounting structures.
- 3.3. DC and AC cables of appropriate sizes with adequate safety and insulation
- 3.4. Power Conditioning Units (PCU) with SCADA compatibility, common AC power evacuation panel with bus bars and circuit breakers, LT & HT Power Interfacing Panels, Plant Monitoring Desk, AC & DC Distribution boards and UPS for emergency power supply along with required batteries
- 3.5. Step – up transformers (inverter duty) in relevance with state grid code and inverter manufacturer requirements.

- 3.6. Battery Energy Storage System (BESS) excluding all variants of lead acid batteries of required power and energy capacity including unit batteries, Battery Management System (BMS), Power Conditioning System (PCS), Step-up transformers, LT & HT switchgear panels, Auxiliary supply system, DC & AC power cables, control and communication cables, along with RTU and related accessories for communication, HVAC system, firefighting system and other related accessories.
- 3.7. Power Transformer in relevance with technical specifications provided in this document and state grid code requirements.
- 3.8. Auxiliary transformer (s) along with cables and accessories for plant internal consumption.
- 3.9. Relay and protection system along with battery system.
- 3.10. LT Power and Control Cables including end terminations and other required accessories for both AC & DC power
- 3.11. Internal 415V interconnection & Indoor feeder panels to cater auxiliary needs of plant
- 3.12. Indoor panels / outdoor structures having incoming and outgoing feeders with VCBs, CTs, PTs, Bus bars, cables terminals kits and Bus coupler having Main and transfer Bus. Each bay shall consist of VCB, CT, Isolators with earth switch, LAs and PT's etc.
- 3.13. Installation, Testing and Commissioning of ABT meters with AMR facility and all necessary metering rated CTs and PTs as per CEA Metering Regulation 2006 as amended time to time and state metering code to comply with relevant regulations issued from time to time.
- 3.14. Providing necessary communication and Data Acquisition System to transfer real time data to SLDC/RLDC as per the specifications of SLDC/RLDC wing and as per grid connectivity approving authority
- 3.15. Lightning arrestors for entire plant area.
- 3.16. HDPE pipes, cable conduits, cable trays and accessories/trenches.
- 3.17. Earthing of the entire plant as per relevant standards.
- 3.18. Control room equipment
- 3.19. Testing instruments for maintenance and monitoring of equipment.
- 3.20. Mandatory spares as per Annexure-D for each package
- 3.21. CCTV cameras for plant surveillance
- 3.22. Fire protection system in buildings and fire extinguishers.
- 3.23. Weather monitoring station shall include but not be limited to the following:
- Pyranometers – for Irradiation in horizontal and tilted plane and Albedo
  - Ultrasonic Anemometer (wind speed and direction)
  - Temperature Sensor – Ambient and module surface
  - Power source to the all sensors
  - Data Logger
- 3.24. Construction of suitable structures for termination of transmission line for taking off from plant end and receipt of lines at Substation end (S/S-4) including construction of terminal bay.
- 3.25. Design & construction of Transmission line/ cable at required voltage level from plant take off point to the designated substation(S/S-4) including right of way (ROW) and construction of bay at designated substation.
- 3.26. Any re-arrangement/ replacement of substation equipment/ materials, including bay construction, if required, at the evacuating substation necessary for evacuation of power from the Plant.

- 3.27. All safety equipment including PPE, mats etc. for safe working environment
- 3.28. Materials and accessories, which are required for satisfactory and trouble-free operation and maintenance of the above equipment like module cleaning system, supply of spares for all equipment, supply of tools and tackles etc.,
- 3.29. Any other equipment / material not mentioned but required to complete the Solar Power Plant with BESS facilities in all respect to comply with existing regulations issued by the appropriate authorities from time to time..

#### **4. Construction and Erection Works**

The items of civil design and construction work shall include all works required for solar PV project and BESS along with terminal bay and should be performed specifically with respect to following but not limited to:

- 4.1. Conducting geotechnical investigation and topographical survey of the given area.
- 4.2. Earthwork for site grading, cutting, filling, levelling & compaction of land.
- 4.3. Construction and erection of boundary wall/fence and main/ security gate(s).
- 4.4. Construction of foundation for mounting structures for SPV panels.
- 4.5. Construction of foundation for BESS.
- 4.6. Civil foundation work of transformers, switchgears, equipment, Water tank etc.
- 4.7. Construction of internal roads with WBM base.
- 4.8. Construction of Equipment room with necessary illumination system and finishing as required.
- 4.9. Office cum stores cum control room building with Supervisor room, pantry, washroom, conference room etc. along with requisite furniture, workstations, air conditioning, internal and external illumination, other equipment as per the specifications.
- 4.10. Suitable arrangement of water shall be ensured to cater to day-to-day requirement of drinking water and permanent water supply for module cleaning and other needs of SPV power plant during entire O&M period.
- 4.11. Suitable Communication System for telemetry, SCADA with remote monitoring capabilities and internet facility.
- 4.12. Construction of Storm water drainage to its nearest outfall point & sewage network including rainwater harvesting mechanism.
- 4.13. Erection of Perimeter lighting along with all accessories and cabling.
- 4.14. Laying of underground / over ground cables (all types, as applicable) with proper arrangements along with appropriate sized ferrules, lugs, glands and terminal blocks. Laying of cables inside the building trench and other locations as required shall be over GI cable trays with proper support and accessories.
- 4.15. Construction of transmission line and terminal bay including Design, route survey, foundation, erection stringing, commissioning as per applicable procedure from take-off point at plant end/ substation to the delivery point at the evacuation substation as per Project Particulars provided above.
- 4.16. Suitable earthing for plant along with earth pits as per standards
- 4.17. All approvals, for equipment, items and works, which are not otherwise specifically mentioned in this document but are required for successful completion of the work in all aspects, including

construction, commissioning, O&M of Solar PV Power Plant and guaranteed performance are deemed to be included in the scope of the contractor.

## **5. Statutory Approvals**

- 5.1. Obtaining statutory approvals /clearances/ compliances on behalf of the Employer from various Government Departments, not limited to, the following: -
  - Pollution control board clearance, if required
  - Drawing and safety approval from chief electrical inspector, GoK
  - RT and MRT (Meter and Relay Testing) pre-commissioning approval from the RT department, Karnataka Power Transmission Corporation (KPTCL)
  - Project commissioning and synchronization approval from KSPDCL
  - License, other fees, cess, and taxes in respect of the allotted land and local, police, municipal laws, policies, rules, and regulations
  - Forest Department, if required
  - All other approval as and when, as necessary for setting up of the solar power plant with BESS including CEIG/ CEA, power evacuation, etc. as per the suggested guidelines. Grid connectivity approval will be in the Scope of the Contractor.
- 5.2. All statutory approvals/permissions and/or No Objection Certificates (NoC) etc. or obtaining connectivity at the substation as per Project Particulars provided above.
- 5.3. All other statutory approvals and permissions and their respective compliances not mentioned specifically but are required to carry out hassle free Construction and O&M of the plant.
- 5.4. Adequate and seamless insurance coverage during EPC and O&M period to mitigate all risks related to construction and O&M of the plant to indemnify the Employer.
- 5.5. The Contractor shall comply with the provision of all relevant acts of Central or State Governments including payment of Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, Workmen's Compensation Act 1923, Industrial Dispute Act 1947, Maturity Benefit Act 1961, Mines Act 1952, Employees State Insurance Act 1948, Contract Labour (Regulations & Abolishment) Act 1970, Electricity Act 2003, Grid Code, Metering Code, MNRE guidelines or any modification thereof or any other law relating whereto and rules made there under or amended from time to time.

## **6. Operation and Maintenance**

- 6.1. Total Operation & Maintenance of the SPV Plant with BESS shall be with the Contractor, after operational acceptance of the plant till culmination of the O&M period and shall include deployment of engineering personnel, technicians and security personnel.
- 6.2. To provide a detailed training plan for all O&M procedures to Employer's nominated staff, which shall have prior approval from the Employer.
- 6.3. Employ and coordinate the training of contractors' personnel who will be qualified and experienced to operate and monitor the facility and to coordinate operations of the facility with the grid system. Discharge obligations relating to retirement/ Superannuating benefits to employees or any other benefit accruing to them in the nature of compensation, profit in lieu / in addition to

salary, etc. for the period of service with the contractor, irrespective continuance of employees with the project as employees of Contractor, after conclusion of O&M period.

- 6.4. To maintain accurate and up-to-date operating logs, records and monthly Operation & Maintenance reports at the facility. Contractor shall keep the measured daily data at regular intervals and provide the same to Employer in electronic form, compatible in CSV format. The right to use the data shall remain with the Employer.
- 6.5. The Contractor shall establish forecasting tools for submitting schedule and comply with CERC Regulations on Forecasting, Scheduling and Deviation settlement of solar generation.
- 6.6. The scope under this Clause shall also include establishing and maintaining forecasting tools and appointment of QCA/Aggregator, if required. % Error (Deviation) shall be calculated as per the said regulations and DSM Charges in case of deviation beyond the permissible limits shall be borne by the Contractor.
- 6.7. Procurement of spare parts, overhaul parts, tools & tackles, equipment, consumables, etc. required for smooth operation and maintenance of the plant as per prudent/ standard utility practices, OEM recommendations and warranty clauses for the entire O&M period.
- 6.8. To upkeep all administrative offices, roads, tool room, stores room, equipment in clean, green and workable conditions.
- 6.9. To carry out periodic overhauls or maintenance required as per the recommendations of the original equipment manufacturer (OEM) and to furnish all such periodic maintenance schedules at the time of plant commissioning/ start of O&M contract.
- 6.10. Handover the system to maintain an inventory of spare parts, tools, equipment, consumables and supplies for the facility's operation along-with required details of recommended spares list with all associated information regarding replacement records, supplier details, tentative cost, storage details, specifications on the basis of replacement frequency and mean time between failures and mean time to restore at the culmination of penultimate year under O&M period.
- 6.11. Availability of vehicles for Employer staff during construction and O&M period as per requirement may be ensured, failing which Employer shall have full right for alternate arrangement at the risk & cost of the contractor.
- 6.12. The contractor shall be responsible for all the required activities for the successful running, committed energy generation & maintenance of the Solar Photovoltaic Power Plant with BESS covering:
  - Deputation of qualified and experienced engineers and technicians at the facility.
  - Deputation of Security personnel for the complete security of plant.
  - Successful running of Solar Power Plant for committed energy generation.
  - Co-ordination with KSPDCL/CTU/other statutory organizations as per the requirement on behalf of Employer for Joint Metering Report (JMR), furnishing generations schedules as per requirement, revising schedules as necessary and complying with grid requirements.
  - Monitoring, controlling, troubleshooting maintaining of logs & records, registers.
  - Furnishing generation data monthly to Employer/Owner by 1st week of every month for the previous month to enable Employer raise commercial bills on BESCOM.
  - Periodic cleaning of solar modules as approved by the Employer and water quality as per the recommendations of OEM

- Replacement of Modules, Invertors/PCU's and other equipment as and when required during the O&M period without additional cost to Employer
- 6.13. Continuous monitoring the performance of the Solar Power Plant with BESS and regular maintenance of the whole system including Modules, BESS, PCU's, transformers, overhead line, outdoor/indoor panels/ kiosks etc. are necessary for extracting and maintaining the maximum energy output from the Solar Power Plant and BESS.
- 6.14. Preventive and corrective O&M of the Solar Photovoltaic Power Plant and BESS including supply of spares, consumables, wear and tear, overhauling, replacement of damaged modules, battery cells/modules, invertors, PCU's and insurance covering all risks (Fire & allied perils, earthquake, terrorists, burglary and others) as required.
- 6.15. The period of Operation and Maintenance will be deemed to commence from the date of completion of performance demonstration/Operational acceptance and successively the complete Solar Photovoltaic Power Plant to be handed over to the O&M contractor for operation and maintenance of the same. O&M contract shall further be extended on the mutually agreed terms and conditions for the mutually agreed period.
- 6.16. All the equipment required for Testing, Commissioning and O&M for the healthy operation of the Plant must be calibrated, time to time, from the NABL accredited labs and the certificate of calibration must be provided prior to its deployment.
- 6.17. The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his or his sub-contractor or Employer's Workmen. This will include procurement of all safety gadgets during Construction and O&M period including but not limited to, rubber mats of appropriate grade, PPE, rubber gloves and suitable shoes etc.

## **7. Operation and Performance Monitoring**

- 7.1. Operation part consists of deputing necessary manpower necessary to operate the Solar Photovoltaic Power Plant and BESS at the full capacity. Operation procedures such as preparation to starting, running, routine operations with safety precautions, monitoring etc., shall be carried out as per the manufacturer's instructions to have trouble free operation of the complete system.
- 7.2. Daily work of the operation and maintenance in the Solar Photovoltaic Power Plant and BESS involves periodic cleaning of Modules including periodic tilt angle change as and when required, logging the voltage, current, power factor, power and energy output of the Plant at different levels. The operator shall also note down time/ failures, interruption in supply and tripping of different relays, reason for such tripping, duration of such interruption etc. The other task of the operators is to check battery voltage-specific gravity and temperature. The operator shall record monthly energy output, down time, etc.
- 7.3. Earth resistance of Plant as well as individual earth pit is to be measured and recorded every month. If the earth resistance is high (compared to standards) suitable action is to be taken to bring down the same.
- 7.4. A maintenance record is to be maintained by the operator/ O&M-in-charge to record the regular maintenance work carried out as well as any breakdown maintenance along with the reasons for the breakdowns and steps taken to attend the breakdown, duration of the breakdown etc.

- 7.5. The Preventive Maintenance Schedules will be drawn such that some of the jobs other than breakdown, which may require comparatively long stoppage of the Power Plant, shall be carried out preferably during the non-sunny days or evenings. Prior information shall be provided to the Employer for such preventive maintenance prior to start.
- 7.6. The Contractor will attend to any breakdown jobs immediately for repair/ replacement/ adjustments and complete at the earliest working round the clock. During breakdowns (not attributable to normal wear and tear) in O&M period, the Contractor shall immediately report the accidents, if any, to the Employer showing the circumstances under which it happened, and the extent of damage and/or injury caused.
- 7.7. The contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules. If negligence / mal operation of the contractor's operator results in failure of equipment, such equipment should be repaired/replaced by the contractor free of cost.

## **8. Security Services**

- 8.1. The contractor has to arrange proper security system including deputation of security personnel at his own cost for the check vigil for the Solar Power Plant for the complete scope of works including comprehensive O&M period.
- 8.2. The security staff may be organized to work on suitable shift system; proper checking & recording of all incoming & outgoing materials vehicles shall be maintained. Any occurrence of unlawful activities shall be informed to Employer immediately. A monthly report shall be sent to Employer on the security aspects.
- 8.3. Any other activities required for completion of project, but not specified in the above shall be in the scope of contractor. The Contractor must provide the BOM of the plant as per the design during the time of submission of design basis report. The detailed technical specifications of major equipment to be followed strictly and are described in the technical specification section.

# Section II: Technical Specifications

## **DISCLAIMER:**

1. Though adequate care has been taken while preparing the Bidding documents, the Bidders/Applicants shall satisfy themselves that the document is complete in all respects. Intimation of any discrepancy shall be given to this office immediately. If no intimation is received from any Bidder within fifteen (15) 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. Karnataka Renewable Energy Development Limited (KREDL), the Employer, reserves the right to modify, amend or supplement this NIT documents including all formats and Annexures.
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 specifications mentioned for all the equipment which include Solar modules, PCU, combiner boxes, DC cables, module mounting structures, transformer, CT, PT, LT/ HT cables, interfacing panels, switch gears & other associated equipment etc., to complete the power generation and evacuation to the designated substation, in the present bidding documents are for the reference only. It is subject to revise/ alter as per the design/ planning/ good engineering practices etc., to be carried out by the selected bidder, to the satisfaction of the Employer or its authorized representatives. It is advised that the bidders must satisfy himself with the prevailing site conditions before design/ plan. The design must be optimized as per the site conditions and directed to achieve the maximum output from the installed capacity at all times. Moreover, the components not separately mentioned, but are required to complete the plant for operation is also included in the scope of bidder and shall be vetted by the Employer or its authorized representatives.

Place:

(Signature)

Name and Designation of bidder

Date:

## **1. Design Philosophy**

1. The main objective of the design philosophy is to construct the plant with in-built Quality and appropriate redundancy to achieve high availability and reliability with minimum maintenance efforts. In order to achieve this, the following principles shall be adopted while designing the system.
  - 1.1. Adequate capacity of SPV modules, PCUs, Junction boxes etc. to ensure generation of power as per design estimates. This will be done by applying liberal de-rating factors for the array and recognizing the efficiency parameters of PCUs, transformers, conductor losses, system losses, site conditions etc.
  - 1.2. Use of equipment and systems with proven design and performance that have high availability track records under similar service conditions.
  - 1.3. Selection of the equipment and adoption of a plant layout to ensure ease of maintenance.
  - 1.4. Strict compliance with approved and proven quality assurance (QA) systems and procedures during different stages of the project, starting from sizing, selection of make, shipment, storage (at site), during erection, testing and commissioning.
  - 1.5. Proper monitoring of synchronization and recording, to ensure availability of power to the grid.
  - 1.6. The plant instrumentation and control system should be designed to ensure high availability and reliability of the plant to assist the operators in the safe and efficient operation of the plant with minimum effort.
  - 1.7. It should also provide the analysis of the historical data and help in the plant maintenance people to take up the plant and equipment on predictive maintenance.
  - 1.8. System design shall have intelligent protection mechanism which may include very fast responsive microprocessor-based relays etc., so that any disturbance from the grid will not cause any damage to the equipment of the Solar Power Plant.
2. The basic and detailed engineering of the plant shall aim at achieving high standards of operational performance especially considering following:
  - 2.1. SPV power plant should be designed to operate satisfactorily in synchronization with the grid within permissible limits of high voltage and frequency fluctuation conditions. It is also extremely important to safeguard the system during major disturbances, internal and external surge conditions while ensuring safe operation of the plant.
  - 2.2. The Module Mounting Structures shall be designed for such that SPV arrays produce maximum energy during the period of respective tilt.
  - 2.3. Shadow free plant layout to ensure minimum losses in generation during the daytime.
  - 2.4. Higher system voltage and lower current options to be followed to minimize ohmic losses.
  - 2.5. Selection of PCUs with proven reliability and minimum downtime. Ready availability of requisite spares.
  - 2.6. Careful logging of operational data / historical information from the Data Monitoring Systems, and periodical analysis of the same to identify any abnormal or slowly deteriorating conditions.
  - 2.7. The designed array capacity at STC shall be suitably determined to meet the proposed guaranteed generation output at the point of interconnection by the contractor in his bid. The Contractor shall take care of first year degradation also by installing additional DC capacity as the CUF calculations will not factor the first-year degradation of the modules.
  - 2.8. Each component offered by the bidder shall be of established reliability. The minimum target reliability of each equipment shall be established by the bidder considering its mean time between failures and mean time to restore, such that the availability of complete system is assured. Bidder's recommendation of the spares shall be on the basis of established reliability.
  - 2.9. Bidder shall design the plant and equipment in order to have sustained life of 22 years with minimum maintenance efforts.
  - 2.10. The work execution planning for supply, erection, commissioning and all other allied works for SPV Power Plant shall be such that it is completed within stipulated time from the date of order/ LOI/ NTP, whichever is later.
3. The specifications provided with this bid document are functional ones; any design provided in this document is only meant as an example. The Contractor must submit a detailed design philosophy document for the project to meet the functional requirements based upon their own design in-line with the above. The bidders are advised to visit the site and satisfy themselves before bidding.

## 2. Electrical System

### 1. Photovoltaic Modules

#### 1.1. Standards and Codes

Standard	Description
IEC 61215-1:2016 Ed.1	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements
IEC 61215-1-1:2016 Ed.1	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules
IEC 61215-1-2 Ed.1	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules
IEC 61730-1:2016 Ed.2	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
IEC 61730-2:2016 Ed.2	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
IEC 61701:2011 Ed.2	Salt mist corrosion testing of photovoltaic (PV) modules (Applicable for coastal and marine environment)
IEC 62716:2013 Ed.1	Photovoltaic (PV) modules - Ammonia corrosion testing (if applicable)
IEC TS 62804-1:2015 Ed.1	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon (under conditions of 85°C/85% RH for minimum 192 hours)
As per the Solar Photovoltaics, Systems, Devices and Components Goods(Requirements for Compulsory Registration) Order, 2017, PV Modules used in the grid connected solar power projects shall be registered with BIS and bear the Standard Mark as notified by the Bureau of Indian Standards.	
Further, PV Modules should have been included in the ALMM list as per MNRE Approved Models and Manufacturers of Solar Photovoltaic Modules (Requirements for Compulsory Registration) Order, 2019 and its subsequent orders.	

#### 1.2. Technical Requirements

Parameter	Specification
Cell/ Module Technology	Crystalline Technology
Origin	Modules shall be domestically manufactured
Module Efficiency (Frontside)	$\geq 19.5\%$
Bifaciality Factor, $\phi$ (Pmp Back / PmpFront at STC)	$0.7 \pm 0.05$

Parameter	Specification
Rated power at STC	No negative tolerance is allowed
Temperature co-efficient of power	Not less than -0.40%/°C
Application Class as per IEC 61730	Class A

Note: Bifaciality shall be verified in accordance with IEC TS 60904-1-2:2019 – Photovoltaic devices - Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices.

### 1.3. Supplier Qualification Criteria

The PV Modules Supplier should have supplied minimum 2MW capacity globally or 2.5 MW in India in the past 5 years (as on last date of Bid submission). The PV Module supplier shall be Class-I local supplier as per MNRE Order dated 23rd Sep, 2020 and its amendments from time to time on Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Renewable Energy (RE) Sector.

### 1.4. Component Specifications

#### 1.4.1. The PV Modules glass panel shall be:

- i. Glass-glass Modules, with minimum of 2 mm glass thickness on each side. It shall be laminated using a laminator with symmetrical structure, i.e. heating plates on both sides.
- ii. The glass used shall have transmittance of above 90%.

#### 1.4.2. Void

#### 1.4.3. The encapsulant used for the PV modules should be polyolefin based, UV resistant and PID resistant in nature. No yellowing of the encapsulant with prolonged exposure shall occur. The encapsulant shall have the following properties.

Parameter	Value
Gel content	> 75%
Volume resistivity	> $1 \times 10^{14}$ Ω.cm
Peeling strength with glass	> 40 N/cm

1.4.4. The sealant used for edge sealing of PV modules shall have excellent moisture ingress protection with good electrical insulation (Break down voltage >15 kV/mm) and with good adhesion strength. Edge tapes for sealing are not allowed.

1.4.5. The module frame shall be made of anodized Aluminum, which shall be electrically & chemically compatible with the structural material used for mounting the modules. It is required to have provision for earthing to connect it to the earthing grid. The anodization thickness shall not be less than 15 micron.

1.4.6. The material used for junction box shall be UV resistant to avoid degradation during module life. The degree of protection of the junction box shall be at least IP67. Minimum three number of bypass diodes and two number of IEC 62852/EN 50521 certified MC4 compatible connectors with appropriate length of IEC 62930/EN 50618 certified 4 sq.mm copper cable shall be provided. The cable length shall be in accordance with the PV Module wiring strategy and adequate to ensure that the cable bending radius standard is not exceeded.

1.4.7. Each PV Module shall be provided a bar code which is embedded inside the module lamination and must be able to withstand harsh environmental conditions. The bar code data

base shall contain the following information. Bar code scanner and database of all the modules containing the following information shall also be provided.

- i. Name of the manufacturer of PV Module
- ii. Name of the Manufacturer of Solar cells
- iii. Type of cell: Mono / Multi
- iv. Month and year of the manufacture (separately for solar cells and module)
- v. Country of origin (separately for solar cells and module)
- vi. I-V curve for the module
- vii. Peak Wattage,  $I_m$ ,  $V_m$  and FF for the module
- viii. Unique Serial No. and Model No. of the module.
- ix. Date and year of obtaining IEC PV module qualification certificate
- x. Name of the test lab issuing IEC certificate
- xi. Other relevant information on traceability of solar cells and modules as per ISO 9000 series.

#### 1.5. Warranty

1.5.1. PV modules must be warranted with linear degradation rate of power output except for first year (maximum 3% including LID) and shall guarantee 80% of the initial rated power output at the end of 25 years.

1.5.2. The modules shall be warranted for minimum of 10 years against all material/ manufacturing defects and workmanship.

1.5.3. The above warranties shall be backed by third party insurance.

#### 1.6. Approval

1.6.1. The Contractor shall provide Guaranteed Technical Particular (GTP) datasheet and Bill of Materials (BOM) of the module that is submitted for approval along with the datasheets of each component. The component datasheet shall contain all the information to substantiate the compliance for component specifications mentioned above.

1.6.2. The Contractor shall also provide test certificates corresponding to the standards mentioned above along with complete test reports for the proposed module. The tests should have been conducted at a test laboratory compliant with ISO 17025 for testing and calibration and accredited by an ILAC/IECEE member signatory. Laboratory accreditation certificate or weblink along with scope of accreditation shall also be submitted.

1.6.3. The BOM proposed shall be the subset of Constructional Data Form (CDF)'s of all the test reports.

1.6.4. The Contractor shall submit a detailed Manufacturing Quality Plan (MQP) for the PV Module with list of checks/tests performed during incoming material inspection, production, pre-dispatch and package.

1.6.5. The Contractor shall obtain the approval of the proposed module make & model prior to manufacturing/ inspection call.

#### 1.7. Manufacturing and Inspection

1.7.1. The Contractor shall inform the module manufacturing schedule to the Employer at least 7 (seven) working days before the start of proposed schedule.

1.7.2. The Employer shall perform material inspection at the Manufacturer's factory before the start of proposed manufacturing schedule. Proof of procurement of components as per the approved BOM mentioning manufacturer name, manufacturing date and relevant test certificate shall be submitted during material inspection for verification.

1.7.3. The Manufacturing shall start only after the clearance by the Employer after the material inspection.

1.7.4. The cells used for module making shall be free from all defects like edge chipping, breakages, printing defects, discoloration of top surface etc. Only Class A solar cell shall be used.

1.7.5. The modules shall be uniformly laminated without any lamination defects.

1.7.6. Current binning of modules shall be employed to limit current mismatch of modules. Different color codes shall be provided on the modules as well as pallet for identification of different bins. Maximum three nos. of bins will be allowed for each module rating.

1.7.7. Pre-dispatch inspection of modules shall be performed as per the inspection protocol attached in Annexure – A.

#### 1.8. Transportation, Handling, Storage and Installation

- 1.8.1.** Transportation, handling, storage and installation of modules shall be in accordance with the manufacturer manual so as not to breach warranty conditions. The Standard Operating Procedure (SOP) for the same shall be shared by the Contractor prior to dispatch.
- 1.8.2.** It is required to construct a temporary platform (graded) while keeping the modules at least above the highest flood level. If the contractor scheduled/ planned to mount the modules immediately after the receipt at site, then the module shall be kept in common storage area with proper arrangement.
- 1.8.3.** Modules shall be dispatched in line with the Construction schedule. If Modules are dispatched ahead of schedule, following measures shall be undertaken:  
Modules shall be covered with tarpaulin sheet. Alternatively, the Modules, properly stacked as per OEM recommendations, shall be stores under a temporary shed. Further, the temporary platform for keeping the modules shall be treated with anti-termite treatment.

## 2. String Monitoring Unit (SMU)

### 2.1. Standards and Codes

Standard/Code	Description
IEC 60529	Enclosure Ingress Protection
IEC 62262	Enclosure Impact Protection
IEC 60269	Fuse
IEC 61643-11	Surge Protection Device
IEC 62852 or EN 50521	Solar cable connector
IEC 60695-2-11	Fire hazard testing

### 2.2. Construction

- 2.2.1. SMU enclosure shall be made of UV resistant, fire retardant, thermoplastic material. Enclosure degree of protection shall be at least IP65 and mechanical impact resistance shall be at least IK08.
- 2.2.2. Not more than two strings can be connected in parallel to a single input of SMU. One spare input terminal along with connector shall be provided for each SMU.
- 2.2.3. Every SMU input shall be provided with fuses on both positive and negative side. In case of negative grounded system, fuse at positive side only is acceptable. The rating of the fuses shall be selected such that it protects the modules from reverse current overload. The fuses shall be 'gPV' type conforming to IEC 60269-6.
- 2.2.4. DC switch disconnector of suitable rating shall be provided at SMU output to disconnect both positive and negative side simultaneously.
- 2.2.5. Type-II surge protective device (SPD) conforming to IEC 61643-11/IEC 61643-31/ EN 50539-11 shall be connected between positive/negative bus and earth.
- 2.2.6. Resistance Temperature Detector (RTD) type or semiconductor type temperature sensor shall be provided to monitor the cabinet temperature.
- 2.2.7. MC4 connector conforming to IEC 62852 or EN 50521 shall be provided at each SMU input. Cable gland (double compression metallic) of suitable size for DC cables shall be provided at the SMU output.
- 2.2.8. UV resistant printed cable ferrules for solar cables & communication cables and punched/ embossed aluminum tags for DC cables shall be provided at cable termination points for identification.
- 2.2.9. Suitable communication interface shall be provided to communicate the data to SCADA. The following parameters shall be measured/ monitored and made available at SCADA.
- i. String current
  - ii. Bus voltage
  - iii. Output current
  - iv. Cabinet temperature
  - v. DC disconnector switch ON/OFF status

vi. SPD operating status

2.3. Warranty

The SMU unit shall be warranted against all material/ manufacturing defects and workmanship for minimum of 2 (two) years from the date of supply.

2.4. Tests

Routine tests and acceptance tests for the assembled unit shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

3. Solar and DC Cables

3.1. Standards and Codes

Cable	From	To	Conductor	Voltage	Applicable
			Insulation	Rating	Standard
Solar Cable*	Module	SMU	Copper/ XLPO	1.1 kV DC/ 1.5 kV DC	IEC 62930/ EN 50618/
DC Cable	SMU	PCU	Copper or Aluminum/ XLPE	1.1 kV DC/ 1.5 kV DC	IS 7098 Part I for 1.1 kV DC IS 7098 Part II for 1.5 kV DC

\* Cable used for module interconnection shall also be referred as solar cable.

3.2. Solar cable outer sheath shall be flame retardant, UV resistant and black in colour. Solar cable with positive polarity should have marking of red line on black outer sheath.

3.3. DC cables shall be single core, armored, Flame Retardant Low smoke (FRLS), PVC outer sheath conforming to IS 7098-I /IS 7098-II. DC cable with positive polarity should have marking of red line on black outer sheath.

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

- i. Cable size and voltage grade
- ii. Word 'FRNC/ FRLS' (as applicable) at every meter
- iii. Sequential marking of length of the cable in meters at every meter

3.5. Cables shall be sized based on the following considerations:

- i. Rated current of module
- ii. In case of central inverters, average voltage drop in the cables (from PV Modules to PCU) shall be limited to 1.5 % of the rated voltage. In case of string Inverters, average voltage drop (from PV module to string inverter) shall be limited to 0.5% of the rated voltage drop. The Contractor shall provide voltage drop calculations in excel sheet.
- iii. Short circuit withstand capability
- iv. De-rating factors according to laying pattern

3.6. Warranty

The cables (Solar and DC) shall be warranted against all material/ manufacturing defects and workmanship for minimum of 1 (one) year from the date of supply.

3.7. Tests

Type test, routine test and acceptance tests requirements shall be as per IEC 62930/EN 50618 for solar cables and IS 7098-1 for DC cables.

3.8. Installation

3.8.1. Cable installation shall be as per IS 1255.

3.8.2. Only terminal cable joints shall be accepted. No cable joint to join two cable ends shall be accepted.

- 3.8.3. Solar cables shall be provided with UV resistant printed ferrules and DC cables shall be provided with punched/ embossed aluminum tags. The marking shall be done with good quality letter and numbers of proper size so that the cables can be identified easily.
- 3.8.4. Cable terminations shall be made with properly crimped lugs and passed through cable glands at the entry & exit point of the cubicles. Bimetallic lugs shall be used for connecting Cu bus bar and Al cables or vice-versa.
- 3.8.5. Solar cables, wherever exposed to direct sunlight and buried underground, shall be laid through Double Wall Corrugated (DWC) HDPE conduits. The size of the conduit or pipe shall be selected on the basis of 40% fill criteria.
- 3.8.6. Solar cables shall be aesthetically tied to Module Mounting Structure using UV resistant cable-ties suitable for outdoor application.
- 3.8.7. A.C and D.C cables shall be kept in separate trenches. The horizontal and vertical clearances between power and communication cable shall not be less than 300mm.

#### 4. Power Conditioning Unit

##### 4.1. Standards and Codes

Power Conditioning Unit (PCU) shall comply with the specified edition of the following standards and codes

<b>Standard</b>	<b>Description</b>
IEC 61683 Ed. 1	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IEC 62109-1 Ed. 1	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
IEC 62109-2 Ed. 1	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
IEC 61000-6-2 Ed. 2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
IEC 61000-6-4 Ed. 2.1	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
IEC 62116 Ed. 2	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC 60068-2-1:2007	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2:2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat
IEC 60068-2-14:2009	Environmental testing - Part 2-14: Tests - Test N: Change of temperature
IEC 60068-2-30:2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)
CEA Technical Standards for Connectivity to the Grid Regulations 2007 with 2013 and 2019 Amendment	
As per the Solar Photovoltaics, Systems, Devices and Components Goods (Requirements for Compulsory Registration) Order, 2017, Inverters used in the grid connected solar power projects shall be registered with BIS and bear the Standard Mark as notified by the Bureau of Indian Standards.	

##### 4.2. Supplier Qualification Criteria

4.2.1. The Inverter Supplier should have supplied minimum 2MW capacity globally or 2.5 MW in India in the past 5 years (as on last date of the bid submission). The solar inverter supplier shall be Class-I local supplier as per MNRE Order dated 23rd Sep, 2020 and its amendments from time to time on Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Renewable Energy (RE) Sector.

#### 4.3. Technical Requirements

Parameter	Specification
Type (String/Central)	String/central
Rated AC power	As per design
Maximum input voltage	1000 V / 1500 V
Rated AC output voltage	As per design
Tolerance on rated AC output voltage	+/-10%
Rated frequency	50 Hz
Operating frequency range	47.5 Hz to 52 Hz
Power factor control range	0.9 lag to 0.9 lead
European efficiency	Minimum 98%
Maximum loss in Sleep Mode	0.05% of rated AC power
Total Harmonic Distortion	Less than 3% at 100% load
Degree of protection	IP 20 (Indoor)/IP 54 (Outdoor)

4.3.1. The rated/ name plate AC capacity of the PCU shall be AC power output of the PCU at 50°C.

4.3.2. Maximum power point tracker (MPPT) shall be integrated in the PCU to maximize energy drawn from the Solar PV array. The MPPT voltage window shall be sufficient enough to accommodate the output voltage of the PV array at extreme temperatures prevailing at site.

4.3.3. The PCU output shall always follow the grid in terms of voltage and frequency. The operating voltage and frequency range of the PCU shall be sufficient enough to accommodate the allowable grid voltage and frequency variations.

#### 4.4. Construction

4.4.1. Power Conditioning Unit (PCU) shall consist of an electronic three phase inverter along with associated control, protection, filtering, measurement and data logging devices.

4.4.2. Every DC input terminal of PCU shall be provided with fuse of appropriate rating. The combined DC feeder shall have suitably rated isolators for safe start up and shut down of the system. One spare DC input terminal shall be provided for each PCU.

4.4.3. Type-II surge protective device (SPD) conforming to IEC 61643-11/IEC 61643-31/ EN 50539-11 shall be connected between positive/ negative bus and earth.

4.4.4. In case external auxiliary power supply is required, UPS shall be used to meet auxiliary power requirement of PCU. It shall have a backup storage capacity of 2 hours.

4.4.5. Circuit Breaker of appropriate voltage and current rating shall be provided at the output to isolate the PCU from grid in case of faults.

4.4.6. The PCU shall be tropicalized and the design shall be compatible with conditions prevailing at site. Suitable number of exhaust fan with proper ducting shall be provided for cooling keeping in mind the extreme climatic condition of the site as per the recommendations of OEM to achieve desired performance and life expectancy.

4.4.7. All the conducting parts of the PCU that are not intended to carry current shall be bonded together and connected to dedicated earth pits through protective conductor of appropriate size. DC negative terminal shall be grounded. In case DC negative grounding is not possible, appropriate anti-PID device shall be provided.

4.4.8. Dedicated communication interface shall be provided to monitor the PCU from SCADA.

4.4.9. PCU front panel shall be provided with LCD/ LED to display all the relevant parameters related to PCU operation and fault conditions. It shall include, but not limited to, the following parameters.

- i. DC input power
- ii. DC input voltage
- iii. DC input current (for each terminal)
- iv. AC output power
- v. AC output voltage (all the 3 phases and line)
- vi. AC output current (all the 3 phases and line)
- vii. Frequency
- viii. Power Factor

#### 4.5. Operating Modes

Operating modes of PCU shall include, but not limited to, the following modes. These operating modes and conditions for transition are indicative only. The Contractor shall provide the detailed flow chart indicating the various operating modes and conditions for transition during detailed engineering.

##### 4.5.1. Standby Mode

The PCU shall continuously monitor the input DC voltage and remain on Standby Mode until it reaches the pre-set value.

##### 4.5.2. MPPT Mode

When the input DC voltage is above the pre-set value and AC grid connection conditions are fulfilled, the PCU shall enter into MPPT mode.

##### 4.5.3. Sleep Mode

When the AC output power/DC input voltage decreases below the pre-set value for pre-set time delay, the PCU shall switch into Sleep Mode.

#### 4.6. Protection Features

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

The PCU shall provide protection against the following type of faults, among others.

- i. DC/AC over current
- ii. DC/AC over voltage
- iii. DC reverse polarity
- iv. DC earth fault
- v. AC under voltage
- vi. AC under frequency/over frequency
- vii. Islanding
- viii. Over temperature
- ix. Lightning surges

#### 4.7. Grid Support Functions

##### 4.7.1. Active power regulation

The PCU shall be able to limit the active power exported to the grid based on the set point provided through PCU front control panel. The PCU shall also be able to automatically limit the active power after an increase in grid frequency above a pre-set value. The ramp rate

shall be adjustable during operation and start-up after fault. The applicability of the requirement shall be as per CEA regulation and compliance.

#### 4.7.2. Reactive power control

The PCU shall be able to inject /absorb reactive power to/ from the grid based on the set point provided through PCU front control panel. The same shall be performed automatically with adjustable ramp rate based on dynamic changes in grid voltage or reactive power reference.

#### 4.7.3. Voltage Ride Through

The PCU shall remain connected to the grid during temporary dip or rise in grid voltage as per the LVRT and HVRT requirements of CEA Technical Standards for Connectivity to the Grid Regulations. The PCU shall also be able to inject reactive power during the period of voltage dip.

### 4.8. Warranty

The complete Power Conditioning Unit shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 (five) years.

### 4.9. Tests

#### 4.9.1. Type Tests

The type test certificates as per the standards mentioned above should be from any of the ILAC/IECEE member signatory accredited test centres. Laboratory accreditation certificate or weblink along with scope of accreditation shall also be submitted. It is the responsibility of the Contractor to substantiate the compliance for CEA Regulations using test reports.

#### 4.9.2. Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

## 5. Inverter Transformer and Auxiliary Transformer

### 5.1. Standards and Codes

Inverter transformer and auxiliary transformer, wherever applicable, shall comply with the latest edition of the following standards and codes including amendments.

Standard	Description
IS 2026, IEC 60076	Specification of Power Transformers
IS 11171, IEC 60076	Dry-Type Power Transformers
IS 2099, IEC 60137	Bushings for alternate voltage above 1000 V
IS 335, IEC 60296	Insulating oil
IS 3639	Fittings and Accessories for Power Transformers
IS 12063	Degree of protection provided by enclosures
CBIP publication no. 295	
Indian Electricity rules and other statutory regulations	

### 5.2. Technical Requirements

Parameters	Inverter Transformer	Auxiliary Transformer
VA Rating	As per system design requirement	

<b>Parameters</b>	<b>Inverter Transformer</b>	<b>Auxiliary Transformer</b>
Voltage Ratio	33 kV / Inverter output voltage	As per system design
Duty, Service & Application	Continuous Solar Inverter application and converter Duty (Outdoor)	Continuous application (Outdoor/Indoor)
Winding	As per system design requirement	2
Frequency	50 Hz	50Hz
Nos. of Phase	3	3
Vector Group & Neutral earthing	As per system/inverter manufacturer requirement	Dyn11
Cooling	ONAN	ONAN/ AN
Tap Changer	OCTC, No. of steps shall be as per system requirement	
Impedance at 75°C	As per Inverter Manufacturer requirement	As per system requirement
<b>Permissible Temperature rise over an ambient of 50°C (irrespective of tap)</b>		
Top Oil	50°C	As per IS/IEC
Winding	55°C	As per IS/IEC
SC withstand time (thermal)	2 second	2 second
Short Circuit Apparent power	As per system requirement	
Termination	As per system requirement	
Bushing rating, Insulation class (Winding & bushing)	33 kV – porcelain bushings 1.1 kV – epoxy bushings	As per the system requirement
Noise level	As per NEMA TR-1	
Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/- 3%, also transformer shall be capable of being loaded in accordance with IEC 60076-7	
Flux density	Not to exceed 1.9 Wb/sq.m. at any tap position with combined frequency and voltage variation from rated V/f ratio by 10% corresponding to the tap. Transformer shall also withstand following over fluxing conditions due to combined voltage and frequency fluctuations: 110% for continuous rating 125% for at least one minute 140% for at least five seconds. Bidder shall furnish over fluxing characteristic up to 150%	
Air Clearance	As per CBIP	

### 5.3. Construction

- 5.3.1. The transformer shall be provided with conventional single compartment conservator with prismatic toughened glass oil gauge. The top of the conservator shall be connected to the atmosphere through indicating type cobalt free silica gel breather with transparent enclosure. Silica gel shall be isolated from atmosphere by an oil seal. Inverter transformers shall be provided with Magnetic Oil Gauge (MOG) with low oil level alarm contact.
- 5.3.2. It is the responsibility of the Contractor to ensure that the inverter transformer comply with all the requirements of inverter provided by the inverter manufacturer.
- 5.3.3. Inverter Transformer shall be designed for at least 5% total harmonic distortion (THD) to withstand distortion generated by the inverter as well as possible outside harmonics from the network.
- 5.3.4. The transformer shall be suitable for continuous operation with a frequency variation of  $\pm$  2.5% from nominal frequency of 50 Hz without exceeding the specified temperature rise.
- 5.3.5. Inverter Transformer shall have shield winding between LV & HV windings. Each LV winding must be capable of handling non-sinusoidal voltage with voltage gradient as specified by the inverter manufacturer. Also, shield winding shall be taken out from tank through shield bushing and the same shall be brought down to the bottom of the tank using copper flat and support insulator for independent grounding.
- 5.3.6. Neutral bushing of Inverter duty transformer shall be brought outside the tank for the testing purpose. It shall be covered with MS sheet and a sticker "For testing purpose only. Do not earth". Neutral bushing of auxiliary transformer shall be brought outside the tank for earthing.
- 5.3.7. Transformer shall have 150 mm dial type Oil Temperature Indicator (OTI) and Winding Temperature Indicator (WTI) with alarm and trip contacts. All indicators shall have accuracy of 1.5%. For inverter transformers, WTI shall be provided for all the windings.
- 5.3.8. The radiators shall be detachable type, mounted on the tank with shut off valve at each point of connection to the tank, lifts, along with drain plug/ valve at the bottom and air release plug at the top.
- 5.3.9. Marshalling Box shall be of sheet steel, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. One dummy terminal block in between each trip wire terminal shall be provided. At least 10% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. Wiring scheme (TB details) shall be engraved in a stainless-steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door
- 5.3.10. Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting arrangement shall be provided.
- 5.3.11. Inverter transformer shall be provided with spring operated Pressure Relief Device (with trip contacts) with suitable discharge arrangement for oil. For Auxiliary transformers, diaphragm type explosion vent shall be provided.
- 5.3.12. Filter valve at top the tank and drain cum sampling valve at bottom of the tank shall be provided.
- 5.3.13. All external surface of the transformer shall be painted with two coats of epoxy-based paint of colour shade RAL 7032. Internal surface of cable boxes and marshalling box shall be painted with epoxy enamel white paint. The minimum dry film thickness (DFT) shall be 100 microns.
- 5.3.14. LV and HV cable box shall be provided with disconnecting chamber to facilitate the movement of transformer without disturbing cable box and termination.
- 5.3.15. Air release plug, bi-directional wheel/skids, cover lifting eyes, transformer lifting lugs, jacking pads, towing holes, core and winding lifting lugs, inspection cover, rating plate, valve schedule plate, accessories and terminal marking plates, two nos. of earthing terminals shall be provided.
- 5.3.16. Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.
- 5.3.17. The accessories listed above are indicative only. Accessories which are not mentioned above but required for satisfactory operation of the transformers are deemed to be included in the contract without extra charges.
- 5.3.18. Fire-protection for inverter transformer shall be provided in accordance with relevant CEA regulations as amended time to time.

#### **5.4. Dry/oil Type Auxiliary Transformer**

5.4.1. Transformer shall be cast resin encapsulated dry type transformer, made of cold rolled grain-oriented silicon steel laminations of M4 grade or better. Winding conductor shall be electrolytic grade Copper/Aluminum and insulation shall be Class F or better.

5.4.2. The transformers shall be housed in a metal protective housing, having a degree of protection of IP-23 suitable for indoor installation. The enclosure shall be provided with suitable hardware and accessories required for satisfactory operation of the transformer per the relevant standard.

#### **5.5. Warranty**

The transformer shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 (five) years from the date of supply.

#### **5.6. Testing and Inspection**

##### **5.6.1. Type Tests and Special Tests**

The following type test and special test reports shall be submitted during detailed engineering. The tests should have been conducted on the similar transformer by NABL accredited laboratory.

###### **5.6.1.1. Type Tests**

- i. Lightning impulse (Full & Chopped Wave) test on windings as per IEC 60076-3
- ii. Temperature Rise test at a tap corresponding to maximum losses as per IEC 60076-2

###### **5.6.1.2. Special Tests**

- i. Measurement of zero-sequence impedance as per IEC 60076-1
- ii. Measurement of harmonics of no-load current as per IEC 60076-1
- iii. Measurement of acoustic noise level as per NEMA TR-1
- iv. Short-circuit withstand test as per IEC 60076-5

In case the contractor is not able to submit the test reports during detailed engineering, the contractor shall submit the reports of type/special tests either conducted by NABL accredited laboratory or witnessed by Employer.

5.6.1.3. Type and Special tests are not required for auxiliary transformers of rating including 100 KVA and below. However, auxiliary transformer shall have minimum 3 star BEE rating as per BIS guidelines.

##### **5.6.2. Routine Tests**

Each completed transformer shall be subjected to following routine tests as per the latest edition of IEC 60076 unless specified otherwise.

- i. Measurement of winding resistance at each tap
- ii. Measurement of voltage ratio between HV and LV windings at each tap
- iii. Check of vector group
- iv. Measurement of no-load loss and no-load current
- v. Measurement of short-circuit impedance and load loss
- vi. Magnetic balance test as per CBIP manual publication no. 295
- vii. Separate source voltage withstand test
- viii. Induced over voltage withstand test
- ix. Measurement of insulation resistance
- x. Marshalling box functional test
- xi. IR Measurement on wiring of marshalling box
- xii. Breakdown voltage test on transformer oil as per IS 335
- xiii. Oil leakage test on completely assembled transformer along with radiators

##### **5.6.3. Tests at Site**

After erection at site all transformer(s) shall be subjected to the following tests.

- i. Measurement of voltage ratio
- ii. Check of vector group
- iii. Magnetic balance test

- iv. Measurement of insulation resistance
- v. Breakdown voltage test on transformer oil

In case the equipment is not found as per the requirements of the Technical Specifications of NIT, all expenses incurred during site testing will be to the Contractor's account and the equipment shall be replaced by him at free of cost.

## 6. HT Switchgear

### 6.1. Standards and Codes

All equipment provided under HT switchgear shall comply with latest editions and amendments of the relevant IEC standards and IS codes. In particular, the switchgear shall comply with the following standards and codes.

<b>Standard/Code</b>	<b>Description</b>
IS/IEC 62271-1	High Voltage Switchgear and Control gear - Part 1: Common Specifications
IS/IEC 62271-100	High Voltage Switchgear and Control gear - Part 100: AC Circuit Breakers
IS/IEC 62271-102	High Voltage Switchgear and Control gear - Part 102: AC Disconnectors and Earthing Switches
IS/IEC 62271-200	High Voltage Switchgear and Control gear - Part 200: AC Metal Enclosed Switchgear and Control gear for Rated Voltages Above 1 kV and Up to and Including 52 kV
IEC 61869	Instrument Transformers
IS 3231	Electrical relays for power systems protection
IEC 60255	Measuring relays and protection equipment
IEC 61850	Communication networks and systems for power utility automation
IEC 61131-3	Programmable controllers - Part 3: Programming languages
IS 9385	High voltage fuses
IS 9431	Indoor post insulators of organic material for systems with nominal voltages greater than 1000 V up to and including 300 kV
IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for A.C. systems
IS 3070-3	Lightning Arresters for Alternating Current Systems - Part 3: Metal Oxide Lightning Arresters Without Gaps
IEC 62052-11	Electricity metering equipment (A.C.) - General requirements, tests and test conditions - Part 11: Metering equipment
IEC 62053	Electricity metering equipment (A.C.) - Particular requirements
IS 14697	AC Static Transformer Operated Watthour and Var-hour Meters, Class 0.2S and 0.5S

### 6.2. Technical Parameters

<b>Parameter</b>	<b>Specification</b>
------------------	----------------------

<b>System Parameters</b>	
Highest system voltage	[36] kV
Rated system voltage	[33] kV
Rated frequency	50 Hz
Number of phases	3
Power frequency withstand voltage	[70] kV (r.m.s.)
Lightning impulse withstand voltage	[170] kV (peak)
System fault current	As per system requirement
<b>Circuit Breaker</b>	
Type	Vacuum type
Operating duty cycle	O – 0.3sec – CO – 3min – CO
Short circuit breaking current	As per system requirement
Short circuit making current	2.5 times S.C. breaking current
Re-strike performance class	C2
Mechanical endurance class	M1

<b>Current Transformer</b>	
Accuracy class	0.2 for metering (0.2s for metering at outgoing feeder), 5P20 for protection
Rated VA burden	As per requirement
Insulation class	Class F
<b>Voltage Transformer</b>	
Accuracy class	0.2 for metering, 3P for protection
Rated VA burden	As per requirement
Insulation class	Class F

### 6.3. Switchgear Panel

- 6.3.1. The switchgear panel shall be free standing, floor mounted, single front, single tier fully compartmentalized, metal enclosed construction. Each panel shall have separate compartments for circuit breaker, bus bars, cable termination and auxiliary circuit.
- 6.3.2. The circuit breakers shall be mounted on horizontally withdrawable trucks with locking facility in SERVICE and TEST positions.
- 6.3.3. The panel enclosure shall be constructed with CRCA steel/Aluzinc sheet. The thickness of load bearing members shall be minimum 3 mm and that of non-load bearing members shall be minimum 2 mm.
- 6.3.4. All surfaces shall be painted with two coats of epoxy-based paint of colour shade RAL 7032. The minimum dry film thickness (DFT) shall be 100 microns.
- 6.3.5. The circuit breaker and auxiliary circuit compartments provided on the front side shall have separate concealed hinged doors. Cable and bus bar compartments provided on the rear side shall have separate bolted covers. All doors and covers shall be provided with neoprene/synthetic rubber gaskets to prevent entry of vermin and dust.

- 6.3.6. Pressure relief device shall be provided in each high voltage compartment of a panel to safely vent the gases in the event of internal arc. Seal-off bushing arrangement shall be provided between the breaker compartment and bus bar/cable compartments to prevent transfer of arc from one compartment to other.
- 6.3.7. Automatic safety shutters shall be provided to cover up the fixed high voltage contacts on bus bar and cable sides when the truck is moved to TEST position.
- 6.3.8. Degree of protection shall not be less than IP 5X for auxiliary circuit compartment. However, for remaining compartments it shall not be less than IP 4X. For outdoor panels, degree of protection shall not be less than IP 55.
- 6.3.9. Mechanical /Electrical interlocks shall be provided to prevent mal-operation and in particular to ensure the following.
- (i) The breaker shall be operated only if it is in SERVICE or TEST position.
  - (ii) Movement of the breaker truck between SERVICE and TEST positions shall be possible only if the breaker is OFF.
  - (iii) It shall be possible to open the door only when the breaker is in TEST position.
- 6.3.10. Panel shall be provided with local bus-bar protection
- 6.3.11. Each switchgear panel shall be provided with thermostatically controlled space heaters, separately for breaker, cable and bus bar compartments, to prevent condensation within the compartment. The space heater shall be connected to 240 V, 50 Hz, single phase AC supply through suitable switch and fuse.
- 6.3.12. 240 V, 5 A, SPN industrial socket-outlet with ON/OFF switch shall be provided in each panel.
- 6.3.13. Each panel shall be provided with LED lamp rated for 240 V, 50 Hz, single phase AC supply for interior illumination controlled by door switch.
- 6.3.14. Gapless, metal-oxide surge arrestors shall be provided between line and earth in cable compartment of the switchgear panel.
- 6.3.15. Suitable lifting hooks shall be provided for each panel.

#### 6.4. Circuit Breakers

- 6.4.1. Circuit breakers shall be of vacuum type. It shall comprise of three separate identical single pole units operated through the common shaft and shall be fully interchangeable both electrically and mechanically.
- 6.4.2. The circuit breaker operating mechanism shall be based on motor operated spring charging and it shall be re-strike free, trip free both electrically and mechanically, with anti-pumping feature.
- 6.4.3. The rated control voltage of the spring charging motor shall be 110 VDC/230 VAC. Closing coil shall operate at all values of voltages between 85% and 110% of rated voltage. Opening coil shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity and at all values of supply voltage between 70% and 110% of rated voltage.
- 6.4.4. The spring charging motor shall have adequate thermal rating such that continuous sequence of the closing and opening operations is possible as long as power supply is available to the motor. It shall also be possible to charge the spring manually and close the breaker in the event of failure of motor / control supply to motor. Operating handle shall be provided for charging the operating mechanism. After failure of control supply to the motor, one open-close-open operation shall be possible with the energy contained in the operating mechanism.
- 6.4.5. The motor rating shall be such that it requires not more than 30 seconds for full charging of the closing spring. Closing action of the circuit breaker shall compress the opening spring ready for tripping. When closing springs are discharged after closing the breaker, they shall be automatically charged for the next operation.
- 6.4.6. Mechanical indicators shall be provided to indicate OPEN/CLOSED positions of the circuit breaker and CHARGED/ DISCHARGED positions of the closing spring. An operation counter shall also be provided. These indicators and counter shall be visible from the panel front door without opening it.

#### 6.5. Relays

6.5.1. All relays shall be microprocessor based numerical type. However, auxiliary relays can be static or electromechanical type. The relays shall be flush mounted on panel front with connections from the inside.

6.5.2. Auxiliary voltage of the relays shall be 110 VDC and the relays shall be capable of operating continuously between 80 – 120% of auxiliary voltage.

6.5.3. All numerical relays shall have adequate number of freely configurable, optically isolated, Binary Inputs (BI) and potential free Binary Outputs (BO).

6.5.4. All numerical relays shall have minimum four no. of current inputs, three for phase current and one for earth current, suitable for CT secondary current of 1A. The current inputs shall be compatible with both residual connected CT and Core Balance CT (CBCT). In addition, numerical relay in main outgoing feeder shall have three no. of voltage inputs for Under Voltage/Over Voltage protection.

6.5.5. All I/O's shall have galvanic isolation. Analog inputs shall be protected against switching surges and harmonics.

6.5.6. Making, breaking and continuous capacity of the relay contacts shall be adequate for the circuits in which they are used.

6.5.7. The numerical relay shall have the following protection functions with at least two independent protection setting groups. The protection functions shall be selectable from any of the IEC characteristic curves.

- (i) Definite time (DT) phase over current protection
- (ii) Inverse Definite Minimum Time (IDMT) phase over current protection
- (iii) Definite time (DT) earth fault current protection
- (iv) Inverse Definite Minimum Time (IDMT) earth fault current protection
- (v) Under Voltage protection
- (vi) Over Voltage protection

6.5.8. Transformer feeder protection relay shall have provision for the following protection functions.

- (i) Buchholz alarm & trip
- (ii) Oil Temperature Indicator (OTI) alarm & trip
- (iii) Winding Temperature Indicator (WTI) alarm & trip
- (iv) Pressure Relief Valve (PRV) trip
- (v) Magnetic Oil Gauge (MOG) alarm

6.5.9. All numerical relays shall have provision for measurement and storage of electrical parameters such as voltage, current, frequency, active power, reactive power etc.

6.5.10. The numerical relay shall be able to record faults and events in non-volatile memory.

- (i) Fault record – At least 5 recent faults including the protection function operated, operating phase(s), voltages and currents along with date and time stamp.
- (ii) Event record – At least 200 events with date and time stamp.

6.5.11. The numerical relay shall have trip circuit supervision facility to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions. The relay shall also be able to provide circuit breaker monitoring, CT and VT supervision.

6.5.12. The numerical relay shall have self-diagnostic feature with separate output contact for indication of any internal relay failure.

6.5.13. The numerical relay shall have RS-232/RS-485/RJ-45/USB ports on front side for local communication with PC and on rear side for remote communication to SCADA system.

6.5.14. The numerical relay shall have feature for time synchronization through the SCADA System / networking.

6.5.15. The numerical relay shall be provided with backlit alphanumeric LCD to access protection settings, measurement parameters, fault and event records. Read and write access to protection settings shall be password protected.

## 6.6. Instrument Transformers

6.6.1. Instrument transformers shall be completely encapsulated cast resin type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchgear is operating at its rated load and the outside ambient temperature is 50°C.

6.6.2. Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

6.6.3. Voltage transformers shall be single phase units. Bus voltage transformers shall be housed in a separate panel on withdrawable truck.

6.6.4. HRC fuses of suitable rating shall be provided on primary side of voltage transformers. For secondary side, four pole Miniature Circuit Breakers (MCB) shall be provided with its supervision facility.

#### 6.7. Earthing

6.7.1. An earth bus made of copper shall be provided throughout the length of the panel. It shall be bolted to the framework of each panel and brazed to each breaker earthing contact bar.

6.7.2. The earth bus shall have sufficient cross section to carry maximum fault current without exceeding the allowable temperature rise.

6.7.3. All non-current carrying conductors of the panel shall be connected to the earth bus. All joints to the earth bus shall be made through at least two bolts. Hinged doors shall be earthed through flexible earthing braid of adequate cross section. Suitable provision shall be provided at each end of the earth bus for connection with Owner's Earth conductor.

6.7.4. Positive earthing of the breaker truck and frame shall be maintained when it is in the connected position and in all other positions whilst the auxiliary circuits are not totally disconnected.

6.7.5. All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth bus by independent copper wires of size not less than 2.5 sq. mm with green colour insulation.

6.7.6. Instrument transformer secondary neutral point shall be earthed at one place only on the terminal block. Such earthing shall be made through links so that earthing of one circuit may be removed without disturbing the earthing of other circuits.

6.7.7. Separate earthing trucks shall be provided for earthing of busbars and incoming/outgoing feeders. The trucks shall have voltage transformer to indicate presence of voltage prior to earthing. An audible alarm shall also be provided in case of voltage on the earthing terminal. Integral earth switches may also be considered instead of earthing trucks. The earthing truck/switch shall have short circuit withstand capability equal to that of the associated switchgear panel.

6.7.8. The interlocks shall be provided to ensure the following.

- (i) It is not possible to rack-in the earthing truck/close the earthing switch when the breaker truck is in SERVICE position.
- (ii) It is not possible to rack-in the breaker truck into SERVICE position when earthing truck is connected/earthing switch is in closed position.

#### 6.8. Bus bar

6.8.1. Bus bar shall be made of copper or aluminum with uniform cross section throughout their length. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit current.

6.8.2. All bus bars joints shall be thoroughly cleaned and anti-oxide grease shall be applied. Plain and spring washers shall be provided to ensure good contacts at the joints and taps. Wherever aluminum to copper connections are required, suitable bimetallic connectors or clamps shall be used.

6.8.3. Bus bars shall be provided with heat shrinkable sleeves of suitable insulation class throughout their length with proper colour coding. All bus bar joints and taps shall be shrouded.

6.8.4. Bus bar support insulators shall be made of non-hygroscopic, arc and track resistant, high strength material suitable to withstand stresses due to over voltage and short circuit current.

6.8.5. The Contractor shall submit busbar sizing calculation for specified continuous and short time current ratings during detailed engineering.

#### 6.9. Measuring Instruments

6.9.1. All the measuring instruments shall be digital, flush mounting type with communication facility.

6.9.2. All feeders except main outgoing feeder shall be provided with digital Multi-Function Meter (MFM). Tri Vector Meter (TVM) shall be provided for the main outgoing feeder (in the HT Panel). Accuracy class of MFM shall be 0.2 and that of TVM shall be 0.2S. 6.9.3

Measuring instruments shall have provision to display the following parameters.

- (i) Line and phase voltages
- (ii) Line and phase currents
- (iii) Active power, Reactive power, Apparent power

- (iv) Frequency
- (v) Power factor
- (vi) Total Harmonic Distortion (THD)

#### 6.10.Wiring and Terminal blocks

- 6.10.1. All internal wiring shall be done with 650 V grade, 1.5 sq.mm. PVC insulated stranded flexible copper wire. For CT secondary circuits, 2.5 sq.mm copper wire shall be used.
- 6.10.2. Wire terminations shall be made with solderless crimping type tinned copper lugs, which shall firmly grip the conductor. Insulation sleeves shall be provided at all the wire terminations.
- 6.10.3. Printed identification ferrules marked to correspond with panel wiring diagram shall be provided at both ends of each wire. The ferrules shall be firmly located on each wire so that they cannot move or turn freely on the wire. Wire identification shall be done in accordance with IS 11353.
- 6.10.4. The Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.
- 6.10.5. All internal wiring to be connected to the external equipment shall terminate on terminal blocks. Terminal blocks shall be rated for 650 V, 10 A and made of non- inflammable material.
- 6.10.6. CT and VT secondary circuits shall be terminated on stud type, non-disconnecting terminal blocks.
- 6.10.7. At least 10% spare terminals shall be provided on each panel and these spare terminals shall be distributed on all terminal blocks.

#### 6.11.Warranty

The HT panel unit shall be warranted against all material/ manufacturing defects and workmanship for minimum of 2 (Two) years from the date of supply.

#### 6.12.Testing and Inspection

##### 6.12.1. Type Tests

The switchgear panel shall be of type tested design. The following type test reports shall be submitted during detailed engineering. The tests should have been conducted on the similar equipment by NABL accredited laboratory.

<b>Test</b>	<b>Standard</b>	<b>Relevant IEC Clause</b>
<b>Switchgear Panel</b>		
Dielectric tests		
Power frequency voltage test	IEC 62271-200	6.2.6.1
Lightning impulse voltage test	IEC 62271-200	6.2.6.2
Dielectric tests on auxiliary and control circuits	IEC 62271-200	6.2.10
Measurement of the resistance of the main circuit	IEC 62271-200	6.4.1
Temperature-rise tests	IEC 62271-200	6.5
Short-time withstand current and peak withstand current tests	IEC 62271-200	6.6
Verification of the IP coding	IEC 62271-200	6.7.1
Verification of making and breaking capacities	IEC 62271-200	6.101
Mechanical operation test	IEC 62271-200	6.102
Internal arc test	IEC 62271-200	6.106

<b>Test</b>	<b>Standard</b>	<b>Relevant IEC Clause</b>
<b>Circuit Breaker</b>		
Mechanical operation test at ambient air temperature (M2 Class)	IEC 62271-100	6.101.2
Basic short-circuit test-duties	IEC 62271-100	6.106
<b>Relays</b>		
Vibration tests	IEC 60255-21-1	
Shock and bump tests	IEC 60255-21-2	
Seismic tests	IEC 60255-21-3	
Electromagneticcompatibilityrequirements	IEC 60255-26	
Product safety requirements	IEC 60255-27	
Common requirements	IEC 60255-1	
Functional requirements	Relevant parts of IEC 60255-100 series	
Communication requirements	IEC 61850	
<b>Current Transformers</b>		
Temperature-rise test	IEC 61869-2	7.2.2
Impulse voltage withstand test on primary terminals	IEC 61869-2	7.2.3
Tests for accuracy	IEC 61869-2	7.2.6
Short-time current tests	IEC 61869-2	7.2.201
<b>Voltage Transformer</b>		
Temperature-rise test	IEC 61869-3	7.2.2
Impulse voltage withstand test on primary terminals	IEC 61869-3	7.2.3
Test for accuracy	IEC 61869-3	7.2.6
Short-circuit withstand capability test	IEC 61869-3	7.2.301

In case the contractor is not able to submit the test reports during detailed engineering, the contractor shall submit the reports of type/special tests either conducted by NABL accredited laboratory or witnessed by Employer.

#### 6.12.2. Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

### 7. AC Cables

#### 7.1. Standards and Codes

All AC Cables shall conform to the following standards and codes.

IS 7098	Crosslinked polyethylene insulated PVC sheathed cables, Part 1: For working voltage up to and including 1100 V
IS 7098	Crosslinked Polyethylene Insulated Thermoplastics Sheathed Cables Part 2: for Working Voltages from 3.3 kV up to and Including 33 kV

- 7.2. All AC cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions.
- 7.3. Only terminal cable joints shall be accepted. No cable joint to join two cable ends shall be accepted. However, cable joints may be allowed if the route length is more than maximum available drum length subject to Employer's approval.
- 7.4. In addition to manufacturer's identification on cables as per relevant standard, following marking shall also be provided over outer sheath.
  - (i) Cable size and voltage grade
  - (ii) Word 'FRLS' at every meter
  - (iii) Sequential marking of length of the cable in meters at every meter
- 7.5. Cables shall be sized based on the following considerations:
  - (i) Rated current the equipment
  - (ii) In case of Central inverters, maximum voltage drop in LT cable (from PCU to inverter transformer) shall be limited to 0.5% of the rated voltage. In case of String inverters, maximum voltage drop (from string inverter to LT combiner panel and from LT combiner panel to Inverter duty transformer) shall be limited to 1.5%. For HT cables (from inverter transformer to plant take off point), maximum voltage drop shall be limited to 0.5 % of the rated voltage. The Contactor shall provide voltage drop calculations in excel sheet.
  - (iii) Short circuit withstand capability as per design for 1s.
  - (iv) De-rating factors according to laying pattern
- 7.6. Warranty
 

All cables shall be warranted for minimum of 1 (one) year against all material/ manufacturing defects and workmanship.
- 7.7. Testing
 

Type, routine and acceptance tests requirements shall be as per relevant standards for all cable sizes.
- 7.8. Installation
  - 7.8.1. Cable installation shall be as per IS 1255.
  - 7.8.2. Cables within transformer yard and switchyard shall be laid through RCC cable trench with supports.
  - 7.8.3. Cable terminations shall be made with properly crimped lugs and passed through cable glands at the entry & exit point of the cubicles. Bimetallic lugs shall be used for connecting Cu bus bar and Al cables or vice-versa.
  - 7.8.4. All AC cables shall be provided with punched/embossed aluminum tags. The marking shall be done with good quality letter and numbers of proper size so that the cables can be identified easily.
- 8. Auxiliary Supply System
  - 8.1. Scheme for Auxiliary supply system shall be submitted by contractor during detailed engineering for the approval by Employer.
  - 8.2. It shall mainly comprise of auxiliary transformer, AC distribution board(s) (ACDB), Battery & battery charger system, emergency lighting network, Uninterrupted power supply (UPS), distribution cables and metering & protective devices.

8.3. Auxiliary system shall be provided with two independent sources for reliable auxiliary power supply.

- a. Following consideration shall be taken into account while sizing the auxiliary transformer:
  - (i) 20% future load margin
  - (ii) 20% design margin
  - (iii) Total connected load at 0.8 power factor

## 9. LT Switchgear

### 9.1. Standards and Codes

All equipment provided under LT switchgear shall comply with latest revisions and amendments of the relevant IEC standards and IS codes. In particular, the switchgear shall comply with the following standards and codes.

<b>Standard/Code</b>	<b>Description</b>
IEC 61439-1	Low-voltage switchgear and control gear assemblies - Part 1: General rules
IEC 61439-2	Low-voltage switchgear and control gear assemblies - Part 2: Power switchgear and control gear assemblies
IEC 60947-1	Low-voltage switchgear and control gear - Part 1: General rules
IEC 60947-2	Low-Voltage Switchgear and Control gear: Circuit Breakers
IEC 60947-3	Low voltage switchgear and control gear: Part 3 Switches, disconnectors, switch-disconnectors and fuse combination units
IEC 60947-4-1	Low-voltage switchgear and control gear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters
IEC 60947-5-1	Low-voltage switchgear and control gear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices
IEC 62052-11	Electricity metering equipment (a.c.) - General requirements, tests and test conditions - Part 11: Metering equipment
IS 694	Polyvinyl chloride insulated unsheathed-and sheathed cables/ cords with rigid and flexible conductor for rated voltages - up to and including 450/750V
IEC 61869	Instrument Transformers
IS 3043	Code of practice for earthing
IEC 60255	Measuring relays and protection equipment - Part 1: Common requirements

### 9.2. Technical Parameters

<b>System Details</b>	
Rated system voltage	415 V $\pm$ 10%, 3 Phase, 50Hz, 4 wire, Neutral Solidly Earthed
<b>Digital Multifunctional Meter (MFM)</b>	

Accuracy class	0.5 class for main distribution board at main control room and 0.5 class for DB at inverter room(s)
Communication with SCADA	RS485 communication with Modbus RTU
<b>Current transformer (CT)</b>	
Type	Cast Resin Bar Primary
Voltage class and frequency	650V, 50Hz
CT Secondary Current	1 or 5 A
Class of insulation	Class F
Accuracy class & burden	
a) For Protection	5P20, 5VA PS Class for REF and core balance CT (CBCT)
b) For Metering	Class 0.5, 5VA (min)
Minimum primary earth fault current to be detected by CBCT	1 A
Instrument Security Factor for metering CT	5
<b>Voltage transformer (VT)</b>	
Type	Cast Resin
Accuracy class	0.5
Rated Voltage factor	1.1 continuous, 1.5 for 30 seconds
Class of insulation	E or better
<b>Moulded case circuit breaker (MCCB)</b>	
Rated voltage	415V
Release	Thermal-Magnetic/Microprocessor
Rated current	As per system requirement
Poles	4 poles
Rated insulation level	690V
Rated ultimate and service short circuit breaking Capacity	As per system requirement
Rated Making capacity (as per system requirement)	2.1 X Short circuit breaking Capacity
Utilization category	A

### 9.3. Constructional Details

9.3.1. The panel shall be metal enclosed, free standing, floor mounted, modular type with compartmentalized construction having degree of protection of IP 24 (Indoor) and IP54

(outdoor) as per IS/IEC 60529. All doors and covers shall be provided with neoprene gaskets to prevent entry of vermin and dust.

9.3.2. All switches, push buttons etc. shall be operated front and shall be flush/semi-flush mounted.

9.3.3. The panel shall be fabricated from 2 mm CRCA sheet steel for frame & load bearing surfaces. Partitions may be fabricated from 1.6 mm CRCA if no components are mounted on them.

9.3.4. Cable entries shall be from bottom. The opening of cable entry shall be covered by 3mm thick gland plates with proper sealing to avoid water and rodent entry.

9.3.5. Earthing bus bar of suitable cross section shall be provided throughout the length of panel.

9.3.6. The panel shall be duly wired with suitable size of 1.1kV, PVC insulated cable and terminals shall be brought out for cable connections. 10% spare terminals subjected to minimum one of each rating shall be provided on each distribution switchgear. All wire shall have ferrules as per wiring diagram.

9.3.7. The panel shall be painted with 2 coats of primer after pre-treatment and 2 coats of Polyurethane / epoxy paint with shade as decided by the Owner.

9.3.8. The panel shall be of dead front construction suitable for front operated and back maintained functioning.

9.3.9. 240 V, 5 A, 3 pin industrial socket-outlet with ON/OFF switch shall be provided in each panel.

9.3.10. Each panel shall be provided with LED lamp rated for 240 V, 50 Hz, single phase AC supply for interior illumination controlled by door switch.

9.3.11. Suitable lifting hooks shall be provided for each panel.

9.3.12. Each switchgear panel shall be provided with thermostatically controlled space heaters to prevent condensation within the enclosure. The space heater shall be connected to 240 V, 50 Hz, single phase AC supply through suitable switch and fuse.

9.3.13. Earth leakage relay with Core balance CTs (CBCT) shall be provided on main incoming feeders having phase CT ratio more than 50/1A. CBCT's shall be circular window type with window size based on the overall diameter of the cables, to be finalized during detailed engineering.

#### 9.4. Warranty

Distribution panels (ACDB and DCDB) shall be warranted against all material/ manufacturing defects and workmanship for minimum of 1 (one) year from the date of supply.

#### 9.5. Testing

Routine test and acceptance tests requirements shall be as per relevant standards for all cable sizes.

### 10. Uninterrupted Power Supply

#### 10.1. Standards and Codes

Standard/Code	Description
IEC 62040-1	Uninterruptible power systems (UPS) - Part 1: General and safety requirements for UPS
IEC 62040-2	Uninterruptible power systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements
IEC 62040-3	Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements

#### 10.2. General Requirements

10.2.1. The Uninterrupted Power Supply (UPS) system shall be designed to supply power to following loads (but not limited to).

- (i) Data logger / SCADA
- (ii) Fire Detection/ Alarm Panel
- (iii) HMI of SCADA
- (iv) Emergency Lighting
- (v) Inverter's Auxiliary supply (if applicable)

- (vi) HT panel auxiliary
- (vii) CCTV

10.2.2. Sizing of UPS shall be done considering the above-mentioned load at power factor of 0.8 lagging inclusive of 10% design margin at 50 °C.

#### 10.3. System Description

10.3.1. The UPS shall automatically provide continuous, regulated AC power to critical loads under normal and abnormal conditions, including loss of input AC power. The UPS system shall consist of the following major equipment.

- (i) UPS Module Insulated Gate Bipolar Transistor (IGBT) Converter Insulated Gate Bipolar Transistor (IGBT) Inverter Digital Signal Processor (DSP) using Pulse Width Modulation (PWM) for Direct Digital Control (DDC) of all UPS control and monitoring functions Static bypass switch
- (ii) Battery system for 2 hours
- (iii) Battery protective and disconnect device
- (iv) Maintenance bypass switch
- (v) LCD display panel and LED indications
- (vi) Integrated UPS Communications Protocols capable of communicating with SCADA system

10.3.2. The UPS shall meet the following minimum specifications

Parameter	Specification
Topology	Online double conversion UPS
<b>Input</b>	
Voltage	230 V ± 10% AC
Frequency	50 ± 5 Hz
Power factor	0.95
<b>Output</b>	
Voltage	230V ± 1% AC
Frequency	50 Hz
Power factor	0.8
<b>Battery</b>	
Type	Sealed, Maintenance-Free (AGM) battery
Capacity	100% UPS load for 2 hours
<b>Monitoring and communication</b>	
LED Indicators	Load on Inverter, Battery operation, Load on Bypass, Overload, LCD Fault, UPS Fault
Electrical contacts	Closing contacts for each of the following conditions: 1. Unit on Battery 2. Low Battery 3. Summary Alarm 4. UPS On 5. Input Fail
Local Display	LCD/ LED

Parameter	Specification
SCADA communications	RS-232 & RS-485 Interface Port
Overall efficiency	>90%
Electrical Protection	Input/ output under voltage, over temperature, overload, Short circuit, battery low trip

10.3.3. The UPS shall be forced air cooled by internally mounted fans. The fans shall be redundant in nature to ensure maximum reliability. The fans shall be easily replaceable without the use of special tools.

10.3.4. Contractor shall provide the Operation & Maintenance Manual and mandatory spare parts list along with the equipment

#### 10.4.Warranty

UPS shall be warranted for minimum of 5 (five) years and batteries shall be warranted for a minimum of 2 (two) years against all material/ manufacturing defects and workmanship from the date of supply.

#### 10.5.Tests

10.5.1. Routine tests and acceptance tests on final product shall be done as per QAP approved by the Employer.

10.5.2. On completion of installation and commissioning of the equipment on site tests shall be carried out with the max. available load, which does not exceed the rated continuous load. An on-site test procedure shall be submitted by contractor include a check of controls and indicators after installation of the equipment.

### 11. Battery and Battery Charger for UPS

#### 11.1. Standards and Codes

Standard/Code	Description
IEC 60896-22:2004	Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements
IEC 60896-21:2004	Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test
IS 1652	Specification for stationary cells and batteries, lead acid type (with plante positive plates)
IS 8320	General requirements and methods of tests for lead acid storage batteries.
IS 15549	Stationary Regulated Lead Acid Batteries
AIS 048 & AIS 156 and IP 65 Rating, IEC 61427	BESS system comprising of Lithium ion batteries should comply with these standards

#### 11.2.General

110 V DC system (Battery, Battery Charger & DCDB) in accordance with this specification and standards stated herein, shall comprise of the following.

- (i) Sealed Maintenance Free (VRLA) Battery complete with racks & accessories.
- (ii) One No. Float charger.

- (iii) One No. Float cum Boost charger.
- (iv) DC Distribution Board (DCDB)

#### 11.3.Battery

11.3.1. Battery shall be used to supply the following loads with back up of two hours in case of complete power failure:

- (i) Trip and closing coil of HT circuit breaker
- (ii) Spring charging motors for HT circuit breaker
- (iii) Annunciator and Indication circuit of HT panel
- (iv) Auxiliary supply to protection relays

11.3.2. The battery sizing shall account for suitable temperature correction factors, ageing factors of 1.25, design margin of 1.25 & depth of discharge of 90%.

11.3.3. The design of the battery bank and sizing calculation along with the data sheet for the battery and battery charger shall be submitted for approval.

11.3.4. Battery voltage – 220V dc or 110V dc

#### 11.4.Battery Charger

11.4.1. The Float Charger shall be used to supply normal DC loads and float charging current of charged battery. The Float cum Boost charger shall be designed to supply boost charging current requirement of the associated battery as well as to supply normal DC load. After full discharge of battery bank, the Float Cum boost charger shall be capable of charging the battery to its full capacity in 8 hours duration while supplying normal DC load.

11.4.2. The float charger shall have both auto and manual voltage regulation arrangements with provision of selector switch.

11.4.3. Suitable filter circuits shall be provided in all the chargers to limit the ripple content (peak to peak) in the output voltage and current to 2% and 5% respectively.

11.4.4. Digital Outputs shall be configured for connection to the SCADA to monitor the outputs like charger output current, output voltage, float/boost mode, etc.

11.4.5. The charging equipment shall be housed in a free standing, floor mounted compartmentalized panels. Panel shall have provision for bottom cable entry with removable undrilled cable gland plate of 3.0 mm thickness.

11.4.6. The panel shall be of CRCA sheet steel construction having thickness of at least 2.0 mm. Degree of protection provided by the enclosure to the internals of charger shall be IP-42.

11.4.7. The instruments, switches and indicating lamps shall be flush mounted on the front panel.

#### 11.5.DC distribution board (DCDB)

11.5.1. DCDB shall be an integral part of battery charger panel board.

11.5.2. Doors and covers shall be provided with neoprene gaskets to prevent entry of vermin and dust. Also, door shall be provided with lock and key arrangement to prevent unauthorized access to the board.

11.5.3. DCDB shall have adequate number of outgoing feeders with double pole, DC MCBs. At least 20% feeders shall be provided as spare.

#### 11.6.Warranty

Batteries and battery charger shall be warranted for minimum of 2 (two) years against all material/ manufacturing defects and workmanship.

#### 11.7.Tests

11.8.Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

### 12. Earthing

#### 12.1.Standards and Codes

Earthing system shall comply with latest revisions and amendments of the relevant IEC standards and IS codes. In particular, earthing system shall comply with the following standards and codes.

<b>Standard/Code</b>	<b>Description</b>
IS 3043	Code of Practice for Earthing
IEC 62561-2	Requirements for conductors and earth electrodes

IEC 62561-7	Requirements for earthing enhancing compounds
IEEE 80	IEEE Guide for Safety in AC Substation Grounding
IEEE 142	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
Indian Electricity Rules	

## 12.2.General Requirements

- 12.2.1. Earthing system shall be designed based on system fault current and soil resistivity value obtained from geo-technical investigation report. Earth grid shall be formed consisting of number of earth electrodes sufficient enough to dissipate the system fault current interconnected by earthing conductors.
- 12.2.2. The earth electrode shall be made of high tensile low carbon steel rod, molecularly bonded by high conductivity copper on outer surface with coating thickness not less than 250 micron as per relevant standards. Suitable earth enhancing material shall be filled around the electrode to lower the resistance to earth. Inspection chamber and lid shall be provided as per IS 3043.
- 12.2.3. Earth conductors shall be made of copper bonded steel or galvanized steel of sufficient cross section to carry the fault current and withstand corrosion.
- 12.2.4. Earth conductors buried in ground shall be laid minimum 600 mm below ground level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures.
- 12.2.5. Earth electrodes shall not be situated within 1.5m from any building whose installation system is being earthed. Minimum distance between earth electrodes shall be two times the driven depth of the electrode.
- 12.2.6. Transformer yard and switchyard fence shall be connected to the earth grid by one GS flat and gates by flexible lead to the earthed post.
- 12.2.7. All welded connections shall be made by electric arc welding. For rust protection, the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound.

## 12.3.Earthing of PV array field

- 12.3.1. All PV Modules, Module Mounting Structures (MMS) and String Monitoring Unit (SMU) structures in the PV array field shall be bonded to the earthing system by two distinct connections.
- 12.3.2. Each PV Module frame shall be earthed using copper wire of sufficient cross section. The copper wire shall be connected to the earth hole provided in the module frame using suitable arrangement in line with the manufacturer recommendation. The earthing arrangement shall use stainless washers to prevent galvanic corrosion between aluminum frame and copper wire. In order to achieve effective earthing, serrated washers shall be employed to penetrate the anodization layer of the module frame.
- 12.3.3. Continuous copper earthing wire shall be run to connect a group of modules and both ends of the loop shall be bolted to the DC earth grid using bimetallic lugs and stainless-steel fasteners. The copper earthing wire shall be routed in such a way to avoid physical contact with the module aluminum frame.
- 12.3.4. The connection between MMS and DC earth grid shall be bolted or welded. Portion of the MMS which undergoes welding at site shall be coated with two coats of cold galvanizing and anti-corrosion paint afterwards.
- 12.3.5. Earth electrodes of the DC earth grid shall be uniformly distributed throughout the PV array field so that optimum earth resistance is offered to leakage current flowing from any module frame or MMS.
- 12.3.6. SMU equipment earthing point shall be connected to the DC earth grid using flexible copper cable of sufficient cross section as recommended by the manufacturer. The connection with the DC earth grid shall be done using suitable bimetallic lugs and stainless-steel fasteners.

## 12.4.PCU Earthing

DC negative bus bar of the PCU shall be earthed to avoid Potential Induced Degradation (PID). DC negative bus bar and PCU equipment earth shall be bonded to the PCU earth bus and connected to earth electrodes through flexible copper cable of sufficient cross section as mentioned by the manufacturer. The interconnection of PCU earth electrodes with DC earth grid shall be as per PCU manufacturer recommendation.

#### 12.5. Transformer Earthing

- 12.5.1. Inverter transformer neutral shall be floating, not to be earthed. However, recommendation of inverter manufacturer shall also be taken into account.
- 12.5.2. Transformer tank, cable box, marshalling box and all other body earth points shall be earthed.
- 12.5.3. Inverter transformer shield shall be earthed separately using minimum two no. of earth electrodes. Earthing conductor between shield bushing and earth electrodes shall be copper flat of suitable size not less than 25 x 6 mm.
- 12.5.4. Neutral and body of the auxiliary transformer shall be earthed.

#### 12.6. Inverter Room and Main Control Room Earthing

- 12.6.1. Metallic enclosure of all electrical equipment inside the inverter room and main control room shall be connected to the earth grid by two separate and distinct connections.
- 12.6.2. Cable racks and trays shall be connected to the earth grid at minimum two places using galvanized steel flat.
- 12.6.3. SCADA and other related electronic devices shall be earthed separately using minimum two no. of earth electrodes.

#### 12.7. Switchyard Earthing

The metallic frame work of all switchyard equipment and support structures shall be connected to the earth grid by means of two separate and distinct connections. Switchyard shall be shielded against direct lightning stroke by provision of over head shield wire or earth wire or spikes(masts) or a combination there of as per CEA regulations 2010 (Technical standards)- 42(2)(C).

#### 12.8. Tests

Type test reports for earthing electrode, earth enhancing compound and its associated accessories shall be submitted during detailed engineering for approval. On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. The earth plate shall be provided to facilitate its identification and for carrying out periodical inspection.

### 13. Lightning Protection System

- 13.1. Lightning Protection System (LPS) for entire plant against direct lighting strokes shall be provided as per IEC 62305:2010 or NFC 17-102:2011.
- 13.2. Protection level for the entire plant shall be Level-III.
- 13.3. PS as per IEC 62305 Location of air terminals shall be designed as per rolling sphere method.
- 13.4. LPS as per NFC 17-102  
Lightning Protection System shall consist of following accessories.
  - (i) Early Streamer Emission (ESE) air terminal
  - (ii) Highly insulated poly-plastic adaptor to fix the ESE air terminal with the FRP mast
  - (iii) Fiberglass Reinforced Plastic (FRP) mast
  - (iv) Coupler to connect FRP mast with GI mast
  - (v) Galvanized Iron mast with base plate and guy wire kit
  - (vi) Down-conductor: PVC insulated flexible copper cable of suitable size complying with EN 50164-2 or equivalent standard. It shall be routed along the mast with suitable fixings and connectors
  - (vii) Test joint with each down conductor
  - (viii) Lightning event counter complying with EN 50164-6 or equivalent standard. It shall be fixed at suitable height in series with the down conductor.
  - (ix) Earth termination system in accordance with NFC 17-102. Earth electrodes shall comply with the EN 50164-2 or equivalent standard. Earth enhancing compounds complying with EN 50164-7 or equivalent standard, may be used where soil resistivity is higher and making it impossible to achieve system resistance within specified limit.

- 13.5. Accessories listed above are indicative only and any other fittings or accessories, which are usual or necessary for satisfactory operation of the lightning protection shall be provided by the Contractor without extra charges.
- 13.6. Necessary foundation/anchoring for holding the lightning mast in position to be made after giving due consideration to shadow on PV array, maximum wind speed and maintenance requirement at site in future.
- 13.7. The product shall be warranted for minimum of 2 (two) years against all material/ manufacturing defects and workmanship.
- 13.8. Type test reports as per IEC 62305:2010 or NFC 17-102:2011 shall be submitted during detailed engineering for approval.

#### 14. Communication Cables

##### 14.1. Optical Fiber Cables

- 14.1.1. Optic Fiber cable shall be 4/8/12 core, galvanized corrugated steel taped armored, fully water blocked with dielectric central member for outdoor/ indoor application so as to prevent any physical damage
- 14.1.2. The cable shall have multiple single-mode or multimode fibers on as required basis so as to avoid the usage of any repeaters.
- 14.1.3. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturing, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.
- 14.1.4. The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling.
- 14.1.5. All testing of the optic fiber cable being supplied shall be as per the relevant IEC, EIA and other international standards.
- 14.1.6. The Contractor shall ensure that minimum 100% cores are kept as spare in all types of optical fiber cables.
- 14.1.7. Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground buried installation.
- 14.1.8. Spliced/ Repaired cables are not acceptable. Penetration of water resistance and impact resistance shall be as per IEC standard.

##### 14.2. Communication Cable (Modbus)

- 14.2.1. Data (Modbus) Cable to be used shall be shielded type with stranded copper conductor. Cable shall have minimum 2 pair each with conductor size of 0.5 Sq.mm. Cable shall be flame retardant according to IEC 60332-1-2.
- 14.2.2. Cable shall be tested for Peak working voltage of not less than 300 V and shall be suitable for serial interfaces (RS 422 and RS 485).
- 14.2.3. Communication cable shall be laid through underground with suitable HDPE ducts.

#### 15. SCADA

##### 15.1. General Requirements

- 15.1.1. 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 solar plant and its auxiliary systems.
- 15.1.2. 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.
- 15.1.3. 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.
- (vii) Interface with different field equipment in the plant and work seamlessly with field equipment supplied by different companies.
- (viii) 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)

15.1.4. 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.

#### 15.2. Architecture

- 15.2.1. The SCADA System shall be built over Industrial IoT architecture with integrated Analytics, secure web access, enterprise software and Database.
- 15.2.2. Data acquisition shall be distributed across MCR and LCRs while plant level data aggregation shall be done in both local and remote server (as specified by Owner).
- 15.2.3. Analog and Digital IO modules shall have integrated processor for distributed IO processing and control.
- 15.2.4. Data communication system shall be built over fiber 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.
- 15.2.5. Plant SCADA Server shall have Industrial Grade server hardware running SCADA &
- 15.2.6. Monitoring Software with data storage (complete plant data) space for 2 years. 15.2.6 Plant data for monitoring and control operations should be accessible without dependence on external network.
- 15.2.7. A virtual/cloud 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 complete plant data.  
Note: Configuration of Cloud server and procurement of associated subscription services shall be in the scope of the EPC Contractor.
- 15.2.8. 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.
- 15.2.9. 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.
- 15.2.10. 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.

#### 15.3. Industrial IoT Controllers & Data Acquisition

The Plant SCADA and Monitoring System may use one or more IIoT Controllers at each Inverter Control Room 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:

- 15.3.1. The IIoT Controllers shall be distributed in nature and work independently of other IIoT Controllers or any central controller in the system.
- 15.3.2. Shall be capable of supporting wide range of field protocols to communicate with different field equipment (Modbus over RS485/Ethernet, etc.)
- 15.3.3. Shall have local storage for a minimum of 2 weeks (in case of network failure).

- 15.3.4. Provide web-based interface to configure the controller for various equipment in the field.
- 15.3.5. IO Functionality: Shall support status monitoring of VCBs & Trip relays on RMU/HT & Transformer panels through distributed DI/AI modules.
- 15.3.6. Controls: Shall be capable of Controlling breakers (ON/OFF). Both ON/OFF and Parameter control of inverters shall be supported.
- 15.3.7. 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.
- 15.3.8. Controllers shall be capable of sending data over Internet connections USB data cards.
- 15.3.9. Shall not require a static public IP address, at the plant for the purpose of remote access.

#### 15.4. Functionalities

- 15.4.1. 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.
- 15.4.2. The SCADA system shall monitor Instantaneous and cumulative environment parameters from weather sensors or data loggers at same interval as electrical parameters and provide PR, CUF on the fly.
- 15.4.3. 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.
- 15.4.4. The SCADA system shall provide configurable alerts on any parameter crossing settable thresholds. The list of such parameters shall be finalized in consultation with the Owner.
- 15.4.5. 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.
- 15.4.6. 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, irradiance, Inverter Control Room level generation and performance indicators like PR and CUF.
- 15.4.7. Reporting: The SCADA system shall provide downloadable reports in Excel/PDF, configurable for equipment parameters across the plant.
- 15.4.8. The system shall have Configurable Analysis page for self-configured as well as on demand Analytics charts.
- 15.4.9. 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.
- 15.4.10. 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, OPC-UA, data files, as required – with Owner's Central Monitoring System in New Delhi. The data recording intervals for different parameters from different devices in the solar plant shall be considered when creating schedules to “push” the data from Plant SCADA to data receivers stationed at New Delhi.
- 15.4.11. Mobile User Interface: summary of plant performance and issues should be accessible in a mobile Native UI or browser UI.
- 15.4.12. 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.
- 15.4.13. 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.
- 15.4.14. 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.

15.4.15. 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.

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

15.4.17. 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.

#### 15.5. Earthing

15.5.1. 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.

15.5.2. 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.

#### 15.6. Communication Cable Laying

15.6.1. 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.

15.6.2. 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.

15.6.3. 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.

15.6.4. 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.

#### 15.7. Control Cabinets / Panels / Desks at Main Control Room

15.7.1. 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.

15.7.2. 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.

#### 15.8. Software Licenses

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.

#### 15.9. Hardware at Main Control Room

15.9.1. 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.

15.9.2. 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, androdent-proof Server Rack.
Operating System	Operating System and Database shall be of enterprise scale (preferably RedHat Linux or equivalent Linux OS, Oracle/MySQL or Windows 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	Screen Display Unit: Min 50" LED Flat Monitor with wall mounted arrangement for the display of SCADA screen A4 size monochrome laser printer. UPS of required capacity with 2 hour battery backup.

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

#### 15.10. Factory Acceptance Test (FAT)

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

### 16. Power Transformer

#### 16.1. Standards and Codes

Power Transformer shall comply with the latest edition of the following standards and codes including amendments.

Standard	Description
IS 2026, IEC 60076	Specification of Power Transformers
IS 2099, IEC 60137	Bushings for alternate voltage above 1000 V
IS 8468	On-load tap changers
IS 335, IEC 60296	Insulating oil
IS 3639	Fittings and Accessories for Power Transformers

#### 16.2. Technical Requirements

Parameter	Specification
Rated Capacity	As per system design
Rated Voltage	11 kV / 33 kV
Duty & Service	Continuous duty & Outdoor
Number of phases	3
Frequency	50 Hz

<b>Parameter</b>	<b>Specification</b>
Vector group	As per system requirement
Impedance at principal tap and 75°C	10%
Tap changer	On Load Tap Changer (OLTC) on HV side +5% to -15% with steps of 1.25%
Power frequency withstand voltage (winding & bushing)	LV – 70 kV (rms) HV – 140 kV (rms)
Lightning impulse withstand voltage (winding & bushing)	LV – 170 kVp HV – 325 kVp
Permissible temperature rise over an ambient of 50°C (irrespective of tap)	
Top oil	50°C
Winding	55°C
Fault level & duration	As per system requirement
Short-circuit withstand time (Thermal)	2 second
Bushing	HV – 72.5 kV oil filled condenser bushing LV – 36 kV porcelain bushing
Termination	As per system requirement
Noise level	As per NEMA TR-1
Loading capability	Continuous operation at rated MVA on any tap with voltage variation of +/-3%, also transformer shall be capable of being loaded in accordance with IEC 60076-7
Flux density	Not to exceed 1.9 Wb/sq.m. at any tap position with combined frequency and voltage variation from rated V/f ratio by 10% corresponding to the tap. Transformer shall also withstand following over fluxing conditions due to combined voltage and frequency fluctuations: a)110% for continuous rating b)125% for at least one minute c)140% for at least five seconds The Contractor shall furnish over fluxing characteristic up to 150%
Air clearance	As per CBIP

### 16.3.Tank

16.3.1. The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of adequate thickness. The tank and the tank cover shall be of welded construction. All seams and joints shall be welded and where practicable, they shall be double welded. The tank so welded shall be reinforced by stiffener of structural steel for general rigidity.

- 16.3.2. The transformer top shall be provided with a detachable tank cover with bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitably sloped so that it does not retain rain water.
- 16.3.3. The main tank body of the transformer, excluding tap changing compartments and radiators, shall be capable of withstanding pressure of 760mm of Hg.
- 16.3.4. Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
- 16.3.5. Suitable guides shall be provided for positioning the various parts during assembly or dismantling. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.
- 16.3.6. All bolted connections to tank shall be fitted with suitable oil-tight gasket, which shall give satisfactory service under the operating conditions. All gaskets shall be closed design (without open ends) and shall be of one piece only. Gasket of nitrile rubber or equivalent shall be used. Gaskets of neoprene and / or any kind of impregnated / bonded core or cork only which can easily be damaged by over-pressing are not acceptable. Use of hemp as gasket material is also not acceptable.
- 16.3.7. Lifting lugs shall be provided on all parts of the transformer requiring independent handling during assembly or dismantling. In addition, the transformer tank shall be provided with lifting lugs and bosses properly secured to the sides of the tank for lifting the complete transformer assembly with oil either by crane or by jacks.
- 16.3.8. The transformer tank shall be supported on a structural steel base equipped with forged steel single flanged wheels suitable for moving the transformer completely with oil. The wheels shall be bi-directional and mounted on swivels which may be turned through 90° when the tank is jacked up and capable of being locked in position parallel to and at right angles to the longitudinal axis.

#### 16.4.Core

- 16.4.1. The transformer core shall be built up with high-grade non-ageing cold rolled grain oriented (CRGO) silicon steel laminations having high permeability and low hysteresis loss. The thickness of lamination shall be 0.27 mm or less.
- 16.4.2. The transformer shall be so designed that the flux density in the core shall not exceed 1.7 tesla at rated voltage and rated frequency. The maximum flux density in any part of core or yoke at 10% continuous over voltage condition shall not exceed 1.9 tesla.
- 16.4.3. The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulating coating resistant to the action of hot oil.
- 16.4.4. The core shall be rigidly clamped to ensure adequate mechanical strength and to prevent vibration during operation and transportation. The clamping structure shall be designed to minimize eddy current loss.
- 16.4.5. The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and production of flux components at right angles to the plane of the laminations which may cause local heating.

16.4.6. The core shall be provided with lugs suitable for lifting the complete CCA of the transformer. The CCA shall be fixed with the tank so that it does not shift when transformer is moved or during short circuit.

16.4.7. The insulation of core to bolts and core to clamp plates shall be able to withstand a voltage of 2 kV RMS for one minute.

16.4.8. The core shall not be earthed at multiple locations. Terminal shall be brought on top of tank and earthed through link. Core and Frame terminals should be brought out on transformer top so as to enable megger.

#### 16.5. Winding

16.5.1. The conductor for winding shall be made of electrolytic grade copper. The winding shall be so designed that all coil assemblies of identical voltage ratings shall be interchangeable and field repairs can be readily done without special equipment.

16.5.2. The coils shall be supported between adjacent sections by insulating spacers and barriers. Bracings and other insulation used in the assembly of the windings shall be arranged to ensure a free circulation of the oil and to reduce hot spots in the windings.

16.5.3. The insulation paper shall be of high quality and the value of degree of polymerization shall not be less than 1200 Pv.

16.5.4. Materials used for insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise get affected under the operating conditions.

16.5.5. All threaded connections shall be provided with locking facilities. All leads from the winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.

16.5.6. The conductor shall be transposed at sufficient intervals in order to minimize eddy currents and equalize the distribution of currents and temperature along the windings.

16.5.7. Windings shall be subjected to a shrinkage treatment before final assembly, so that no further shrinkage occurs during service. Adjustable device shall be provided for taking up any possible shrinkage of coils in service if required.

16.5.8. The windings shall be clamped securely in place so that they will not be displaced or deformed during short circuits. The assembled core and windings shall be vacuum dried and suitably impregnated before removal from the treating tank. The copper conductors used in the coil structure shall be best suited to the requirements and all permanent current carrying joints in the windings and the locks shall be welded or brazed.

#### 16.6. Insulating Oil

The oil for first filling together with 10% extra shall be supplied with the transformer. The oil shall comply in all respects with the provisions of the latest edition of IS 335 (as amended up to date). Particular attention shall be paid to deliver the oil free from moisture having uniform quality throughout in non-returnable steel drums.

#### 16.7. On-Load Tap Changer

16.7.1. On-Load Tap Changer (OLTC) shall be designed for remote control operation from Remote Tap Change Control (RTCC) Panel in the control room in addition to being capable of local manual as well as local electrical operation. The OLTC shall include the following.

- (i) An oil immersed tap selector and arcing switch or arc suppressing tap selector, provided with reactor or resistor for reduction of make and break arcing voltages and short circuits.
- (ii) Motor driven mechanism
- (iii) Control and protection devices
- (iv) Local /Remote tap changer position indicator
- (v) Manual/Electrical operating device
- (vi) Pressure relief device

16.7.2. The OLTC shall be so designed that the contacts do not interrupt arc within the main tank of the transformer. The tap selector and arcing switch or arc suppressing selector switch shall be located in oil filled compartment. The compartment shall be provided with Oil Surge Relay. It shall be designed so as to prevent oil in the tap selector compartment from mixing with the oil in the transformer tank.

16.7.3. The contactors and associated gear for the driving motor shall be housed in a local kiosk mounted adjacent to or on the transformer. The degree of protection of the complete arrangement shall be IP 55 or better. The motor shall be suitable for operation with three phase, 415 V, 50 Hz external power supply.

#### 16.7.4. RTCC Panel

Remote Tap Change Control (RTCC) Panel shall include, but not limited to, the following.

- (i) Automatic Voltage Regulator with SCADA compatibility
- (ii) Under voltage relay to monitor the taper changer control voltage
- (iii) Raise and lower push button
- (iv) Tap position indicator
- (v) Indication lamp showing tap changing in progress
- (vi) Alarms and Annunciation
- (vii) Any other accessory required for satisfactory operation or required during detail engineering

#### 16.8. Bushing

16.8.1. The bushings shall have high factor of safety against leakage to ground and shall be so located as to provide adequate electrical clearances between bushings and grounded parts. Bushings of identical voltage rating shall be interchangeable.

16.8.2. All bushings shall be equipped with terminals suitable for bimetallic connection. Each bushing shall be so coordinated with the transformer insulation that all flash over will occur outside the tank.

16.8.3. HV bushings shall be 72.5 kV voltage class, oil filled condenser type and hermetically sealed. The bushings shall have provision for measurement of capacitance and loss factor without dismantling of the bushing. The bushings shall be removable without disturbing the Bushing Current Transformers if any. LV bushings shall be 36 kV voltage class, porcelain type. The oil used for the oil filled type bushings shall be the same as that used in the transformer.

#### 16.9. Radiators

16.9.1. Radiators provided shall have sufficient cooling surface to limit the temperature rise to the values as specified in the 'Technical Requirements'. The radiators shall be seamless and made of mild steel/CRCA with minimum thickness not less than 1.2 mm. It shall be suitably braced to protect them from mechanical shocks.

16.9.2. The radiators shall be connected to the tank by machined steel flanges with adequate gaskets to avoid oil leakage. Each radiator unit shall be provided with butterfly type or

positive operated gate type oil leak proof shut-off valve which can be fastened in either closed or open position and separate oil tight flange for each tank connection for use when the radiator unit is detached. Each radiator unit shall have a lifting arrangement and oil drain at the bottom and a vent at the top.

16.9.3. It shall be possible to take out any of the radiator unit without disturbing the transformer.

The radiators shall be so designed as to prevent any accumulation of water on the outer surface or formation of gas pockets when the tank is being filled.

#### 16.10. Accessories

##### 16.10.1. Conservator

The conservator shall have air cell type constant oil preservation system to prevent oxidation and contamination of oil due to contact with moisture. The conservator shall be provided with separate compartment for OLTC. No separate conservator tank shall be provided for OLTC. The conservator shall be fitted with oil filling hole, cap and drain valve. Prismatic toughened glass oil level gauge and 150 mm Magnetic Oil Gauge (MOG) with low oil level alarm contact shall also be provided.

##### 16.10.2. Silica gel breather

The top of the conservator shall be connected to the atmosphere through indicating type cobalt free silica gel dehydrating breather with transparent enclosure. Silica gel shall be isolated from atmosphere by an oil seal. The capacity of breather should be such that it can contain minimum 5 kg silica gel for main conservator compartment and minimum 1 kg silica gel for OLTC conservator compartment. The GI pipe connecting breather with conservator should be seamless and no joint is permitted.

##### 16.10.3. Buchholz relay

Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting arrangement shall be provided. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation and taking gas sample. A copper or stainless-steel tube shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate sampling when the transformer in service. The relay shall be provided with shut off valve on the conservator side as well as on the tank side.

##### 16.10.4. Pressure Relief Device

Pressure Relief Device shall be provided on main tank and OLTC for rapid release of any pressure in transformer which may endanger the equipment. The device shall operate at a static pressure of less than hydraulic test pressure of transformer tank/OLTC chamber. The terminal box of the PRD shall be water tight with protection class IP 56 or better as per IEC 60529. Electrically insulated contact shall be provided for trip signal.

##### 16.10.5. Temperature Indicators

###### 16.10.5.1. Oil Temperature Indicator (OTI)

150 mm dial type temperature indicator with 'Maximum' reading pointer and resetting device shall be provided. The indicator shall have adjustable, electrically independent, potential free alarm and trip contacts. A temperature sensing element suitably located in a pocket on top oil shall be provided. Accuracy class of OTI shall be 1.5% or better.

###### 16.10.5.2. Winding Temperature Indicator (WTI)

A device for measuring the hot spot temperature of each of the winding shall be provided. It shall comprise the following.

- (i) Temperature sensing elements, one each on HV and LV winding.
- (ii) Image coil.
- (iii) Auxiliary CTs, if required to match the image coil.
- (iv) 150 mm dial type temperature indicator with 'Maximum' reading pointer and resetting device with adjustable, electrically independent, potential free alarm and trip contacts.
- (v) Calibration device.

The winding temperature indicator shall be responsive to the combination of top oil temperature and winding current, calibrated to follow the hottest spot temperature of the transformer winding. Accuracy class of WTI shall be 1.5% or better.

#### 16.10.6. Marshalling Box

Marshalling Box shall be of sheet steel, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. One dummy terminal block in between each trip wire terminal shall be provided. At least 10% spare terminals shall be provided on each panel. The gasket used shall be of neoprene or synthetic rubber. Wiring scheme (TB details) shall be engraved in a stainless-steel plate with viewable font size and the same shall be fixed inside the marshalling box door.

#### 16.10.7. Valves

The transformer shall be provided with the following (but not limited to) valves.

- (i) Two nos. of filter valves, one at top and another at bottom on diagonally opposite corners
- (ii) Two nos. of sampling valves at top and bottom of the tank
- (iii) Drain valve on main tank
- (iv) Drain valves on main and OLTC compartment of conservator
- (v) Valves (for nitrogen injection and oil drain) as required by firefighting system All valves shall be constructed of stainless steel, brass or gun metal except of shutoff valve for radiator and cooler. For radiator and cooler, valve shall be made up of gun metal or cast iron.

#### 16.11. Painting

16.11.1. Before painting or filling with oil, un-galvanized parts shall be completely cleaned and free from rust, scale and grease. All external rough surfaces on casting shall be filled by metal deposition. The interior of transformer tank and other filled chambers and internal structural steel work shall be cleaned of all scale and rust by sand blasting or other approved method. These surfaces shall be painted with an oil resisting varnish or paint.

16.11.2. Except for nuts, bolts and washers, all external surfaces shall receive a minimum of three coats of paint. The primary coat shall be applied immediately after cleaning. The second coat shall be of oil paint of weather resisting nature. The final coat shall be of a glossy, oil and weather resisting non-fading paint. The paint shade shall be as provided by the Employer during detailed engineering.

16.11.3. All internal surfaces of mechanism chambers and kiosk except those which have received anticorrosion treatment, shall receive three coats of paint applied to the thoroughly cleaned metal surface. The final coat shall be of light coloured anti-condensation mixture.

16.11.4. Any damage to paint work incurred during transport and erection shall be made good by thoroughly cleaning the damaged portion and by applying full number of coats of paints.

#### 16.12. Transportation

16.12.1. Transformer tank is filled with oil or pure dry nitrogen/ air depending upon the transport weight limitations. Necessary arrangement shall be ensured to take care of pressure drop of nitrogen or dry air during transit and storage till completion of oil filling during erection. A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided.

16.12.2. Bushings shall be crated, packed and transported as per standard guidelines of the Bushing Manufacturer. All care should be taken to avoid any damage of the porcelain due to vibration during transport.

16.12.3. Special attention shall be paid in packing the accessories & spares to avoid moisture ingress. All parts shall be adequately marked to facilitate field erection.

#### 16.13. Warranty

The power transformer shall be warranted for minimum of 5 (five) years against all material/ manufacturing defects and workmanship.

#### 16.14. Testing and Inspection

##### 16.14.1. Type Tests and Special Tests

The following type test and special test reports shall be submitted during detailed engineering. The tests should have been conducted on the similar transformer by NABL accredited laboratory.

###### 16.14.1.1. Type Tests

- (i) Lightning impulse (Full & Chopped Wave) test on windings as per IS 2026- 3/IEC 60076-3
- (ii) Temperature Rise test at a tap corresponding to maximum losses as per IS 2026-2/IEC 60076-2. Dissolved Gas Analysis (DGA) shall be conducted on oil sample taken before and immediately after temperature rise test. Gas analysis shall be as per IS 9434/IEC 60567 and results will be interpreted as per IS 10593/IEC 60599.

###### 16.14.1.2. Special Tests

- (i) Short circuit withstand test as per IS 2026-5/IEC 60076-5
- (ii) Measurement of zero-sequence impedance as per IS 2026-1/IEC 60076-1
- (iii) Measurement of harmonics of no-load current as per IS IEC 60076-1
- (iv) Measurement of acoustic noise level as per NEMA TR-1

In case the contractor is not able to submit the test reports during detailed engineering, the contractor shall submit the reports of type/special tests either conducted by NABL accredited laboratory or witnessed by Employer.

##### 16.14.2. Routine Tests

Each completed transformer shall be subjected to following routine tests as per the latest edition of IEC 60076 unless specified otherwise.

- (i) Measurement of winding resistance at each tap
- (ii) Measurement of voltage ratio between HV and LV windings at each tap
- (iii) Check of vector group
- (iv) Measurement of no-load loss and no-load current at 90%, 100% & 110% of rated voltage
- (v) Measurement of short-circuit impedance and load loss at principal and extreme taps
- (vi) Magnetic balance test & magnetizing current test as per CBIP manual publication no. 295
- (vii) Separate source voltage withstand test
- (viii) Induced over voltage withstand test
- (ix) Measurement of insulation resistance and polarization index
- (x) Measurement of tan delta and capacitance of winding
- (xi) Core isolation test

- (xii) Marshalling box functional test
- (xiii) IR Measurement on wiring of marshalling box
- (xiv) Test on on-load tap changer
- (xv) Breakdown voltage test on transformer oil as per IS 335
- (xvi) Jacking test followed by D.P. test
- (xvii) Oil leakage test on completely assembled transformer along with radiators

## 17. Nitrogen Injection Fire Protection System

Nitrogen Injection Fire Protection System (NIFPS) shall use nitrogen as fire quenching medium. The protection system shall prevent transformer oil tank explosion and possible fire in case of internal faults. In the event of fire by external causes such as bushing fire, OLTC fire, fire from surrounding equipment etc., it shall act as a fast and effective fire extinguisher without any manual intervention.

### 17.1. Standards and Codes

All the equipment of NIFPS shall comply with the latest edition of the following standards and codes including amendments.

Standard	Description
IS 10028-2	Code of practice for selection, installation and maintenance of transformers; Part 2: Installation
IS 7285-2	Refillable Seamless Steel Gas Cylinders - Specification Part 2: Quenched and Tempered Steel Cylinders With Tensile Strength Less Than 1100 MPa (112 kgf/mm <sup>2</sup> )
CEA Technical Standards for Construction of Electrical Plants and Electric Lines Regulations, 2010 with 2015 amendment	
CEA Measures relating to Safety and Electric Supply Regulations, 2010 with 2015 amendment	
CBIP Manual on Transformers, Publication No. 317	

### 17.2. Technical Requirements

Parameter	Specification
Fire extinction period from commencement of nitrogen injection	30 second (maximum)
Total time duration to bring oil temperature below flash point	30 minute (maximum)
Fire detector heat sensing temperature	141°C
TCIV setting for normal operation to ensure no obstacle for transformer breathing	40 litre per minute
TCIV setting for operation during abnormal flow of oil	60 litre per minute

Parameter	Specification
Capacity of nitrogen gas cylinder	10 m3 gas at pressure of 150 kg/cm <sup>2</sup> for up to 60,000 litre of oil 20 m3 gas at pressure of 150 kg/cm <sup>2</sup> for above 60,000 litre of oil

### 17.3. System Components

NIFPS shall broadly consists of the following components. However, all other components which are necessary for fast, reliable and effective working of the fire protection system shall be deemed to be included in the scope of supply. The NIFPS shall have provision for SCADA connectivity.

#### 17.3.1. Fire Extinguishing Cubicle

The Fire Extinguishing Cubicle (FEC) shall be made of CRCA sheet of minimum 3 mm thick with Polyurethane painting. The degree of protection shall be IP55 or better. It shall have hinged split doors fitted with high quality tamper proof lock. The following components shall be provided in the FEC.

- (i) Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer. The nitrogen gas cylinder should have been certified by Bureau of Indian Standards and approved by Chief Controller of Explosives, Government of India.
- (ii) Oil drain pipe with mechanical quick drain valve
- (iii) Control equipment for draining of oil and injecting nitrogen gas
- (iv) Pressure monitoring switch for backup protection for nitrogen release
- (v) Limit switches for monitoring of the system
- (vi) Butterfly valve with flanges on top of the cubicle for connecting oil drain pipe and nitrogen injection pipe
- (vii) Panel lighting
- (viii) Oil drain pipe extension of suitable sizes for connecting pipes to oil pit

#### 17.3.2. Control Box

Control box shall be placed in the Master Control Room (MCR) for monitoring, automatic control and remote control. The rated control voltage of the control box shall be 110 VDC. The control box shall have suitable indications, alarms, switches and push buttons for complete monitoring and control of the system.

#### 17.3.3. Transformer Conservator Isolation Valve

Transformer conservator isolation valve (TCIV) shall be fitted in the conservator pipe line between conservator and buchholz relay which shall operate for isolating the conservator during abnormal flow of oil due to rupture / explosion of tank or bursting of bushing. The valve shall not isolate conservator during normal flow of oil during filtration or filling or refilling. Locking plates shall be provided with handle for pad locking. It shall have proximity switch for remote alarm and indication glass window for visual inspection for physical checking of the status of valve. The TCIV shall be of the best quality and proven design as malfunctioning of TCIV could lead to serious consequences.

#### 17.3.4. Fire Detector

Adequate number of fire detectors shall be fitted on top cover of the transformer and OLTC with brackets. Heat sensing temperature of the fire detectors shall be 141°C.

#### 17.3.5. Signal Box

Signal box shall be mounted way from the transformer preferably near the marshalling box for terminating the cables from TCIV & fire detectors and to further connection to control box at the MCR. The degree of protection of the signal box shall be IP 55 or better.

#### 17.3.6. Cables

The interconnecting cables shall be Fire Retardant Low Smoke (FRLS) type. Cables passing along the top of the transformer shall be Fire Survival type.

#### 17.3.7. Pipes

Heavy duty pipe connecting the transformer tank for oil drain and for nitrogen injection shall be provided. Pipes, complete with supports, connections, flanges, bends and tees etc. shall be supplied along with the system.

#### 17.3.8. Other Items

- (i) Doors and covers of all the panels (FEC, Control box, Signal box, etc.) shall be provided with neoprene gaskets.
- (ii) All the panels and piping system shall be painted with enameled paint.

### 17.4. Protection Philosophy

17.4.1. The NIFPS shall have the operating modes and operate on receipt of corresponding activation signals.

#### 17.4.1.1. Auto Mode

##### A. Fire Prevention

The system shall operate on receipt of all the following three signals.

- i. Differential relay trip
- ii. Operation of Buchholz relay (OR) Pressure Relief Device (OR) Rapid Pressure Rise Relay
- iii. Master trip (OR) Tripping of LV / HV circuit breaker in series

##### B. Fire Extinction

The system shall operate on receipt of all the following three signals.

- i. Operation of fire detector
- ii. Operation of Buchholz relay (OR) Pressure Relief Device (OR) Rapid Pressure Rise Relay (OR) Oil Surge Relay
- iii. Master trip (OR) Tripping of LV / HV circuit breaker in series

#### 17.4.1.2. Remote Manual Mode

The system shall operate on receipt of both the following signals.

- i. Master trip (OR) Tripping of LV / HV circuit breaker in series
- ii. Operation of emergency operating switch on the control box

#### 17.4.1.3. Local Manual Mode

In case the system fails in Auto Mode / Local Remote Mode (OR) Power Failure, the system can be operated manually from the Fire Extinguisher Cubicle.

17.4.2. On receipt of all required activating signals, the system shall drain pre-determined volume of oil from top of the tank through outlet valve to reduce tank pressure and simultaneously inject nitrogen gas at high pressure through inlet valves for stirring the oil and thus bringing the temperature of oil below flash point to extinguish the fire. Transformer conservator isolation valve shall block the flow of oil from conservator tank.

## 18. Control and Relay Panel

### 18.1. Standards and Codes

All equipment provided under Control and Relay Panel shall comply with latest editions and amendments of the relevant IEC standards and IS codes. In particular, the C&R Panel shall comply with the following standards and codes.

<b>Standard/Code</b>	<b>Description</b>
IS 3231	Electrical relays for power systems protection
IEC 60255	Measuring relays and protection equipment
IEC 61850	Communication networks and systems for power utility automation
IEC 61131-3	Programmable controllers - Part 3: Programming languages
IS 9385	High voltage fuses
IS 9431	Indoor post insulators of organic material for systems with nominal voltages greater than 1000 V up to and including 300 kV
IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for A.C. systems
IS 3070-3	Lightning Arresters for Alternating Current Systems - Part 3: Metal Oxide Lightning Arresters Without Gaps
IEC 62052-11	Electricity metering equipment (A.C.) - General requirements, tests and test conditions - Part 11: Metering equipment
IEC 62053	Electricity metering equipment (A.C.) - Particular requirements
IS 14697	AC Static Transformer Operated Watthour and Var-hour Meters, Class 0.2S and 0.5S

## 18.2. Construction

18.2.1. The control and relay panel shall be free standing, floor mounted, simplex type, metal enclosed construction. The panel enclosure shall be made of CRCA steel sheet. The thickness of load bearing members shall be minimum 3 mm and that of non-load bearing members shall be minimum 2 mm.

18.2.2. All external surface shall be painted with two coats of epoxy-based paint of colour shade RAL 7032. Internal surface shall be painted with epoxy enamel white paint. The minimum dry film thickness (DFT) shall be 100 micron.

18.2.3. Controls, indications, meters and other instruments shall be flush mounted on the front of the panel. Door shall be provided at the rear of the panel. All doors and removable covers shall be provided with neoprene or synthetic rubber gasket.

18.2.4. The panel shall be dust, moisture and vermin proof with degree of protection not less than IP 4X as per IEC 60529.

18.2.5. Cable entry shall be through the bottom of the panel. Gland plate of thickness not less than 3 mm shall be provided.

## 18.3. Relays

- 18.3.1. All relays shall be microprocessor based numerical type. However, auxiliary relays can be static or electromechanical type. The relays shall be flush mounted on panel front with connections from the inside.
- 18.3.2. Auxiliary voltage of the relays shall be 110 VDC and the relays shall be capable of operating continuously between 80 – 120% of auxiliary voltage.
- 18.3.3. All numerical relays shall have adequate number of freely configurable, optically isolated, Binary Inputs (BI) and potential free Binary Outputs (BO). All I/O's shall have galvanic isolation. Analog inputs shall be protected against switching surges and harmonics.
- 18.3.4. All numerical relays shall have sufficient number of current and voltage inputs required for all the required protection functions.
- 18.3.5. The numerical relay shall provide choice of ANSI/IEC/IEEE relay characteristic curves with wide protection setting ranges through a minimum of two protection setting groups.
- 18.3.6. Making, breaking and continuous capacity of the relay contacts shall be adequate enough for the circuits in which they are used.
- 18.3.7. All numerical relays shall have provision for measurement and storage of electrical parameters such as voltage, current, frequency, active power, reactive power etc.
- 18.3.8. The numerical relay shall be able to record faults and events in non-volatile memory.
- i. Fault record – At least 5 recent faults including the protection function operated, operating phase(s), voltages and currents along with date and time stamp.
  - ii. Event record – At least 200 events with date and time stamp.
- 18.3.9. The numerical relay shall have trip circuit supervision facility to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions. The relay shall also be able to provide circuit breaker monitoring, CT and VT supervision.
- 18.3.10. The numerical relay shall have self-diagnostic feature with separate output contact for indication of any internal relay failure.
- 18.3.11. The numerical relay shall have two serial communication ports, one on front side for local communication with PC and another on rear side for remote communication with SCADA system as per IEC 61850.
- 18.3.12. The numerical relay shall have feature for time synchronization through the SCADA System / networking.
- 18.3.13. The numerical relay shall be provided with backlit alphanumeric LCD or LED to access protection settings, measurement parameters, fault and event records. Read and write access to protection settings shall be password protected.
- 18.3.14. Necessary software and hardware to up/down load the data to/from the relay from/to the PC shall also be provided.

#### 18.4. Protection Scheme

The following protection schemes shall be implemented for the protection of power transformer and its feeder.

- i. Biased Differential Protection with Second Harmonic Restraint
- ii. Non-directional Over Current and Earth Fault Protection
- iii. Restricted Earth Fault Protection
- iv. Under Voltage and Over Voltage Protection
- v. Buchholz Alarm and Trip
- vi. OTI Alarm and Trip
- vii. WTI Alarm and Trip
- viii. PRV Trip

- ix. MOG Alarm
- x. OSR Trip

The above-mentioned protection schemes are indicative only. All the protection schemes required for safe and reliable operation of power transformer and the feeder shall be provided.

#### 18.5. Measuring Instruments

- 18.5.1. All measuring instruments shall be enclosed in dust proof, moisture resistant cases and flush mounted on the panel.
- 18.5.2. Analog Ammeter and Voltmeter with selector switch shall be provided. Accuracy class shall be 0.5 or better. Instrument dial shall be with white scale, black pointer and black numerals.
- 18.5.3. Digital Multi Function Meter (MFM) of accuracy class 0.2 or better shall be provided. It shall have communication capability for integration with SCADA. MFM shall be able to measure line & phase voltages, line & phase currents, active power, reactive power, apparent power, power factor and frequency.

#### 18.6. Control Switches

All control switches shall be rotary operated type with adequate making, carrying and breaking current ratings. The control switches shall be pistol grip type, lockable with spring return to normal position. They shall be flush mounted on the panel with shrouded terminals.

#### 18.7. Indications

All indicating lamps shall be flush mounted LED type with supply voltage of 110 VDC. Lamp covers shall preferably be screwed type and molded from heat resisting material. Indicating lamps shall be provided for R, Y, B PT supply, Breaker ON & OFF, Auto trip, Spring charged, Trip circuit healthy, etc.

#### 18.8. Annunciation

Flush mounted static type annunciator with sufficient number of windows to accommodate all trip and alarm signals shall be provided. Separate audible annunciation for alarm and trip shall be provided by means of buzzer and hooter. Visual annunciation shall be by flickering of facia. Push buttons for test, accept and reset shall also be provided.

#### 18.9. Earthing

- 18.9.1. An earth bus made of copper or aluminum shall be provided throughout the length of the panel and bolted to the framework of the panel. The earth bus shall have sufficient cross section to carry maximum fault current without exceeding the allowable temperature rise.
- 18.9.2. All non-current carrying conductors of the panel shall be connected to the earth bus. All joints to the earth bus shall be made through at least two bolts. Hinged doors shall be earthed through flexible earthing braid of adequate cross section. Suitable provision shall be provided at each end of the earth bus for connection with earth grid.
- 18.9.3. All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth bus by independent copper wires of size not less than 2.5 sq. mm with green colour insulation.
- 18.9.4. Instrument transformer secondary neutral point shall be earthed at one place only on the terminal block. Such earthing shall be made through links so that earthing of one circuit may be removed without disturbing the earthing of other circuits.

#### 18.10. Mimic Diagram

18.10.1. Coloured mimic diagram made of metal or plastic with symbols to facilitate exact representation of the system shall be fixed on the front of control panel. Semaphore indicators shall be incorporated in the mimic diagram for indicating position of circuit breakers, isolators and earthing switches. The rated control voltage of semaphore indicator shall be 110 / 220 VDC.

#### 18.11. Wiring and Terminal Blocks

18.11.1. All internal wiring shall be done with 1100 V grade, 2.5 sq.mm. PVC insulated stranded flexible copper wire. For CT secondary circuits, 4 sq.mm copper wire shall be used.

18.11.2. Wire terminations shall be made with solderless crimping type tinned copper lugs, which shall firmly grip the conductor. Insulation sleeves shall be provided at all the wire terminations.

18.11.3. Printed identification ferrules marked to correspond with panel wiring diagram shall be provided at both ends of each wire. The ferrules shall be firmly located on each wire so that they cannot move or turn freely on the wire. Wire identification shall be done in accordance with IS 11353.

18.11.4. The Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

18.11.5. All internal wiring to be connected to the external equipment shall terminate on terminal blocks. Terminal blocks shall be rated for 1100 V, 10 A and made of non-inflammable material.

18.11.6. CT and VT secondary circuits shall be terminated on stud type, non-disconnecting terminal blocks.

18.11.7. At least 10% spare terminals shall be provided on each panel and these spare terminals shall be distributed on all terminal blocks.

18.11.8. Screw driver operated stud type test terminal block shall be provided.

#### 18.12. Accessories

- i. Thermostatically controlled space heater with switch for isolation
- ii. 240 V, 15 A industrial socket with ON/OFF switch
- iii. LED lamp controlled by door switch

#### 18.13. Warranty

The control and relay panel unit shall be warranted for minimum of 2 (Two) years against all material/ manufacturing defects and workmanship.

#### 18.14. Testing and Inspection

##### 18.14.1. Type Tests

The Contractor shall submit type test report of the panel for degree of protection as required by the Technical Specifications as per IEC 60529. The test should have been conducted by NABL accredited laboratory.

##### 18.14.2. Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

### 19. 33 kV Switchyard Equipment

#### 19.1. Standards and Codes

All equipment provided shall comply with latest editions and amendments of the relevant IEC standards and IS codes. In particular, the switchyard equipment shall comply with the following standards and codes.

<b>Standard/Code</b>	<b>Description</b>
IS/IEC 62271-100	High Voltage Switchgear and Control gear - Part 100: AC Circuit Breakers
IEC 60376, IS 13072	Specification of technical grade sulfur hexafluoride (SF6) for use in electrical equipment
IS/IEC 62271-102	High Voltage Switchgear and Control gear - Part 102: AC Disconnectors and Earthing Switches
IEC 61869	Instrument Transformers
IS 2099	Bushings for alternating voltages above 1000 Volts
IS 2544	Porcelain post insulators for systems with nominal voltage greater than 1000 Volts
IS 335, IEC 60296	Insulating oil
IS/IEC 60034	Rotating electrical machines
IS 996	Single-phase AC industrial motors for general purpose
IS 3070, IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for A.C. systems
Indian Electricity Act, CBIP manual, CEA rules and guidelines	
IS 996	Single-phase AC industrial motors for general purpose
IS 3070, IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for A.C. systems
Indian Electricity Act, CBIP manual, CEA rules and guidelines	

## 19.2.General Technical Parameters

<b>System Parameters</b>	<b>Specification</b>
Highest system voltage	72.5 kV
Rated system voltage	33 kV
Rated frequency	50 Hz
Number of phases	3
Power frequency withstand voltage I. To earth II. Across Isolating distance	140kV(rms) 160 kV (rms)

Lightning impulse withstand voltage I. To earth II. Across Isolating distance	325 kV (peak) 375 kV (peak)
System fault current	As per system requirement
Minimum Creepage distance	25 mm/kV of highest system voltage
System neutral earthing	Effectively earthed

### 19.3. Circuit breaker

#### 19.3.1. Technical parameters

Parameters	Specification
Type	Outdoor SF6
Operating duty cycle	O – 0.3sec – CO – 3min – CO
Short circuit breaking current	As per system requirement
Short circuit making current	2.5 times of Short circuit breaking current
Rated break time	100ms
Re-strike performance lass	C2
Mechanical endurance lass	M1
First pole to clear factor	1.5 (As per IEC 62271 – 100)
Reclosing	Three phase high speed auto reclosing
Auxiliary contacts	As required plus 4NO and 4NC contacts per pole as spare. The contacts shall have continuous rating of 10A and breaking capacity of 2A with circuit time constant of minimum 20 milliseconds at 220V DC

19.3.2. Circuit breakers shall be of SF6 type. It shall comprise of three separate identical single pole units operated through the common shaft and shall be fully interchangeable both electrically and mechanically.

19.3.3. The circuit breaker operating mechanism shall be based on motor operated spring charging and it shall be re-strike free, trip free both electrically and mechanically, with anti-pumping feature.

19.3.4. Circuit breaker shall be provided with two independent set of trip circuit connected to separate fuse or MCB controlled DC supplies for greater reliability.

19.3.5. The rated control voltage of the spring charging motor shall be 110 VDC/230 VAC. Closing coil shall operate at all values of voltages between 85% and 110% of rated voltage. Opening coil shall operate correctly under all operating conditions of the circuit breaker up to the rated

breaking capacity and at all values of supply voltage between 70% and 110% of rated voltage.

- 19.3.6. The spring charging motor shall have adequate thermal rating such that continuous sequence of the closing and opening operations is possible as long as power supply is available to the motor. It shall also be possible to charge the spring manually and close the breaker in the event of failure of motor / control supply to motor. Operating handle shall be provided for charging the operating mechanism. After failure of control supply to the motor, one open-close-open operation shall be possible with the energy contained in the operating mechanism.
- 19.3.7. The motor rating shall be such that it requires not more than 30 seconds for full charging of the closing spring. Closing action of the circuit breaker shall compress the opening spring ready for tripping. When closing springs are discharged after closing the breaker, they shall be automatically charged for the next operation.
- 19.3.8. Temperature compensated SF6 gas density monitor and pressure switches along with pressure indicator shall be provided to monitor and regulate the density of SF6 gas in breaker respectively in each pole. It shall be possible to dismantle the monitor without any seepage of SF6 gas.
- 19.3.9. Interrupter assembly shall be provided with an absorbing product box to eliminate moisture and SF6 decomposition products.
- 19.3.10. 10% of total SF6 gas requirement shall be supplied in separate container as spare in addition to the required SF6 gas to fill the breaker installed at site.
- 19.3.11. Mechanical indicators shall be provided to indicate OPEN/CLOSED positions of the circuit breaker and CHARGED/ DISCHARGED positions of the closing spring. An operation analyzer shall be provided to record contact travel against time and measure opening time. These indicators and counter shall be visible from the panel front door without opening it.
- 19.3.12. Control cabinet shall be free standing, floor mounted, single front, metal enclosed construction. It shall be constructed with CRCA steel/Aluzinc sheet. The thickness of load bearing members shall be minimum 3 mm and that of non-load bearing members shall be minimum 2 mm. All external surface shall be painted with two coats of epoxy-based paint of color shade RAL 7032. Internal surface shall be painted with epoxy enamel white paint. The minimum dry film thickness (DFT) shall be 100 microns. Degree of protection shall not be less than IP5X.
- 19.3.13. Control cabinet shall be provided with thermostatically controlled space heaters to prevent condensation within the compartment. The space heater shall be connected to 240 V, 50 Hz, single phase AC supply through suitable switch and fuse. It shall also be provided with LED lamp rated for 240 V, 50 Hz, single phase AC supply for interior illumination controlled by door switch and a 240 V, 15 A, SPN industrial socket-outlet with ON/OFF switch.
- 19.3.14. The bidder shall furnish complete literature regarding assembly, maintenance and charging procedures as applicable to SF6 breakers.

#### 19.4. Isolator

##### 19.4.1. Technical parameters

<b>System Parameters</b>	<b>Specification</b>
Service	Outdoor
Type of Isolator	Mechanically gang operated, Double break or centre break with earthing switch
Operating Mechanism a) Isolator b) Earth switch	Motor Manual
Auxiliary contacts	As required plus 4NO and 4NC contacts per pole as spare for isolator and earth switch each.
Short time current	As per system requirement
Safe duration of over load 150% of rated current 120% of rated current	5 minutes 30 minutes

- 19.4.2. Isolators shall be outdoor type with blades rotating in horizontal plane, suitable for electrical as well as manual operation and local/remote operation.
- 19.4.3. Isolator and earth switch shall be capable of withstanding dynamic and thermal effects of system fault current in closed position and should not open under influence of fault current and wind pressure together.
- 19.4.4. Isolator shall be provided with heavy duty, self-aligning, high pressure current carrying contacts and moving blades made up of highly conductive, corrosion resistant, hard drawing electrolytic copper alloy. Copper contacts shall be silver-plated with minimum 25-micron thickness.
- 19.4.5. Arcing horns on the fixed and moving contacts, if required shall be of 'make before and break after' type.
- 19.4.6. Each single pole of isolator shall be provided with suitable galvanized steel base channels with holes and designed for mounting on a lattice supporting structure. The bas shall be rigid and self-supporting.
- 19.4.7. Operating mechanism for isolator and earth switch shall provide quick, simple and effective operation and shall be provide on opposite ends.
- 19.4.8. Control cabinet/operating mechanism box shall be constructed with CRCA steel/Aluzinc sheet of minimum 3 mm thickness. All external surface shall be painted with two coats of epoxy-based paint of colour shade RAL 7032. Internal surface shall be painted with epoxy enamel white paint. The minimum dry film thickness (DFT) shall be 100 microns. Degree of protection shall not be less than IP5X. It shall be provided with thermostatically controlled space heaters to prevent condensation within the compartment, LED lamp for interior illumination controlled by door switch and an industrial socket-outlet with ON/OFF switch.
- 19.4.9. Support insulators for Isolator and earth switch shall be solid core type made up of homogenous and vitreous porcelain.

19.4.10. Mechanical indicators shall be provided to indicate OPEN/CLOSED position of the isolator.

19.4.11. Following fail safe type electrical and mechanical interlocks are required between Isolator & earthing switch and Isolator & circuit breaker:

- i. Prevention of opening of isolators on load.
- ii. Prevention of closing of earth switch, when line isolator is closed.
- iii. Prevention of closing of line isolator, when earth-switch is closed.
- iv. Prevention of opening of isolator, when circuit breaker is closed and vice versa.
- v. Provision shall be made for pad locking the mechanism of isolator and earthing switches in both, the 'close' and 'open' position.

#### 19.5. Instrument transformer

##### 19.5.1. Technical parameters

Parameter	Specification
<b>Current Transformer</b>	
Accuracy class	0.2S for metering 5P20 for protection
Rated VA burden	As per requirement
Insulation class	Class E
Rated Short time thermal rating	As per system requirement
Rated short time dynamic rating	80kA
Partial discharge level	10 Pico Coulomb maximum
No. of terminals in Terminal box	As required plus 10 terminals as spare
<b>Voltage Transformer</b>	
Accuracy class	0.2 for metering 3P for protection
Rated VA burden	As per requirement
Insulation class	Class E
Standard reference range of frequencies for which the accuracies are valid	96% to 102% for protection and 99% to 101% for measurement
Partial discharge level	10 Pico Coulomb maximum
Rated voltage factor	1.2 continuous and 1.5 for 30 sec.
No. of terminals in Terminal box	As required plus 10 terminals as spare

19.5.2. Instrument transformers shall be dead tank type, hermetically sealed single-phase units, oil immersed, self-cooled suitable for outdoor installations and shall be supplied with common marshalling box for a set of three single phase units.

19.5.3. Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

19.5.4. The insulators shall have cantilever strength of more than 600 kgf.

19.5.5. Secondary terminals of instrument transformer shall be brought outside in a terminal box constructed with CRCA steel/Aluzinc sheet of minimum 3 mm thickness. All external surface shall be painted with two coats of epoxy-based paint of colour shade RAL 7032. Internal surface shall be painted with epoxy enamel white paint. The minimum dry film thickness (DFT) shall be 100 microns. Degree of protection shall not be less than IP5X. It shall be provided with thermostatically controlled space heaters to prevent condensation within the compartment, LED lamp for interior illumination controlled by door switch and an industrial socket-outlet with ON/OFF switch.

19.5.6. CTs shall be suitable for high speed auto reclosing.

19.5.7. HRC fuses of suitable rating shall be provided on primary side of voltage transformers. For secondary side, four pole Miniature Circuit Breakers (MCB) shall be provided.

19.5.8. Wiring and Terminal blocks of instrument transformers

19.5.8.1. All internal wiring shall be done with 650 V grade, 1.5 sq.mm. PVC insulated stranded flexible copper wire. For CT secondary circuits, 2.5 sq.mm copper wire shall be used.

19.5.8.2. Wire terminations shall be made with solderless crimping type tinned copper lugs, which shall firmly grip the conductor. Insulation sleeves shall be provided at all the wire terminations.

19.5.8.3. Printed identification ferrules marked to correspond with panel wiring diagram shall be provided at both ends of each wire. The ferrules shall be firmly located on each wire so that they cannot move or turn freely on the wire. Wire identification shall be done in accordance with IS 11353.

19.5.8.4. The Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

19.5.8.5. All internal wiring to be connected to the external equipment shall terminate on terminal blocks. Terminal blocks shall be rated for 650 V, 10 A and made of noninflammable material.

19.5.8.6. CT and VT secondary circuits shall be terminated on stud type, non-disconnecting terminal blocks.

19.5.8.7. At least 10% spare terminals shall be provided on each panel and these spare terminals shall be distributed on all terminal blocks.

## 19.6.Warranty

All switchyard equipment shall be warranted for minimum of 2 (Two) years against all material/ manufacturing defects and workmanship.

## 19.7.Testing and Inspection

### 19.7.1. Type Tests

All switchyard equipment shall be of type tested design. Type test reports as per the relevant IEC/IS standards shall be submitted during detailed engineering. The tests should have been conducted on the similar equipment by NABL accredited laboratory. In case the contractor is not able to submit the test reports during detailed engineering, the contractor shall submit the reports of type/special tests either conducted by NABL accredited laboratory or witnessed by Employer.

### 19.7.2. Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

## 20. Illumination

### 20.1. Standards and Codes

LED luminaires shall be tested at independent laboratory as per the following test standards

Standard/Code	Description
LM79-08	Electrical and Photometric Measurements of Solid-State Lighting Products
LM 80-15	Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules

### 20.2. General specification

20.2.1. This specification covers design, supply and installation of uniformly illumination system along the peripheral & internal roads, main control room & inverter rooms, switchyard and other facilities including entry points/gate(s) inside the plant area.

20.2.2. The Contractor shall furnish Guaranteed Technical Particulars of the LED luminaires, from renowned brands available in the market for approval of Employer.

20.2.3. Lighting system shall work on the auxiliary supply and same shall be incorporated in auxiliary loads. The Contractor shall provide minimum 20% of total lighting points as emergency lighting points, fed from UPS DB or DCDB as per scheme adopted by the Contractor. Indoor and outdoor emergency lights shall be provided at each inverter room, main control room, security room and main gate.

### 20.3. Lighting Levels

20.3.1. The average LUX level of 10 lm is to be maintained in switchyard. However, a lux level of 20 lm ((10+10) additional switchable on requirement only) is to be maintained in switchyard on transformer.

20.3.2. The lighting system for outdoor and indoor areas of solar power plant shall be designed in such a way that uniform illumination is achieved. Average LUX level to be maintained in different areas shall be as under:

Area	LUX
Control Room and equipment rooms	300
Office	300
Battery & other rooms	150
Internal	4
Transformer yard/Switchyard	20
H – pole and metering point	10

20.3.3. The lighting level shall take into account appropriate light output ratio of luminaires, coefficient of utilization maintenance factor (of 0.7 or less) to take into account deterioration with time and dust deposition and illuminance uniformity [Uo] shall be min 0.3.

20.3.4. Plant boundary/ Peripheral area shall be illuminated with chain-link/Boundary wall post mounted LED floodlights (at every 100m) for area lighting as per following specifications:

Input Voltage	AC 220-240V
Frequency	50Hz--60Hz
LED power Consumption	50 W
LED luminous efficiency	85 Lm /W
Led Luminous Flux	4500 lm
lamp's Efficiency	>88 %
Color Temperature	Cool White
Color Rendering Index	>75
Light Distribution	Symmetric / circular spot
Light Design	LED+ Reflector
LED Junction Temperature	≤80°C
Working Temperature	-40°C -- 55°C
IP Grade	IP65
Mechanical Strength	IK08
Working Life-span	30000 Hrs
Certification	CE& ROHS
Warranty	3 Years Product Replacement

#### 20.4. LED Luminaire for Outdoor Applications (Other than Peripheral Area)

20.4.1. LED luminaires shall meet the following parameters.

Parameter	Specified Value
Input voltage	170 - 260 V
Input Frequency	50 Hz +/- 1 Hz
Power Factor	0.90 (Minimum)
Luminaire efficacy	> 90 lumens per watt
Beam Angle	Minimum 120°
Total Harmonic Distortion	< 10 %
Working Humidity	10% - 90% RH (Preferably Hermetically sealed unit)
Degree of Protection	Minimum IP 65 (for Outdoor fixtures)

<b>Parameter</b>	<b>Specified Value</b>
Luminaire Casing	Powder coated metal / Aluminium.
Colour Temperature	5700 K (cool day light)
Colour Rendering Index	> 65
Moisture protection in case of casing damage	IP 65 (driver unit shall preferably be totally encapsulated)

20.4.2. The LED luminaire (outdoor) housing, heat sink, pole mounting bracket, individual LED reflectors and front heat resistant tempered glass should be provided.

20.4.3. The LED luminaire (outdoor) housing should be made of non-corrosive, high-pressure, die-cast aluminum and the housing should be power coated grey, so as to ensure good weatherability. Each individual LED source should be provided with an asymmetrical distribution high reflectance aluminized reflector, which should ensure that the light distribution of the luminaire is suitable for road lighting applications (wide beam distribution) and should ensure high pole to pole spacing.

20.4.4. The luminaire should be provided with in-built power unit and electronic driver.

20.4.5. The luminaire should be suitable for standard street light poles and should be suitable for side entry and bottom entry (post top).

20.4.6. GI Lighting pole of suitable diameter capable of withstanding system and wind load, shall be provided with average Zn coating thickness of 80micron. The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB.

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

20.4.8. Lighting panels shall be earthed by two separate and distinct connections with earthing system. Switch boxes, junction boxes, lighting fixtures, etc. shall be earthed by means of separate earth continuity conductor. Cable armour shall be connected to earthing system at both the ends. Proper earthing of street light poles shall be ensured.

20.4.9. Junction box for lighting shall be made of fire retardant material. The degree of protection shall be IP55 for outdoor JB.

20.4.10. Lighting cables, wherever exposed to direct sunlight, shall be laid through Double Wall Corrugated (DWC) HDPE conduits.

## 20.5. LED Luminaire/Lamps for Indoor Applications

20.5.1. LED luminaire/lamps shall have minimum 3-star BEE rating.

20.5.2. All indoor LED luminaire/lamps shall be supplied with proper diffuser to avoid direct visibility of LED and suitable heat sink for longer life

## 20.6. Warranty

20.6.1. All luminaires shall be warranted against all material/manufacturing defects and workmanship for minimum of 2 (two) years from the date of supply.

## 21. Weather Monitoring System

As a part of weather monitoring system, the Contractor shall provide the following measuring instruments with all necessary software and hardware required to integrate with SCADA.

### 21.1.Pyranometer

21.1.1. The Contractor shall provide minimum 6 (six) number of secondary standard pyranometers (ISO 9060 classification) along with necessary accessories for measuring the incidental solar radiation at horizontal, inclined plane of array and albedo at each site.

21.1.2. Specification of the pyranometer shall be as follows

Parameter	Specification
Spectral Response	0.31 to 2.8 micron
Time response (95%)	Maximum 15s
Nonlinearity	$\pm 0.5\%$
Temperature Response	$\pm 2\%$
Tilt error	$<\pm 0.5\%$
Zero offset thermal radiation	$\pm 7 \text{ W/m}^2$
Zero offset temperature change	$\pm 2 \text{ W/m}^2$
Operating temperature range	0°C to +80°C
Non-stability	Maximum $\pm 0.8\%$
Resolution	Minimum +/- 1W/m <sup>2</sup>
Output	Analog output: 4 – 20 mA Serial output: RS485

21.1.3. Each instrument shall be supplied with necessary cables. Calibration certificate with calibration traceability to World Radiation Reference (WRR) or World Radiation Centre (WRC) shall be furnished along with the equipment. The signal cable length shall not exceed 20m. The Contractor shall provide instrument manual in hard and soft form.

21.1.4. Downward facing pyranometer to measure albedo shall be mounted at least 2 m above uniform surface. To avoid reflections, masts/mounting pole shall be painted with black, non-reflective paint. To minimize shading, the pyranometer shall be mounted on boom (minimum length 1 m) extending towards the equator.

### 21.2.Temperature Sensor

21.2.1. The Contractor shall provide minimum 3 (three) temperature sensors (1 (one) for ambient temperature measurement with shielding case and 2 (two) for module temperature measurement) at each site. The temperature sensor shall be Resistance Temperature Detector (RTD)/ Semiconductor type with measurement range of 0°C to 80°C. The instrument shall have valid calibration certificate.

### 21.3.Anemometer

21.3.1. Contractor shall provide minimum one no. ultrasonic wind sensor (no moving parts) for wind speed and direction monitoring.

Parameter	Specification

Parameter	Specification
Velocity range with accuracy limit	0-60m/s with +/-2% accuracy @12 m/s; Resolution: 0.01m/s
Wind direction range with accuracy limit	0 to 360° (No dead band) with +/-2° accuracy @12 m/s; Resolution: 1o
Mounting Bracket	Anodized Aluminium bracket to reduce corrosion, all mounting bolts of SS
Protection Class	IP66
Output	RS232 and RS485

#### 21.4.Data logger and Data Acquisition System

Data logger for the weather monitoring station should have the following features:

##### 21.4.1. Provision for analog, digital and counter type inputs for interfacing with various type of sensors

- i. Analog Input
  - Adequate nos. for all analog sensors with redundancy
  - Provision for operation in different current and voltage ranges as per connected sensors
  - Accuracy of +/-0.1% of FS
- ii. Digital Inputs
  - Adequate no. of Digital inputs and outputs for the application
- iii. Provision for RS232 and RS485 serial outputs
- iv. Built-in battery backup
- v. Connectivity and Data transmission: RS485 MODBUS interface for data collection and storage on SCADA Communication protocol should support fast data transmission rates, enable operation in different Frequency bands and have an encryption-based data security layer for secure data transmission
- vi. Display Settings: Graphic LCD screen which should be easily accessible and should display relevant details like all sensor values, battery strength, network strength etc.
- vii. Provision of Time synchronization from telecom time or server time
- viii. Data Storage: Provision for at least 2 MB internal Flash Memory and at least 8 GB Micro SD card (expandable)
- ix. Protection level: IP65

#### 22. CCTV Camera

22.1.CCTV Cameras along with monitoring stations (sufficient numbers) and all other accessories required for its proper operation must be installed to have complete coverage of following areas for 24 hours.

- i. Main entry: Covering all the entry/exit
- ii. Along the Plant Perimeter: Covering complete perimeter of Plant Area to capture all possible intrusion
- iii. Control Rooms: Covering Entry/Exit and Equipment Rooms
- iv. Switchyard

22.2.Monitoring stations of the CCTV Network shall be installed in Main Control Room.

22.3.The CCTV system shall be designed as a standalone IP based network architecture. System shall use video signals from different cameras at defined locations, process the video signals for

viewing on monitors at control room and simultaneously record all video streams using latest compression techniques.

22.4. Camera shall be colour, suitable for day and night surveillance (even under complete darkness) and network compatible.

22.5. It shall be possible to control all cameras i.e., PTZ auto/ manual focus, selection of pre-sets, video tour selection etc. The software shall support flexible 1/2/4 windows split screen display mode or scroll mode on the display monitor for live video. 22.6 The system shall support video analytics in respect of the following:

- i. Video motion detection
- ii. Object tracking
- iii. Object classification
- iv. Camera server shall be provided with sufficient storage space to storage recordings of all cameras at HD mode for a period of 15 days. All recordings shall have camera ID, location, date and time of recording.

## 23. Fire Alarm System

### 23.1. Standards and Codes

Standard/Code	Description
IS 2189	Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System Code of Practice
IS 2171	Portable Fire Extinguishers, Dry Powder (Cartridge Type)
IS 8149	Functional requirements for twin CO2 fire extinguishers (trolley mounted)
IS 2546	Galvanized mild steel fire bucket
National Building code 2016	

23.2. Contractor shall ensure the compliance of fire detection and alarm system as per relevant standards and regulations. The installation shall meet all applicable statutory requirements and safety regulations of state/central fire department/body or any other competent authority in terms of fire protection.

23.3. Firefighting system for the proposed power plant for fire protection shall be consisting of but not limited to:

- i. Sand buckets
- ii. Portable fire extinguishers (CO2 and dry powder type)
- iii. Microprocessor based fire alarm panel
- iv. Multi sensor smoke detectors
- v. Hooter cum strobe
- vi. Manual call points
- vii. Cables from sensor to fire Panel.

23.4. Minimum two numbers of fire extinguishers (CO2 and Foam type each, of capacity 9 kg having BIS certification marking as per IS: 2171) shall be provided at every building/ enclosure, transformer yard and switchyard. However, contractor must comply with existing building code for fire protection and relevant IS codes.

23.5. Four numbers of stand with four sand buckets on each stand shall be provided in the Transformer Yard. Sand buckets inside the building shall be provided at strategic locations as decided during detailed engineering.

23.6. Digital output from the fire detection system shall be integrated with SCADA

23.7. Contractor shall submit the plan for fire and smoke detection system for the Employer's approval.

#### 24. Testing Instruments

The Contractor shall provide the following set of instruments for on-site testing.

##### 24.1. Earth resistance tester

Parameter	Specification
Display	Backlit LCD or LED display
Range	Earth Resistance: up to 2000 Ω Earth Voltage: 200 V
Accuracy	± (2% + 5)
Safety Ratings	IP 56
Programmable Limits setting	Enabled
<b>Accessories</b>	
Earth Ground Stakes (4 Nos)	
Three cable reels with cable length up to 20 m	
Carry Case-1 (capable of handling tester along with accessories)	
1 set of spare battery	

##### 24.2. Array tester

Parameter	Specification
Display	Backlit LCD or LED display
Functionality	All electrical tests required by IEC 62446- 1:2016
Memory	Up to 200 records & USB downloadable to Computer
<b>Accessories</b>	
A set of two, 4mm fused leads for extra protection during installation tests.	
Leads which enable the array tester to connect directly to PV arrays	
1 set of spare battery	

##### 24.3. Insulation tester

Parameter	Specification
Display	Backlit LCD or LED display

<b>Parameter</b>	<b>Specification</b>
Insulation Test Range	0.1 MΩ to 10 GΩ
Test Voltage	250V, 500V, 1000V, 5000V
Test Voltage accuracy	+20% on positive side only no negative variation is allowed
Insulation Test Current	1 mA nominal
Auto Discharge	Discharge time < 0.5 Second for C = 1
Open Circuit test Voltage	>4 V, <8 V
<b>Accessories</b>	
Heavy duty Test Lead Set – 4 Nos.	
Carry Case with sufficient space for accommodating accessories.	

#### 24.4. Digital Multimeter

<b>Parameter</b>	<b>Specification</b>
Display	Backlit LCD or LED display; Minimum resolution: 4.5 digits for DC, 3.5 digits for AC
Measuring Category	1000V CAT III as per IEC Standard 61010-1; wave shape independent RMS measurement (True RMS) suitable for operation in the site conditions.
Additional Functions	Resistance (Ω), Temperature (oC), Continuity, Diode, Capacitance, Frequency, Duty cycle measurement
<b>Accessories</b>	
Temperature Probe	
Silicon Test Lead	
Alligator Clip	
Carry Case with sufficient space for accommodating accessories.	

#### 24.5. Clamp meter

<b>Parameter</b>	<b>Specification</b>
Display	Backlit LCD or LED display
Measuring Category	1000V CAT III as per IEC Standard

<b>Parameter</b>	<b>Specification</b>
	61010-1; wave shape independent RMS measurement (True RMS) suitable for operation in the site conditions.
Current Range	AC&DC Current up to 1000A/400 A
Voltage range	AC&DC Voltage up to 1000V
Additional Functions	Resistance, continuity, diode and non-contact voltage detection, Active, Reactive and Apparent Power, THD, PF
<b>Accessories</b>	
Test leads	
Electrical test leads	
Probe light & extender	
Carry Case with sufficient space for accommodating accessories.	

#### 24.6. Infra-red thermal imaging camera

<b>Parameter</b>	<b>Specification</b>
Spectral response	8 µm to 14 µm (LW)
Temperature-sensitivity and calibration range	-20 °C to +120 °C
Atmospheric air temperature	-10 °C to +40 °C
Thermal sensitivity	NETD ≤ 0.1 K at 30 °C
Geometric resolution	640 x 480 pixels
Photo camera resolution	Approx. 30 times of IR camera resolution
Absolute error of measurement	< ± 2 K
Adjustable parameters	Emissivity, ambient temperature
Adjustable functions	Focus, temperature level and span
Measurement functions	Measuring spot, measuring area with average and maximum temperature
Calibration	The measuring system (Camera, lens, aperture and filter): The camera has to be traceably calibrated at least every two years. The calibration has to be documented. If the camera is not compliant, it has to be readjusted by the manufacturer.
Documentation	Storing of the infrared picture with the radiometric data

#### 24.7.Digital lux meter

Parameter	Specification
Range	0 – 1000 lux
Accuracy	± (2% + 5)
Resolution	1 lux
Display	3½ digits, Backlit LCD/LED

24.8.All testing equipment shall possess valid calibration certificate issued from approved NABL labs.

24.9.Instruments of superior rating is allowed after seeking consent of the Employer.

24.10.Maintenance, calibration, up keeping, repair & replacement of these tools will be in the scope of the Contractor during O&M.

24.11.It is Contractor's responsibility to arrange for tools, tackles, logistics, test kits, manpower, experts etc. required for trouble free operation of Plant.

#### 25. Power evacuation system

25.1.The contractor has to do the power evacuation and integration to and with the designated substation through underground cables at specified grid voltage with all necessary infrastructures such as protection switchgears and metering systems as per the requirement of the STU/Employer.

25.2.The power evacuation system for the plant shall be as per the local DISCOM requirement and appropriate approval. The contractor shall get the route approval from the Employer prior to start of the construction. Any changes in the route or scheme introduced by KSPDCL at any point of the time prior to commissioning shall be complied without any additional cost to the Employer.

25.3.The ROW for the TL/UG cable shall be obtained prior to the construction of the line from the concerned authorities.

25.4.Overhead Transmission Line: Deleted

#### 25.5.Underground cable

In case the power evacuation is planned with underground cable for plant internal evacuation, the cable shall be approved by the Employer. However, in case of external power evacuation, the evacuation plan shall be as per PDD/CTU's requirement and the same shall be submitted to Employer for approval/ accord.

### 3. Civil,Mechanical and Plumbing Works

#### 1. General Requirement

1.1. This section of Technical Specifications describes detailed technical and functional requirements of all civil, structural, mechanical & plumbing works included in the scope.

1.2. Design, supply and installation of 66 kV transmission poles & accessories which shall be designed following the standards of KPTCL. In absence of KPTCL guidelines REC (Rural electrification corporation) standards shall be followed. Poles at corner with angle > 100 shall be provided with 4-pole structure or lattice tower. Use of Pre-stressed cement concrete spun poles is not acceptable. Approved copies of these designs & drawings shall be submitted to the employer for reference and record.

#### 1.3. Standards & Codes

1.3.1. All design and construction of civil works shall conform to relevant Indian standards such as BIS, IRC, MORTH, NBC etc.

- 1.3.2. Design of steel structures shall conform to IS: 800, 801 or 802 as applicable. Design of concrete structures shall conform to IS: 456. For design of liquid retaining structure IS: 3370 shall be followed. Only in case of non-availability of Indian standard, equivalent American or British standard may be used for design with prior approval of the Engineer and the contractor shall submit proper justification for the same along with his request to the Engineer for review and approval, and the decision of the Engineer shall be final and binding.
- 1.3.3. All the design/ drawings shall be prepared/ approved either by in-house Engineering Team of the contractor (or by his Engineering Consultant) with qualified engineering staff with relevant experience in successful design of solar SPV plants.
- 1.3.4. The design calculations for MMS, RCC structure, Steel structure, Foundation system including piling, Road work, Drainage work, etc. shall be submitted for prior approval of Engineer before commencement of construction.
- 1.3.5. As per project requirements, the Employer may ask for approval of all civil designs and drawings by a Chartered Civil/ Structural Engineer.
- 1.4. The design calculations shall be supplemented with a neat sketch showing the structure geometry, node and member nos., lengths of various typical members, support points and type of supports, types of materials & type of sections with properties considered in analysis & design. The report shall also include back-up calculations for various loads adopted in design, brief write-up on primary load cases and design load combinations considered and conclusions on design results (with supporting sketches) for easy reference and clarity. Where a computer program (other than STAAD) is used for analysis and design, the contractor shall include a write-up on the computer program used along with examples for validation check. Design Input (format suitable to the programme used and also in STAAD format) and output file shall also be given in the design report and in soft copy to facilitate its review and approval by the Engineer.
- 1.5. The methodology for construction of MMS and its foundations, Road & drainage works and Procedure for pile load test shall also be submitted for prior approval of Engineer before start of these works.
2. Topographical Survey
- 2.1. The contractor shall be responsible for detailed Topographical Survey of the proposed project site. The work shall be carried out through an agency with relevant experience and qualified survey team.
  - 2.2. The Topographical survey shall be conducted at 20m x 20m grid, or as directed by the Engineer, only with the help of digital surveying instruments like Total Station/ Auto level.
  - 2.3. The Contractor shall carry the BenchMark from nearest GTS Bench mark or any other established source like Railway station, Permanent PWD/ WRD structure etc. as approved by the Engineer, by fly-levelling and establish two permanent bench marks (PBM) at site. All subsequent transfer of levels shall be carried out with respect to these PBMs. The work shall also include constructing permanent reference pillars (RP) at suitable locations as directed by the Engineer. These reference pillars shall be labelled permanently with their respective coordinates and reduced levels for future use. The Permanent Bench Marks (PBM) and reference pillars (RP) shall be shown on the survey drawings.
  - 2.4. While carrying bench mark to the project site, levels shall also be established on the permanent objects like culverts etc. at least on one object in every 1 (one) km if available along with route with adequate description about the objects. These levels shall be maintained at site & also mentioned in the survey report to facilitate locating these objects later on.
  - 2.5. The survey work shall be carried out in UTM grid system. The contractor shall also establish the latitudes and longitudes and UTM coordinates of all the corners of the project site. At least 50m width of the adjoining plots and surrounding areas shall also be covered in the survey for correlation with adjoining plots and facilities. The grids for the survey work shall be established in N-S & E-W direction (corresponding to Geographical North or Plant North) as directed by the Engineer.
  - 2.6. Positions, both in plan and elevation, of all natural and artificial features in the area like waterways, railway tracks, trees, cultivation, houses, fences, pucca and kutch roads including culverts and crossings, foot tracks, other permanent objects like telephone posts and transmission towers etc. are to be established and subsequently shown on survey maps by means of conventional symbols (preferably symbols of survey of India Maps). All area/areas are to be surveyed and plotted on maps by contours. Any unusual condition or formation on the ground, locations of rock outcrops (if visible on the surface) etc. shall also be noted and plotted on

contour maps. The C/L coordinates of existing road & cross drainage (CD) works (culverts etc.) at intermediate points & at corners/ intersections and width of carriage way of the road shall be recorded with their position on the contour maps.

- 2.7. The record of measurement of all Reduced Levels (RL) shall be submitted in digital format, (in x, y z coordinate system) along with preliminary contour plan of the site, for Engineer's review before submission of final contour map. The contour interval shall be as required for proper representation of the topography however it shall not be more than 0.5m. The Contractor shall submit survey maps of the site in 1:10,000 scale indicating grid lines and contour lines, demarcating all permanent features like roads, buildings, power lines, natural streams, trees, etc. Present condition of the site, existing drainage pattern of the site, possibility of water logging and potential flood level of the area shall also be captured in the document. The project plot boundary with coordinates of all corner points along with coordinate grid of 50m x 50m interval shall be marked on the contour.

### 3. Geotechnical Investigations

- 3.1. The contractor shall be responsible for detailed Geotechnical investigations at the proposed project site for the purpose of foundation design for various buildings, structures, HT lines, MMS etc. and other design/ planning requirements. The investigation work shall be carried out through any Govt. approved/ NABL accredited agency. The contractor shall submit the credentials of the proposed agency along with relevant certificates in support thereof for verification/ approval of the Investigation Agency by the Engineer.
- 3.2. The scope of work includes execution of complete soil exploration including boring and drilling with rotary drilling rig, standard penetration test (SPT), collecting disturbed (DS) and undisturbed samples (UDS), collecting ground water samples, trial pits, electrical resistivity tests (ERT), field & laboratory CBR tests, conducting laboratory tests on collected samples of soil & ground water and preparation and submission of report. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20% met within a borehole (BH). SPT test shall be conducted at every 1.5m interval or at change of strata. The starting depth of SPT shall be 0.5m from ground level. UDS shall be collected at every 1.5m interval or at change of strata. The min. size of trial pit shall be 2.0mx2.0mx2.5m deep.
- 3.3. The field investigations shall mainly include drilling of min. 5m deep BHs (50% of total No. of boreholes shall be 10m deep), conducting SPT and collecting Disturbed (DS) and Undisturbed samples (UDS), conducting in-situ CBR test for approach road to the plant, internal roads & peripheral road; Trial pits(TP) and Electrical resistivity tests (ERT). Number and location of BHs, California bearing ratio (CBR) tests, ERTs and TPs shall be decided as per the project layout, site topography and soil conditions in consultation with the Employer. The proposed locations shall fairly represent the total project site to get the complete required geotechnical information. The BH near MCR and ICR shall be 10m deep. There shall be minimum 1 nos. of BH per 5 acres of the area (However, total number of boreholes shall not be less than 5), 3 nos. of Trial pits, 5 nos. of CBR test & ERT, 5 nos. of Ground water samples for laboratory investigations. The soil/ rock samples for laboratory investigations shall be collected from each borehole and trial pit in sufficient nos. (Note- In case the project plot is divided in to number of discrete blocks separated from each other, min. 3 nos. of bore holes, 2 trial pits, 2 ERT and 2 CBR tests shall be taken per such block with at least 1 No. of BHs per 5 acres as specified above).
- 3.4. The proposed Geotechnical investigation plan indicating proposed locations of TPs, BHs, water sample collection points, CBR test & ERT shall be submitted to the Employer for review and approval before start of work.
- 3.5. Laboratory tests shall be conducted on DS & UDS samples and ground water samples in sufficient no. & shall include, Soil classification, Grain size analysis including Hydrometer analysis, determination of Bulk and dry density, Specific gravity, Natural moisture content, Atterberg limits, Tri-axial shear tests (Unconsolidated Undrained – UU) on UDS, Undrained shear test, Consolidation tests, Unconfined compression tests (UCS), Free swell index, chemical analysis of soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, Organic matter and any other chemicals harmful to concrete and reinforcement/ steel. Laboratory tests on rock samples shall be carried out for Hardness, Specific Gravity, Unit Weight, Uniaxial Compressive Strength (in-situ & saturated), Slake Durability etc. Laboratory CBR test on soaked samples shall also be conducted on min. 5 no. of soil samples to ascertain the suitability of soil for sub-grade and requirement of any treatment of subgrade soil in case of CBR <2% as per IRC requirements.

- 3.6. After completion of field and laboratory work, the contractor shall submit a Geotechnical Investigation Report for Engineer's approval. All bore log details and lab test results shall be presented in the report as per provisions of relevant BIS standards indicating BH coordinates, Existing GL, Depth of water table, Method of drilling etc. The report shall include a Map showing the locations of various field tests including coordinates, calculations and recommendations for foundation type and safe bearing capacity (SBC) for various Plant buildings (ICR, MCR etc.) and Open installations, Switch Yard structures & Sub-Station (as applicable), Transformer foundation, HT lines (as applicable), MMS foundation etc. corresponding to settlement of 25mm.
- 3.7. The report shall include the study for "Liquefaction potential assessment of the ground and suggestions for any ground improvement measures" as required.
- 3.8. The report shall also include ground water analysis (water sample collected from bore well) to ascertain its suitability for construction purposes, recommendations for type of cement, grade of concrete & minimum cement content as per prevalent soil characteristics with respect to presence of aggressive chemicals and environment exposure conditions as per relevant BIS specifications. However, minimum grade of concrete shall be as specified under Clause 14 'Concrete Works'.
- 3.9. In case the contractor wishes to adopt concrete pile foundation for MMS supports the Geo-tech. report shall also include the calculations, based on soil properties, for safe pile capacity under direct compression, lateral load and pull out as per IS:2911. For single pile, Lateral load capacity shall be min. of the values obtained as per IS:2911 & Brom's method corresponding to free pile head. The report shall also include recommendations about type of pile, its depth and dia. to be used.
- 3.9.1. In marshy or swelling type soil, under reamed or driven precast concrete pile shall be used. In case contractor wishes to use helical piles the design, fabrication and installation shall conform to IBC (International building code).
- 3.9.2. The contractor shall carry out field trials for initial load test on pile to verify the pile design to confirm the safe load carrying capacity under direct compression, Lateral load and Pull out. The min. of the two values (design value as per soil characteristics & field test results) shall be adopted.
- 3.9.3. The nos. of piles to be tested under each category shall be finalized corresponding to geotechnical characteristics at site, plot area etc. However, minimum 5 nos. of piles shall be tested {min. 3 nos. in each block (block size < 25 acre) and min. 5 nos. in each block (block size >25 acres) if the plant site is divided in discrete blocks separated from each other} under each category of load.
- 3.9.4. The locations of test piles shall be distributed over the plant site and to be finalized in consultation with Engineer. In case the MMS column is fixed using base plate-anchor bolt assembly, the adequacy of provided pile reinforcement in job (working) pile corresponding to the set of test loads shall be reviewed by the contractor for any additional requirement of reinforcement and the same shall be provided in the pile to be cast for initial load test.
- 3.9.5. In case the Contractor proposes to embed the Column leg in the pile for fixing, the test pile shall be provided with embedded column leg as per approved design and any dowels as required for application of test load. The drawing for the Test pile shall be submitted to Engineer for his approval before casting the test pile. The load test on pile shall be conducted after min. of 28 days from the date of casting. In case the contractor desires to conduct the test earlier than 28 days, he may use suitable higher-grade concrete or if there is substantial evidence from earlier cube test results on design grade concrete to demonstrate the early gain of required compressive strength prior to application of the test load.
- 3.9.6. However, under no circumstances the test shall be conducted before 15 days of the date of casting the pile. All the dial gauges and hydraulic jack assembly shall be properly calibrated as per the requirements of relevant BIS standards and valid calibration certificate to this effect from Govt. / NABL accredited Test agency shall be submitted to the Engineer before use.
- 3.9.7. The contractor shall submit detailed methodology for conducting the tests in line with IS: 2911 (Part 4) for Engineer's approval before commencement of any test. After completion of these tests the contractor shall compile the test results and submit the report in a proper format as specified in the BIS standard with recommendations/ conclusions for Engineer's approval. The pile work shall start only after approval of the final pile design duly verified/ confirmed with initial load test results.

- 3.10. All buildings and Plinth for Open installations (MCR, ICR etc.), Transformer yard, Switchyard and Sub-station area shall have levelled ground as detailed under Cl. No. 5 below.
4. Other Investigations
- 4.1. The contractor shall also obtain and study other input data at proposed project site for design of the project from metrological department/ local govt. authorities. This shall include data related to Rainfall, Maximum & Minimum ambient Temperature, Humidity, HFL etc.
  - 4.2. The contractor shall carry out Shadow Analysis at proposed site and accordingly design strings and array layout with optimum use of space, material and manpower. In case of large variations in topography ( $3^\circ$  to the horizontal) the study shall also include the effect of topographical variations on array layout and MMS structure design adequacy and stability. The contractor shall submit all the details/ design to the Engineer for review/ approval.
  - 4.3. The contractor shall also identify potential quarry areas for coarse and fine aggregates to be used for concrete and shall carry out the concrete mix design for concrete grades to be used in construction of all concrete works (M25 and above) before start of construction. However, for piling M25 concrete with nominal mix of (1:1:2) may be used. For grades of concrete less than M25 to be used in PPC works, nominal mix as specified in IS:456 may be used. The concrete mix shall be designed for each source of cement and aggregates as per provisions of IS:10262 Standard and confirmed through 28 days compressive strength of concrete trial mix samples. Target mean strength of concrete for mix design shall be based on  $\sigma$  (standard deviation) = 5. The concrete mix design shall be carried out through NABL accredited Laboratory or any Govt. agency approved by the Engineer. In case the contractor proposes to use RMC, the same shall conform to IS: 4926. The Contractor shall submit the Concrete mix design proposed to be used by the RMC for review and approval by the Employer. (Reports of periodic quality tests for the supply concrete batch shall be maintained by the RMC supplier as per approved Quality Plan and the same shall be submitted to the Employer for review and record).
5. Area Grading and Land Development
- 5.1. The Finished Grade Level (FGL) of the proposed plant shall be fixed with reference to the highest flood level (HFL) and surrounding ground profile at proposed site to avoid flooding of plant site. The data regarding HFL at proposed site shall be obtained from the metrological department by the contractor. In case of absence of this data, the contractor shall assess the required information through local site reconnaissance. The area at and around (up to 25m beyond external wall/ area including access road & parking whichever is minimum) all buildings/ plinth for open installations (ICR, MCR etc.), transformer yard and switch-yard shall be uniformly levelled at suitable RL (i.e. FGL) to be finalized considering topography and HFL at site. The minimum plinth level of all buildings/ open installations shall be 450mm above FGL. Module mounting structure foundation/ Pile cap or any other pedestal shall be min. 200mm above FGL. Top of transformer foundation pedestal shall be min, 500mm above the FGL.
  - 5.2. A detailed drawing for site levelling and grading (if necessary) shall be submitted by the contractor before commencement of construction of all buildings, plinth for open installation and transformer/switchyard works. The estimated volume of cutting and filling shall also be marked on the Grading drawings for reference. The final grade levels to be adopted for different blocks shall be clearly marked on the Plant Layout/ Array Layout drawing.
  - 5.3. It is envisaged that the MMS are installed on natural/ existing ground without any levelling or grading of the area. Contractor shall accordingly consider the effect of the existing ground slope on the design of MMS structure as specified elsewhere in the specifications. If any ground undulations at column locations are observed the same shall be filled up with PCC (1:3:6) up to surrounding ground level immediately after pile installation before start of erection of other MMS members. In case of pile, the PCC fill shall extend min. 500mm outside pile cap all around and remaining area may be filled up with local soil properly compacted.
  - 5.4. The contractor is responsible for making the site ready and easily approachable by clearing bushes, felling of trees (mandatory permissions/ licenses/ statutory clearances from competent authorities if required for cutting of trees, blasting or mining operations, disposal of waste material etc. shall be obtained by the contractor), cutting, filling with selected excavated earth or borrowed earth including identifying borrow areas. Except in exceptional cases (with approval of the Engineer), filling shall be made up of cohesive non-swelling material. The filling for levelling/ reclaiming the ground/ area shall be done in layers not more than 150mm of compacted thickness in case of cohesive (clayey) soils and 250mm compacted thickness in case of granular (sandy) soils with compaction up to 95% (of modified proctor density) and 80% (of relative density) respectively. The slope at edge of graded areas shall not be steeper than 1:1.5 (1 Vertical: 1.5 Horizontal).

Horizontal) in cutting and 1:2 (1 Vertical: 2 Horizontal) in filling. In case of filling with rock material, the edges shall be provided in line with provisions of relevant BIS standard.

- 5.5. It shall be ensured that the land grading and levelling is done properly to ensure for free flow of surface run-off and the grade levels shall be fixed with respect to high flood level at site, drainage pattern and system requirements. It shall be ensured that the land is used optimally to have maximum solar power generation considering full utilization of the plot areas. It is advisable to follow the natural flow of water at the ground as far as possible for drainage design.
- 5.6. In case the filled up earth is brought from outside the plant or borrow areas (when the material inside plant area is not found suitable for grading work or if directed by the Engineer), the contractor shall carry out all required soil investigations to ascertain the suitability of the borrowed soil for land development and filling purposes. Contractor's scope shall also include arranging land lease, getting all necessary statutory approvals for mining, payment of necessary challan etc. Excess earth, if any, shall be disposed of properly at location as directed by the Engineer.

## 6. Roads

- 6.1. Suitable approach road (as applicable) from nearest parkroad up to plant Main gate, Access road from Main gate to Main control cum office room (MCR), Internal roads connecting MCR and other facilities/ buildings/ open installations like Local control room(s) (LCR)/ Inverter control room(s) (ICR), Sub-station & Switch yard (as applicable) etc. and peripheral road along inside of the boundary fence/ wall shall be provided for safe and easy transportation of men, material and equipment during construction and maintenance.
- 6.2. The Approach road connecting nearest parkroad and the Main gate shall be of 4.0m wide carriage way with 0.5m wide shoulders on either side. The access road connecting Main gate and MCR and internal access road(s) connecting MCR to various facilities/ buildings/ open Installations shall be of 3.0m wide carriage way with 0.5m wide shoulders on either side while the peripheral road shall be of 2.5m wide carriage way with 0.5m shoulders on either side. The top of road (TOR) elevation shall be minimum 150 mm above FGL to avoid flooding of roads during rains. The roads shall be provided with alongside drains as per design requirements of drainage system for effective disposal of storm water and to avoid cross flow of storm water over the road. The roads shall be designed as per IRC SP-72 corresponding to traffic category T3 and critical field CBR value of the subgrade. Shoulder shall be of min. 150mm thickness.
- 6.3. However, following minimum road section details shall be followed:
  - i. Topping: Surface dressing with gravel or gravel-soil mixture conforming to Cl. 402 of MORD specifications for rural roads published by IRC (MORD specs). However, for sites with average annual rainfall > 1500mm, either 2 course surface bituminous dressing conforming to Cl. 505 of MORD specs or 20 mm thick open graded pre-mix carpet + Type – B or Type –C seal coat conforming to Cl. 506 of MORD specs. shall be provided.
  - ii. Base course WBM (CBR>100%) conforming to Cl. 405 of MORD specs: 75mm compacted thick, Grade III
  - iii. Base course WBM (CBR>100%) conforming to Cl. 405 of MORD specs: 75 mm compacted thick, Grade II
  - iv. Granular/ gravel sub-base course (CBR>20%), conforming to Cl. 401 of MORD specs: 175 mm compacted thick, compacted to 100% of max dry density
  - v. Compacted subgrade: 300mm thick below sub-base (non-expansive soil with max. dry density > 1.65 kN/m<sup>3</sup>) conforming to Cl 303 of MORD specs, compacted up to 98% of standard proctor density in layers of 150mm thickness. In case of expansive soils like black cotton soil suitable treatment as per Cl. 403 of MORD specs shall be provided before laying sub-base course.
  - vi. Gravel Shoulders conforming to Cl 407 of MORD specs: 150mm compacted thick, compacted to 100 % of max. dry density
- 6.4. Soaked CBR value of sub-grade shall not be less than 2%. Where the CBR of the subgrade is less than 2 % a capping layer of 100 mm thickness of material with a minimum CBR of 10 % is to be provided in addition to the sub-base required for CBR of 2 %. When the subgrade is silty or clayey soil and the annual rainfall of the area is more than 1000 mm, a drainage layer of 100 mm over the entire formation width should be provided conforming to the gradation given in Chapter 6 of IRC SP-20. This layer will form a part of the designed thickness of sub-base.
- 6.5. In case of no-availability of murru in the nearby areas of the project site, suitable other screening/ blending material for WBM construction may be used conforming to provisions of IRC SP 20.

- 6.6. The construction of road shall conform to MORD specifications for Rural roads published by IRC.
- 6.7. Drain, cable or any other crossing shall be provided with RCC box or precast concrete pipe culvert. The culvert design shall conform to relevant IRC standard. The pipes for road culverts shall be of minimum class NP3 conforming to IS 458 with min. soil cover of 750mm above the pipe. In case of soil cushion less than 750mm the pipe shall be provided with 100 mm thick M20 reinforced concrete encasement with 10 dia. reinforcement rods @ 150mm c/c both ways. However, the water supply pipe for module cleaning and service/ drinking water shall be routed through Medium class GI steel pipe of required dia. conforming to IS: 1161.
- 6.8. Minimum dia. of casing pipe to be used at any facility like electric cable, water pipe line etc. shall be 150mm.
- 6.9. Maintenance pathways of min. 1.0m width shall be provided between SPV arrays for easy movement of maintenance staff, tools, equipment and machinery, washing of modules etc. The pathway area shall be generally levelled and well compacted manually/ mechanically. Areas of depression, valley zones or wherever there is noticeable change in topography, shall be levelled using well compacted good earth matching the top finished surface with ground topography/ grade to avoid accumulation of water in the region and allowing its free flow to keep the area devoid of mud/ sludge.
- 6.10. There shall be no peripheral road. However, about 2.5m wide corridor shall be left along inside of the plant boundary suitably maintained clean of any vegetation and shall be provided with adequate illumination for movement of security personnel. Any undulations shall be made good with locally available coarse-grained material to have fairly level passageway.
- 6.11. The design and drawings for approach road, all internal roads and culverts shall be submitted to the Engineer for approval before execution.
7. SurfaceArea drainage
- 7.1. The contractor shall design and construct storm water drainage network for smooth disposal of storm water from the plant to the nearest available drainage outlet.
- 7.2. The storm water drainage system shall be designed and planned to ensure no water stagnation in the plant.
- 7.3. The plant drainage system shall be designed for maximum hourly rainfall intensity and relevant time of concentration.
- 7.4. The design shall conform to the provisions of IRC SP 42 and best Industry practices. (The design rainfall shall be taken as max. hourly rainfall at 25 years return period at project site as provided in the Isopluvial map of the relevant subzone annexed with Flood Estimation Reports of Central Water Commission (CWC).
- 7.5. The coefficient of run-off for estimation of design discharge shall be considered as per catchment characteristics, however it shall not be less than 0.6.
- 7.6. The drainage scheme shall be designed considering the plant plot area and the surrounding catchment area contributing to the plant area drainage as per the topography.
- 7.7. The storm water drainage system shall be a network of open surface drains (with rectangular or trapezoidal cross section) and shall generally be designed to follow the natural flow of water and ground contours.
- 7.8. Suitable size plant peripheral drain as per design (min. 500mm wide x 500mm deep) along inside of plant boundary wall/ fence shall be provided for smooth channelization of outside storm water and to avoid flooding in the plant. The size of all internal and road side drains shall not be less than 450mm (bottom width) x 500mm (depth).
- 7.9. All trapezoidal drains shall have side slopes not steeper than 1:1 and shall be lined with either brick or RR masonry/ concrete or stone slabs as suitable to the site conditions. The min. Thickness of the lining shall be 115mm for brick masonry, 75mm for concrete slabs, 150mm for RR masonry and 100mm for stone slabs. The lining shall be in CM (1:4) and the joints shall be raked and pointed with CM (1:3), however, the joints in lining of plant peripheral drain may be left without pointing.
- 7.10. In case of rectangular drain, the thickness of the wall shall be checked against structural stability under action of the design loads as specified in Cl. No. 10.0 'Design Loads'. However, Min. thickness shall be 230mm for brick masonry, 300mm for RR masonry and 125mm for RCC work, except for garland drain around buildings where the min. wall thickness can be 115mm, 200mm and 100mm respectively for brick masonry, RR masonry and RCC work.
- 7.11. The structural design of drains shall be as per provisions of relevant BIS standards and good industry practice.

- 7.12. The drain outfall shall be connected to the nearest existing natural drain(s)/ water body outside plant premises and it shall be ensured that the drainage water shall not re-enter the plant nor encroach/ flood in the adjacent property/ plot.
- 7.13. The proposed drainage scheme along with design calculations and drawings shall be submitted to the Engineer for review/ approval before start of construction.
- 7.14. The contractor shall also explore for providing rain water harvesting system for water conservation by constructing suitable collection wells along the drains or through provision of detention ponds or percolation/recharge pit etc. The scheme for rain water harvesting along with design calculations shall be submitted for approval.
8. Peripheral boundary Wall/Fence
- 8.1. The plant peripheral boundary shall be provided with either Chain link or barbed wire fencing or masonry boundary wall as specified.
- 8.2. The boundary fence/ wall shall be provided along the Solar PV plant boundary to demarcate the plant boundary and to keep away the unauthorised access to the plant. The fence/ wall shall be provided with Main entry gate. The fencing/ wall shall be with 2.5m height above grade level including 400mm dia. GI concertina wire along with 3 no. of barbed wires on either arm to be fixed on Y shape angle brackets. The main gate shall be min. 6.0m wide (clear) (4.5 m carriage way + 1.5m wicket gate).
- 8.3. Chain link fencing
- 8.3.1. The fencing shall be of Chain link (GI or poly coat GI as specified) mesh fabric with internal, corner and stay posts of RCC (min 200mm x 200mm size, M30 grade) or Hot dipped GI angle (min. ISA 75x75x6 mm), as applicable, along with 230 thick brick/ 300 thick RR masonry toe wall, with 100mm thick M15 PCC foundation (min. width 450mm and min. depth 450 mm below GL).
- 8.3.2. Intermediate, corner and stay posts shall be supported with min. 300 mm dia. And 850 mm deep (below GL) piles in cement concrete (nominal mix 1:1:2). The column posts shall be extended in to the pile up to 800mm with 50mm cover at the bottom. The pile shall project 150mm above GL. The toe wall shall project 150mm above GL. The intermediate, corner and stay posts shall be supported by angle struts that shall have the same foundation as that of the main posts.
- 8.3.3. The brick masonry toe wall shall be plastered with 15 thick CM (1:4) plaster on both faces and shall have min. 50 thick PCC (1:2:4) coping finished smooth and projecting 35mm on either side of the wall with top sloping inwards.
- 8.3.4. Spacing of intermediate posts shall not be more than 2.5m. Every 10th intermediate post shall be provided with a stay post while every corner post shall be provided with two stay posts on either side.
- 8.3.5. Joints in RR masonry shall be properly raked and pointed with CM (1:3).
- 8.3.6. In case of pond/ drain crossing the fence, RCC beam of adequate size supported on RCC columns on either side and suitable grill of MS square rods (vertical spacing not more than 150mm) of min. Size 25x25 mm and min. 3 no. horizontal 20 SQ MS rods or 50 mm x 8 mm thick flats secured to RCC beam and columns; shall be provided in place of toe wall for smooth flow of water.
- 8.3.7. The GI chain link mesh fabric (40x40 mm with min. wire gauge 3.15mm, both ends twisted) and fencing shall conform to IS: 2721. Poly coat GI chain link mesh (50x50mm) shall conform to ASTM 668 and fencing shall conform to ASTM 668.
- 8.3.8. Each fence panel, in lieu of tie wire, shall be provided with 35x35x3mm GI edge angle at top and bottom with mesh fabric firmly secured to them and to intermediate support angles.
- 8.3.9. All MS sections shall be painted with 2 coats of epoxy paint of approved make and shade over 2 coats of suitable primer.
- 8.4. Boundary wall
- The boundary wall structure shall be a RCC beam-column structure with wall of either brick (min. 230mm thick), concrete block (min. 200mm thick) or of Pre-cast RCC columns and wall panels (min. 75mm thick). The top of the wall shall be provided with concrete coping (min. 50mm thick with 40mm projection on either side).
- 8.5. Barbed wire fencing
- The details of barbed wire fencing shall be same as those for chain link fencing except providing barbed wires (4mm dia.) in place of chain-link mesh. There shall be 10 no. of barbed wires which shall be equally placed along the fence height. The Barbed wire shall be of type 'Iowa' and class

designation 1 with chromate conversion coating and shall conform to IS: 278. Every bay of the fence shall also be provided with one GI diagonal line wire of 4mm dia. conforming to IS: 280.

#### 8.6. Main Gate

- 8.6.1. The Main entry gate of size as specified under clause no. 8.0 (2.5m height) shall of rugged design with solid MS steel sections (25x25mm). The spacing of vertical members shall not be more than 150 mm.
- 8.6.2. The gate shall be complete with MS flat guide track, castor wheel(s), GI fittings & fixtures like hinges, adrop, locking arrangement, posts etc.
- 8.6.3. The main gate shall be of 2.5m height and shall have 4.5m wide Gate for vehicular movement and an adjacent 1.5m wide wicket gate for pedestrian movement.
- 8.6.4. Area near the main gate extending from 500 mm (min) outside the gate to 2700 mm (min) inside the gate, shall be brought to Top of Road elevation with respect to the approach road at main gate for full width of the gate. This shall be achieved by providing 200 mm thick PCC (1:2:4) over 100 mm thick PCC (1:4:8) further underlain with 300 mm thick well compacted boulder soling with interstices filled with sand, resting over well compacted subgrade.
- 8.6.5. The gate shall be provided with the Project name plate (2.5mx 1m, 3mm thick MS plate). The gate shall be painted with 2 coats of epoxy paint over 2 coats of suitable primer.
- 8.6.6. The column posts of the gate shall be supported through RCC pedestal and footing. Min. depth of foundation shall be 1200mm below NGL.

8.7. All design and drawings for peripheral boundary fence/ Wall and Main gate shall be submitted for Engineer's approval before execution.

#### 9. Plant Layout

- 9.1. The contractor shall submit drawing showing proposed Project Plant and SPV module Layout.
- 9.2. The Plant and SPV module layout shall be a comprehensive drawing showing various requirements of the project like, Reference coordinate grid, Geographical and Plant North, Layout of boundary fence including coordinates of all corner points, Location of main entrance gate and any other access gates as per project needs, Block wise FGL, Layout of main approach road to the plant, Internal and peripheral roads, Security Room/ cabin (s), all Buildings and Open installations with coordinates, Temporary Storage yard/ facility to be used by the contractor during construction, Proposed Array layout, Lightening arrester, UG/Over ground water Tank(s), Storm water drains, Corridor for buried cables etc.
- 9.3. The cable corridor shall be laid through clear gap between arrays and shall not be laid below modules for easy maintenance.
- 9.4. All the facilities and buildings shall be presented with suitable Legend.
- 9.5. The drawing shall be in suitable scale to have proper representation of the information.
- 9.6. The Plant & SPV module layout drawing shall be submitted by the contractor for review/ approval by the Engineer.

#### 10. Design Loads

- 10.1. Unless otherwise specified elsewhere, Dead load, Live load, Wind load and Seismic load for buildings and structures shall be considered as per provisions of relevant BIS standards.
- 10.2. The following minimum imposed load as indicated for some of the important areas shall, however, be considered for the design. If actual expected load is more than the specified minimum load, then actual load is to be considered.

S. No.	Area	Imposed (Live) Load
1	Roof	1.50 kN/ Sqm
2	Building floors (GF) & Grade Slab	10.00 kN/ Sqm
3	RCC Floors (General)	5.00 kN/ Sqm
4	Outdoor platforms, Stairs, Landing and Balconies, Walkway, Chequered plate & Grating (except cable trench cover)	5.00 kN/ Sqm

S. No.	Area	Imposed (Live) Load
5	Road culverts & allied structures over drain & pipe crossings subjected to vehicular traffic	Design for Class – ‘AA’ loading (Wheeled & Tracked both) and check for Class – ‘A’ loading as per IRC Standard
6	Underground structures such as Sump, Pit, Trench, Drain, UG tank etc.	In addition to Earth pressure and Ground water table at FGL, a surcharge of 20kN /Sqm (10kN/Sqm for drains) shall also be considered. The structure shall be designed for following criteria – (a) Inside empty with outside fill+ surcharge and water table at GL & (b) Inside water with no fill & water table outside
7	Pre-cast and chequered plate cover over cable trench	4.00 kN/ Sqm
8	Main access & Internal Roads	As per IRC SP 20 corresponding to vehicular traffic of 150 commercial vehicles per day and critical in-field CBR

10.3. Primary Loads

- i. Dead Load (DL)
- ii. Live Load (LL)
- iii. Wind Load (WL) – Both along  $\pm X$  &  $\pm Z$  horizontal direction
- iv. Seismic Load (EL) – Both along  $\pm X$  &  $\pm Z$  horizontal direction

10.4. Basic wind speed ( $V_b$ ) at project site shall be taken as per IS 875 (part-3) unless otherwise specified elsewhere.

10.5. To calculate the design wind speed ( $V_z$ ), the factors  $K_1$  (probability factor or risk coefficient),  $K_2$  (terrain roughness and height factor) and  $K_3$  (topography factor) shall be considered as per IS 875 (Part-3) (However, minimum values for  $K_1$ ,  $K_2$  and  $K_3$  shall be .94, 1.0 and 1.0 respectively)

10.6. Topography factor ‘ $k_3$ ’ shall be taken as 1.0 upto upwards slope of  $3^\circ$ . For topography with upward slope greater than  $3^\circ$ , the value of ‘ $k_3$ ’ shall be calculated as per Annexure- C of IS 875 (Part-3).

10.7. In case of plant site within 60 km of seacoast, the importance factor for cyclonic region, ‘ $k_4$ ’ shall be taken as 1.15.

10.8. To calculate the design wind pressure ‘ $p_d$ ’, factors ‘ $k_a$ ’ (area averaging factor) and ‘ $k_c$ ’ (combination factor) shall be taken as 1.0. (The factor ‘ $k_d$ ’ shall be taken as 1.0 in case of plant site within 60km of sea coast).

10.9. The Seismic Load shall be considered corresponding to Earth quake zone at site as per IS: 1893 (Part- 4) with Importance factor 1.5. Ductile detailing as per IS 13920 shall be followed in concrete structures except in case of concrete support structure upto plinth level supporting open installations of inverter transformers and control panels at ICR/LCR, wherein the detailing shall conform to IS 456 and SP 34.

10.10. Notes for MMS Design

10.10.1. WL shall be considered as detailed below for estimation of WL under primary loads:

- i.  $WL_x$  (downward),  $WL_z$  (downward): Load due to positive pressure on design tilt angles of MMS members for wind acting in both ( $\pm X$ ,  $\pm Z$ ) directions
- ii.  $WL_x$  (upward),  $WL_z$  (upward): Load due to negative pressure on design tilt angles of MMS members for wind acting in both ( $\pm X$ ,  $\pm Z$ ) directions.

iii. WLx (member load), WLz (member load): Load due to wind action on side (exposed) face of respective MMS members (drag force) for wind acting in both ( $\pm X$ ,  $\pm Z$ ) directions.

- $\pm WL_x$  (member load, transverse to MMS table): Load due to wind action on column, front and back bracing, longitudinal bracing
- $\pm WL_z$  (member load, along length of MMS table): Load due to wind action on column, rafter front and back bracing, longitudinal bracing

10.10.2. For estimation of design wind loads on purlins (Table 8 of IS 875- Part 3), WL (downward) and WL (upward) on modules (laid in the profile of mono slope canopy) shall be applied such that the center of pressure should be at  $(0.3 \times \text{length of canopy})$  from windward end (for simplicity, the wind load distribution may be taken as triangular with max. value at windward end). Solidity ratio ( $\phi$ ) shall be taken as 0.5.

10.10.3. In design of MMS (for height of structures less than 10 m from ground), 20% reduction in wind pressure as per Note under Clause 6.3 of IS 875 – Part 3 is not permitted in case of purlins (members supporting modules), which shall be designed against action of WL corresponding to full wind pressure.

#### 10.11. Design Load combinations

10.11.1. Appropriate Load factors in LSM design for concrete structures and appropriate Factor of safety in WSM design (ASD) for all steel structures including MMS shall be considered as per relevant BIS standard. No increase in permissible stress is permitted in design of MMS

10.11.2. Following load combinations shall be considered in design

- For MMS Design:
  - i. DL+LL
  - ii. DL+LL  $\pm$  WLx (upward)  $\pm$  WLx (member load)
  - iii. DL+LL  $\pm$  WLx (downward)  $\pm$  WLx (member load)
  - iv. DL+LL  $\pm$  WLz (upward)  $\pm$  WLz (member load)
  - v. DL+LL  $\pm$  WLz (downward)  $\pm$  WLz (member load)
  - vi. DL+LL  $\pm$  ELx
  - vii. DL+LL  $\pm$  ELz
- For RCC and Steel structures except MMS:
  - i. DL+LL
  - ii. DL+LL  $\pm$  WLx
  - iii. DL+LL  $\pm$  WLz
  - iv. DL+LL  $\pm$  ELx
  - v. DL+LL  $\pm$  ELz

10.11.3. All buildings, structures and foundations shall be designed to withstand loads corresponding to worst design load combination.

### 11. Foundations (General)

11.1. Contractor shall design all foundations for buildings, equipment, HT line Towers, Switchyard structures, Transformer, MMS & other structures as per relevant BIS standards and recommendations of Geotechnical investigation report.

11.2. No foundation for MMS, buildings, switchyard equipment and structures, sub-stations, HT line towers, transformers, etc. shall rest on filled-up ground. However, minor structures like cable trench, cable rack, pipe pedestal, etc. may rest on filled-up soil with max. safe bearing capacity for design considerations not more than 3 T/Sqm.

11.3. Min. depth of foundation for all buildings and plinth for open installations shall be 1.5 m below NGL. For all other structures, min. depth of foundation shall be 1.0 m unless specified otherwise.

11.4. All foundations of a building shall be founded at same RL (Reduced level) with respect to foundation depth below lowest NGL (Natural ground level) in the building area. The Levels shall be obtained with reference to the already established TBM using digital survey instrument such as Total Station/ Auto Level.

11.5. All design & drawings shall be submitted to the Engineer for approval before execution.

### 12. MMS Foundation

12.1. Module mounting structure (MMS) may be supported on isolated/ strip footing or pile foundation.

12.2. Bored cast-in situ, Driven precast or under reamed Concrete pile

12.2.1. In case the contractor proposes to provide bored cast-in-situ concrete pile; the type, dia. and length of pile shall be as per recommendations of Geotechnical investigation report corresponding to prevalent soil characteristics at site. However, the min. dia. and depth of the pile shall be 300mm (min. 350 mm for column web depth more than 175 mm) and

1800mm respectively except when very hard strata/ rock ( $N > 100$ ) is encountered at a higher level, the pile shall be extended in to the hard strata minimum 1.5 times the diameter of the pile with total depth of the pile not less than 1200mm below cut-off level.

12.2.2. As specified above, the MMS support shall project minimum 200mm above FGL (Finished grade level) to avoid any damage to the MMS column/sub support due to direct contact of rain water/ surface run-off. This shall be ensured through either single stage construction of entire pile length including portion above FGL or by providing a collar (to be cast in second stage) which shall project min. 75mm in plan beyond the pile face and shall extend min. 250mm below GL.

12.2.3. For proper bonding, the surface of first stage concrete shall be made rough by troweling and cleaning out laitance and cement slurry by using wire brush on the surface of joint immediately after initial setting of concrete. The prepared surface should be clean watered to get saturated dry condition when fresh concrete is placed against it. The prepared surface shall be applied with a suitable bonding agent before construction of pile cap/ collar as required.

12.2.4. In case the column post/stub is supported through base plate-anchor bolt assembly, the same shall only be provided through RCC pile cap to be designed as per provisions of relevant BIS standard with min. clear overhang of 75mm. The pile shall embedded min. 50mm in the pile cap and the pile reinforcement shall be extended in to the pile cap for proper anchorage.

12.2.5. In case of collapse of foundation strata during drilling of the pile bore, removable steel liner shall be used to maintain design depth and diameter of the pile for proper concreting.

12.2.6. The design & installation of piles shall conform to IS: 2911.

12.2.7. The bore shall be free from water before poring of pile concrete. For under water concreting tremie shall be used.

### 12.3.Helical/ Screw Pile

12.3.1. The design, manufacture, testing and installation of Helical/ Screw pile shall conform to ICB-2009 and Practice Note 28- "Screw Piles: Guidelines for Design, Construction & Installation, ISSN 1176-0907 October 2015 (IPENZ Engineers New Zealand)"

12.3.2. The design of pile shall be undertaken and verified by a suitably qualified geotechnical or structural Chartered Engineer with experience in the design of helical/screw piles.

12.3.3. The pile shall be designed and manufactured in accordance with accepted engineering practice to resist all stresses induced by installation into the ground and service loads.

12.3.4. The steel grade for pile shaft, helix plates and other accessories shall be with min. Fy 350 MPa. Min. thickness (BMT) of shaft and helix plate shall be 6 mm and 8 mm respectively in case of coastal installations and soils containing aggressive chemicals and at other project sites it shall be respectively 5 mm and 6 mm. Cap plate and col base plate shall be min. 12 mm thick and of min. grade E-250 conforming to IS:2062.

12.3.5. All materials shall be hot dip galvanized conforming to relevant BIS standard with min. thickness of galvanization 80 microns.

12.3.6. Wherever the pile shaft is required to be infilled with concrete grout, the same shall be of min. grade M30 (anti shrink).

12.3.7. The allowable axial design load (Direct compression & Pull out), Pa, of helical piles shall be the least of the following values:

- i. Sum of the areas of the helical bearing plates times the bearing capacity of the soil or rock comprising the bearing stratum.
- ii. Capacity determined from well-documented correlations with installation torque.
- iii. Load capacity determined from initial load tests.
- iv. Axial capacity of pile shaft.
- v. Axial capacity of pile shaft couplings.
- vi. Sum of the axial capacity of helical bearing plates affixed to pile.

12.3.8. The lateral allowable load capacity of the pile shall be calculated using P-Y analysis and shall be verified with field trials. The allowable design lateral load shall be equal to the min. of (i) the total lateral load producing max. lateral deflection of 5mm and (ii) 50% of the total lateral load at which the lateral displacement increases to 12mm.

12.3.9. Dimensions of the central shaft and the number, size and thickness of helical bearing plates shall be sufficient to support the design loads.

12.3.10. The Design Report shall include following details.

- i. Design loads

- ii. Geotechnical Strength Reduction Factors and supporting methodology
  - iii. List of design standards
  - iv. Design methodology and how specific loads such as seismic, lateral and settlement are addressed
  - v. Founding stratum
  - vi. Estimated length
  - vii. Connection design and details between pile shaft & pile cap plate and Col base plate
  - viii. Pre-production and production load testing to support design including acceptance criteria.
- 12.3.11. Helical piles shall be installed to specified embedment depth and torsional resistance criteria as per design. The torque applied during installation shall not exceed the maximum allowable installation torque of the helical pile
- 12.3.12. Special inspections shall be performed continuously during installation of helical pile foundations. The information recorded shall include installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required.
- 12.3.13. The installation of piles shall be done by an agency having adequate experience in helical pile construction.
- 12.3.14. The method statement for pre-production load testing (initial test) and construction of Helical Pile shall be submitted for review and approval. The method statement shall comply following requirements:
- 12.3.14.1. Helical pile pre-production load testing
- The Piling Contractor shall provide a method statement for the pre-production load testing. The method statement shall be submitted 2 weeks prior to pile installation for testing and shall contain the following information (as a minimum):
- Programme of the testing, detailing the timing and sequence of each load test including any additional investigations proposed
  - The general arrangement of the equipment
  - A method for measuring the displacement at the head and toe of each test pile
  - Template for the Pile load test report
  - Confirming the criteria for determining the acceptability of the compression, tension and lateral load tests
  - A contingency plan in the event that a load test is deemed not acceptable
  - A procedure for verifying the capacity for each individual pile, this may include correlating the installation torque for each pre-production pile with the load test results
  - All pile load tests shall be supervised by suitably experienced personnel, who are competent to operate, monitor and record each test throughout its duration. Each pile load test shall be continuously monitored throughout its duration.

#### 12.3.14.2 Helical Pile Construction

The contractor shall provide a method statement for each piling operation to be undertaken in executing the Works. The method statement shall describe all proposed equipment and detail the construction sequence. The method statement shall be submitted with the tender and shall contain the following information (as a minimum):

- Programme of the works, detailing the timing and sequence of individual portions of the works
- Full details of the installation plant to be used, including manufacturer's information and proof of servicing/recent upkeep and calibration
- Proposed phasing of excavation/filling operations such that the design stresses in the piles (and any supporting frames) are not exceeded
- The contingency plan to be adopted, to minimize disruption and delay, in the event of encountering obstructions

- Anticipated noise levels (measured in dB) and vibration levels (measured in mm/sec) arising from piling operations (if applicable)
- 12.3.15. The Piling Contractor shall nominate a suitably experienced, professionally qualified engineer, as the "Piling Supervisor".
- 12.3.16. Unless specified else were, the field trials for initial load tests on concrete and helical/screw pile shall conform to IS: 2911 (Part 4) & Practice Note-28 (IPENZ Engineers New Zealand) as applicable. The no. and location of such tests shall be as per the provisions stipulated under Cl. No. 26.8.
- 12.3.17. Contractor shall also carry out routine tests on 0.5 % of the total no. of working/ job piles as per provisions of IS: 2911 (Part 4). In case of unsatisfactory results, min. no. of routine tests may be increased up to 2% of the total no. of working/ job piles as per the directions of the Engineer.

### 13. Module Mounting Structure (MMS)

- 13.1. The module mounting structure design shall generally follow the existing land profile. The top of the table shall be in one plane.
- 13.2. In MMS analysis the column support shall be assumed at EGL/NGL.
- 13.3. In case of topographical variations more than 3°, the contractor shall carry out detailed study of its effect on array layout, shadow analysis and structural stability of MMS.
- 13.4. The structure shall be designed to allow easy replacement of any module and shall be in line with site requirements.
- 13.5. The MMS stub/ column, rafter, purlin, ties and bracing members shall conform to following Indian standards.
- IS: 2062 – Hot rolled Medium and High tensile structural steel
  - IS: 811 – Cold formed light gauge structural steel sections
  - IS: 1161 – Steel tubes for structural purposes
  - IS: 4923 – Hollow steel sections for structural use
  - Minimum grade of steel for sections conforming to IS: 811 & IS: 4923 shall be E350 conforming to IS: 2062 and YSt 310 conforming to IS: 1608 respectively.
- 13.6. The contractor can also propose new light gauge structural steel or structural aluminum sections other than specified in IS: 811 subject to approval of the Engineer. In this case the contractor shall submit his proposal stating the technical advantages of the proposed sections for Engineer's review along with supporting literature and sample design calculations conforming to present specifications at the time of bidding.
- 13.7. Aluminum-Zinc Alloy metallic coated steel strip or sheet of grade YS350 and minimum coating class AZ200 conforming to IS 15961: 2012 may also be used for fabrication of purlin sections. In such a case, all the sections of the base metal exposed after cutting of members and punching of holes shall be provided with sprayed aluminum and zinc coating conforming to IS 5905.
- 13.8. The minimum thickness excluding anti corrosive treatment (BMT) of various elements of MMS structure shall be as following:
- Stub/ column – 3.15mm,
  - Rafter – 2.5mm &
  - Purlin – Minimum thickness of the purlin section excluding anti corrosive treatment (BMT) shall be 1.5 mm. Aluminum-zinc alloy metallic coated steel strip or sheet of grade YS350 and min. coating class AZ150 conforming to IS-15961:2012 may also be used for fabrication of purlin sections. In such a case, all the sections of the base metal exposed after cutting of members and punching of holes shall be provided with sprayed aluminum and zinc coating conforming to IS-5905.
  - Other members – 2.0 mm
- 13.9. The primary loads and load combinations for design of MMS structure shall be as specified under Clause No. A1.1.1. The design shall be done by Working stress method and no increase in allowable stress shall be permitted.
- 13.10. The maximum permissible deflection/ side sway limits for various elements of MMS under serviceability conditions shall be as following:
- Lateral deflection/ side sway for Column – Span/ 240
  - Vertical deflection for Rafter and Purlin – Span/ 180
  - Lateral deflection for Purlin – Span/240

- 13.11.In case of natural frequency in first mode less than 5 Hz, the design of the MMS structure shall also be checked against dynamic effects of wind as per provisions of IS – 875 (Part-3) using gust factor method.
- 13.12.The purlins shall be provided with min. following tie/sag rods or angles or channels:
- 1 no., in the mid of each span and shall connect all the purlin members
  - 1 no., diagonal, at each corner in end spans
- 13.13.Lateral restraint to compression flange if any due to PV panels is not permitted in purlin design.
- 13.14.The vertical diagonal bracing shall be provided in end spans and every alternate span of each unit (table) of MMS.
- 13.15.MMS shall support SPV modules at a given orientation & tilt and shall absorb and transfer the mechanical loads to the ground properly.
- 13.16.Welding of structure at site shall not be allowed and only bolted connections shall be used.
- 13.17.The MMS structure shall be hot dip galvanized with minimum GSM 610 kg/ sqm and/or minimum coating thickness of 80 microns for protection against corrosion. Galvanization shall conform to IS-2629, 4759 & 4736 as applicable.
- 13.18. It is to ensure that before application of this coating, the steel surface shall be thoroughly cleaned of any paint, grease, rust, scale, acid or alkali or any foreign material likely to interfere with the coating process.
- 13.19.The bidder shall ensure that inner side is also provided with galvanization coating.
- 13.20.The galvanization shall be done after fabrication of members and cutting of holes to ensure galvanization of all cut/ exposed edges.
- 13.21.In case the proposed section is made up of Aluminum, anodized coating shall be Gr. AC25 and shall conform to IS: 1868.
- 13.22.The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time
- 13.23.Two numbers of anti-theft fasteners of stainless steel on two diagonally opposite corners for each module shall be provided. All fasteners and washers (2 round + 1 spring) both for MMS connections and fixing of PV Module shall be adequately protected from atmosphere and weather prevailing in the area.
- 13.24.Fasteners and washers to be used for erection of mounting structures and those for fixing Module over MMS shall be of stainless steel grade SS 304 with property class A2-70 conforming to relevant ISO standard and must sustain the adverse climatic conditions to ensure the life of the structure for 25 years.
- 13.25.Min. diameter of bolt for MMS connections shall be 10mm (12 mm in case of single bolt connection for seasonal tilt) except at column-rafter connection, where it shall not be less than 12mm (not less than 16mm in case of single bolt connection for seasonal tilt). In case of fixed tilt, min. two number of bolts shall be provided at each joint.
- 13.26.Modules shall be clamped or bolted with the structure properly. The material of clamps shall be Al / SS having weather resistant properties. Clamp/bolt shall have EPDM rubber washer and shall be designed in such a way so as not to cast any shadow on the active part of a module.
- 13.27.The MMS foundation shall be designed as per Clause No. 12.
- 13.28.MMS column post supported with base plate secured to foundation shall be fixed with galvanized high strength "J" bolts conforming to specifications of IS: 4000/ IS: 1367 and relevant IS code Installation of foundation bolts and embedment of column leg in foundation concrete shall be done by using template to ensure proper alignment. The underside of base plate shall be provided with anti-shrink grout.
- 13.29.In case the contractor proposes to extend the column leg to embed it in the pile/pedestal as an alternate fixing arrangement, the column member shall be extended for full depth of the pile (100mm cover at tip of the pile) with an end plate of min. 4mm thickness to be welded at the bottom of column leg. (However, for plants in coastal area or in case of marshy soil the column post shall be supported only with base secured to foundation through base plate and anchor bolt assembly and no embedment of column leg in foundation is permitted)
- 13.30.The array structure shall be grounded properly using maintenance free earthing kit.
- 13.31.The bidder/manufacturer shall specify installation details of the PV modules and the support structures with appropriate diagram and drawings.
- 13.32.The Bidder should design the structure height considering highest flood level at the site and the finished grade level. The minimum clearance between the lower edge of the module and the finished grade shall be the higher of (i) Highest flood level + 100mm and (ii) 1000 mm, as applicable

- 13.33. The length of one unit (Table) of MMS shall not generally be more than 20m.
- 13.34. The MMS shall be designed to optimize tilt angle and elevation to minimize self-shading and maximize the capture of diffuse light by Bifacial Modules. The Bifacial Module frames shall be rail-edge mounted in landscape configuration to minimize losses.
- 13.35. The contractor shall submit the detailed design calculations and drawings for MMS structure, bill of materials and their specifications/ standards to the Employer for approval before start of fabrication work as per the engineering work program (L2 schedule) as finalized during kick-off meeting.
- 13.36. The length of any cold formed section (CFS) shall not be more than 5.5 m.
- 13.37. In case of seasonal tilt, the front and back bracing members (subject to seasonal rotation) shall be connected to rafter or column through gusset plate and shall not be connected directly to the column or rafter.
- 13.38. The purlin splice shall be near the zone of contra-flexure, i.e. within a distance of 0.15L to 0.25L from the support, where L is the respective span within which splicing is located.
- 13.39. The purlin splice shall comprise of flange and web splice plates and splice design shall conform to Annexure-F of BIS:800. For simplicity in fabrication, the splice member may be of CFS channel section without lips (CU). There shall be min. four number of bolts on either sides of joints in web zones and one number of bolt on either side of joint in flange zones.
- 13.40. For same member type, same section shall be used.
- 13.41. When any sag or tie member to the purlin (rod, angle or channel) is provided, it shall not be considered in modelling the structure for analysis except its effect as lateral support to the purlin members in strength design.

#### 14. Concrete Works

- 14.1. Construction of all RCC works shall be done with approved design mix as per IS 456 and the materials used viz. Cement, coarse & fine aggregate, Reinforcement steel etc. shall conform to relevant BIS standards.
- 14.2. The min. grade of concrete shall be M25 (M30 in coastal areas/marshy soil) for all RCC works except liquid retaining structures like underground water tank, septic tank, etc. where minimum grade of concrete shall be M30 (M35 in coastal areas/marshy soil).
- 14.3. Cement higher than 43 Grade shall not be used in construction.
- 14.4. Unless otherwise specified elsewhere, PCC shall be of min. grade M10 (nominal mix 1:3:6) except for mud mat, back filling of ground pockets or leveling course which shall be of grade M7.5 (nominal mix 1:4:8).
- 14.5. Reinforcement steel shall be of high strength TMT bars of grade Fe500 D conforming to IS: 1786.
- 14.6. Unless specified otherwise for grouting works anti shrink ready mix grout of approved make or cement mortar (CM) grout with non-shrink compound shall be used. The grout shall be high strength grout having min. characteristic strength of 35 N/mm<sup>2</sup> at 28 days.

#### 15. Miscellaneous Steel Works

- 15.1. Unless otherwise specified elsewhere, all structural steel work shall be designed as per provisions of IS: 800 with working stress method of design (WSD).
- 15.2. Structural steel hot rolled sections, flats and plates shall conform IS: 2062, structural Pipes shall be medium (M)/ high (H) grade conforming to IS: 1161, chequered plate shall conform to IS: 3502 and Hollow steel sections for structural purposes shall conform to IS: 4923.

#### 16. Buildings and Plinth for Open Installations

##### 16.1. General Requirement

- 16.1.1. Plant buildings and plinth for open installations are required to be constructed for housing the electrical equipment/ panel (Local Control Room Building - LCR) and Control room cum office cum store (Main Control Room Building - MCR) for operation and maintenance of Photovoltaic Solar Power Plant. Security room at main gate & Security cabin(s) (at strategic locations) shall also be provided to secure the plant from any theft/ burglary/unauthorized entry.
- 16.1.2. Unless otherwise specified elsewhere, all buildings and plinth for open installations except Security room/ cabin shall have RCC framed structure. Masonry partition walls shall be provided for Kitchen, Pantry, Battery room and Toilet units. For other rooms AL Glass partitions shall be provided. The plinth for open installations and equipment area shall be designed with OEM requirements. The security room/ cabin(s) shall be of prefabricated structure.
- 16.1.3. All buildings shall have provision of adequate windows for natural light & ventilation, fire safety provisions and shall be designed as per provisions of National building code (NBC).

16.1.4. The contractor shall submit the proposed equipment layout drawings to the Engineer for approval before development of Architectural drawings. The building layout, exterior elevations shall be aesthetically designed following good architectural practices to get a pleasant look. Horizontal/ vertical bands through projections/ grooves in external plaster may be provided to break the monotony. Roof slab shall have projection of 450mm beyond external walls with RCC parapet wall of 450 mm clear height all-around which shall form a projected band at roof level. For weather protection all doors and windows shall be provided with 450mm wide RCC chajja. However, chajja for rolling shutter shall be 750mm wide.

## 16.2. Functional requirements

### 16.2.1. MCR Building

For operation & maintenance of SPV Plant, unless otherwise specified elsewhere, Control room cum office area of MCR building shall provide following facilities.

- Air-conditioned area (with provision of split A/C unit of adequate capacity) for SCADA room (min. carpet area 12m<sup>2</sup>), Conference room (min. carpet area 20 m<sup>2</sup>) & Supervisor cabin and office area (min. carpet area 20 m<sup>2</sup>)
- Inverter/ Switchgear, equipment room(s) as per OEM requirements
- Store cum record room (min. carpet area 15 m<sup>2</sup>)
- Battery room as per requirement
- Toilet block with separate gents and ladieswashroom facilities (min. total carpet area 12 m<sup>2</sup>)
- Pantry with service platform and utensil washing facilities (min. carpet area 5 m<sup>2</sup>)
- Suitable provision for passage (for smooth movement of O & M personnel), cable trenches, operating area etc. (min. clear width 1500mm)

### 16.2.2. LCR/ ICR

- Inverter and associated equipment shall be installed on plinth as open installations. They shall generally comprise of data loggers, battery, inverter, electrical panels, etc. as per requirements and as per approved system drawings.
- There shall be suitable provision for easy/smooth passage of O&M personnel, cable trench, operating area, etc.
- The plinth supporting the ICR/LCR equipment shall have RCC framed structure with foundations, columns and beams up to plinth level (FFL).
- The size and clear head room (below soffit of beam) for LCR/ICR shall be provided as per system/O&M requirements.
- In case of indoor installation of inverters, MCR and LCR/ICR building shall not be clubbed together unless specified otherwise.
- However, when LCR/ICR and MCR building facilities are clubbed in one single building, the Equipment area (inverter room) and Office cum Control room area shall be separated by a brick wall with provision of internal entry door.
- MCR building shall have separate main entry to office area plus a provision of fire exit door.
- The size of inverter/HT panel room shall be provided as per system requirements.

### 16.2.3. Security Room/ Cabin

16.2.3.1. Contractor shall provide required number of pre-fabricated security cabins at strategic locations & at corners of the plot and 1 nos. security room at Main entry gate.

16.2.3.2. The Security room shall be of min. size 3m x 3m x 2.75m height. The Security cabin shall be of min. size 1.2 x 1.8m x 2.5m height.

16.2.3.3. Security room/ cabin shall be a pre-engineered & pre-fabricated structure. The walls and roof of the building shall be fabricated with double skin insulated sandwiched Al-Zn alloy coated high tensile steel metal panels (BMT- 0.5mm, Al-Zn alloy coating -150 GSM total on both sides). The insulation shall be of PUF with min. density 40 kg/ cum and adequate thickness. Roof shall be provided with suitable slope, not less than 100 to the horizontal (approx. 1V:6H) for proper drainage of rain water and shall project 300mm beyond the walls. The make and (color) shade of pre- coated metal panels shall be subject to approval by the Engineer. Min. thickness of color coating shall be 20 micron (DFT) excluding prime coat 5 micron (DFT). The coating system shall confirm to IS: 15965.

16.2.3.4. The Main security room shall be provided with one Aluminum (AL) glazed door (0.75m wide x 2.1m height) on one face and AL glazed sliding windows (1.2m width x

1.0 m height) with AL grill on remaining three sides. Security cabin shall have one AL glazed door (0.75m width x 2.1m height) and 1 no. AL sliding window (0.8m width x 1.0 m height) with AL (anodized) grill on one side. All glazing shall be of clear float glass with thickness of 4mm for window and 6 mm for door panel.

16.2.3.5. The door and windows shall be provided with all necessary fitting and fixtures like handles, tower bolts, mortise lock for door, stays, door stopper etc. All AL sections for doors and windows shall be anodized (min. average thickness 25 microns) or polyester powder coated (min. DFT 50 microns) with approved color shade for protection against weather.

16.2.3.6. Specially coated/ SS self-drilling screws/ fasteners conforming to class 3 as per ASTM: 3566.1 and 3566.2 shall only be used for all connections.

16.2.3.7. Anchor/ foundation bolts shall conform to IS: 5624 and IS 800.

16.2.3.8. The Security Cabin may be installed on concrete M20 skid platform (min. 250 mm thick, over 250 mm thick compacted rubble soling with interstices filled with sand). The top of skid shall be 200 mm above FGL. The concrete skid shall be provided with shrinkage reinforcement (8 dia @ 200 c/c both ways) near top surface. The concrete skid shall project 200mm beyond the walls.

16.2.3.9. The Security Room shall be supported on RCC framed structure with foundations, columns and plinth beams with 450 high plinth above FGL.

#### 16.2.4. Portable Cabin

16.2.4.1. Portable cabin shall be of size 15 x 10 x 8.6 feet (clear dimensions i.e. available volume) for MCR and Store Room. For other buildings, appropriate sizes as per available space and design may be proposed.

16.2.4.2. The main fabrication of the structural frame work shall be integral and all welded (CO<sub>2</sub> welding) type to comprise of the bottom, top, side & overall frame work. Self-draining roof and desired door-window with Insulation & electrical fittings inside the cabin. The structure should be durable, fire proof, light, sturdy, termite and water proof.

16.2.4.3. The Portable cabin for MCR shall have provision for partition walls for a Supervisor Room and seating area for 4 O&M personnel.

#### 16.2.4.4. Detailed Specifications

Component	Description	Reference Standard
Bottom/base frame	100 mm specially formed channel	IS 2062 for MS or IS 808 for Rolled section
Top frame	75 x 75 sq. mm pipes/tubes	IS4923(tube) IS 1239 (pipe)
Stiffeners Bottom	100 x 50 mm specially formed channels	IS 2062 or IS 808
Stiffeners Top	45 x 45 x 5 mm & 45 x 45 x 5 mm M.S Tee	IS 2062 or IS 808
Side Post	Specially formed 3.15 mm M.S post section	IS 2062
Side wall stiffeners	Specially formed 2.00 mm M.S channels	IS 2062 or IS 808
Panelling outside	M.S Corrugated sheet (10 gauge)	IS 2062
Internal wall panelling	8 mm Pre-laminated sheet for wall	

<b>Component</b>	<b>Description</b>	<b>Reference Standard</b>
Roof outside	M.S Plain sheet (18 gauge) with efficient drain of rain water and to avoid collection of dust leaves etc. on the roof	IS 2062
False ceiling	5 mm 100% water proof sheet	-
Bottom flooring	10 mm MS Chequered Plate	IS 2062
M.S door	50 mm insulated M.S Door of size- 3' x 6'6" with hydraulic door closer, locks, handles. Doors shall be fixed with heavy gauge MS hinges Weather shed for door.	IS 2062 For Hinge – IS 1341-1992 For Hydraulic Door Closer – IS 3564-1996 Type-2
Insulation	At four side walls by 50 mm Glass wool insulation covered with 8 mm pre-laminated sheet At ceiling by 100 mm Glass wool insulation covered with 5 mm pre-laminated sheet (100% waterproof) (All the Glass wool density-24)	Glass wool; IS 8183-1993

#### 16.2.4.5. Accessories

Wiring	Concealed wiring – PVC conduits using fire resistance wires
Electrical Fitting/cabin	Tube lights – 02 nos. Door lights – 01 no. Fans – 01 no. Switches & sockets: 6 amps – 01 no. & 16 amps – 01 no.
Furniture (for MCR)	Office Chairs with swivel mechanism, wheels and adjustable height - 6 Nos., 4 seater Round Discussion Table –1 No., Supervisor Desk Table with Drawers for Supervisor – 1 No.
Painting	Phosphating the cabin internally and painting with coat of epoxy primer (anti corrosive paint) & two coat of epoxy texture paint (corrosion resistant paint) of reputed make. The external surface of the cabin shall be painted with two coats of epoxy texture paint (corrosion resistant paint) of reputed make. The roof of the cabin painted with polyurethane paint.
M.S Racks with shutter OR Storage Cup board	M.S Storage Cupboard - 06 nos. Each Cup board made of M.S with full height door of size-4' 10" (width)x 2'6" (depth) x 6'(ht) comprising with 02 partitions at 2 ft height
Dummy plate	Size- 3'5" x 3'5"

16.2.4.6. The portable cabin for MCR shall be provided with adequate number of split type air conditioning units and fans.

#### 16.2.5. Pre-Engineered Building (PEB)

##### 16.2.5.1. General

The PEB shall be made of structural steel construction with double skinned metal roofing and wall cladding of appropriate profile. PEB shall be complete with painting, metal fascia, metal gutter, rain water down comers, sun-shades, openings, etc., along with associated structural steel, cladding and roofing work insulation, Trims & Flashings. Each item of PEB like panels, masonry, plastering, flooring, foundation, fittings etc. shall be suitable for complete life of solar plant. The construction methodology for PEB shall also be submitted to the Employer/Owner for approval before start of works.

#### 16.2.5.2. Structure and material specification:

Component	Description	Reference Standard
Primary Structural Members including Transverserigidframes,columns,cornercolumns,endwallwindcolumn s,beams, trussmember, base plate.	Steel frame members with minimum thickness 4 mm with minimum yield strength of 345 MPa	IS 2062 min Grade E250 Quality BR/ ASTM A572-12 Grade 50
Secondary Members: Including the purlins, Girts, eave struts, bracing, flange bracing, base angles, clips, flashings and other miscellaneous structural parts. Suitable wind bracings sag rods to be reckoned while designing the structure.	Minimum thickness 3.15 mm. Secondary members for purlins and Girts shall have minimum yield strength of 345 MPa. Miscellaneous secondary members shall have minimum yield strength of 250 MPa.	IS 811 or ASTM A1003-12 steel sheets conforming to ASTM A1011-12b Grade 50
Wall Cladding	Insulated wall cladding or roofing shall consist of double skin metal cladding with Poly Urethane Foam (PUF). PUF must be made of continuous method PU foam and must be CFC free, self-extinguishing, fire retardant type with	
<b>Design Parameters and Design Loads:</b>		
Dead Load:	Self-Weight of Structure including Purlins, Sheeting, Girts, Bracings, weight of turbo ventilators to be added as Dead load etc. Imposed Load (Live Loads) Live loads shall be as per IS –	

Component	Description	Reference Standard
	875. For sloped roofs up to 10 deg. it shall be 0.75 kN/m <sup>2</sup> .	
Wind Load:	Design wind speed factors shall be as per IS: 875-III, however the minimum value of these factors shall be	
Earthquake Load:	All PEB structures shall be designed for Seismic forces. Vertical Deflection and Horizontal Sway Limits: Limiting Deflection: The limiting permissible vertical deflection for structural steel members shall be	
Paint and Coating:	Steel shall be colour coated with total coating thickness of 25 microns (nominal) dry film thickness (DFT) comprising of silicon modified polyester (SMP with silicon content of 30% to 50 %) paint or Super Durable Polyester (XRW) paint of 20 microns (nominal) on one side (exposed face) on 5 micron (nominal) primer coat and 10	
Plinth Protection:	750mm wide plinth protection minimum 75 mm thick of cement concrete 1:3:6 (1cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) over 75 mm bed	
Rolling shutter:	Rolling shutter (Hand operated) shall be fabricated from 18 gauge steel and machine rolled with 75 mm rolling centres with effective bridge depth of 12 mm lath sections, interlocked with each other and ends locked with malleable cast iron clips	
Windows Frame:	Aluminum black powder coated section, frame shall be of 92x31 mm, minimum 16G thick as per approved design. Tinted glass and	

Component	Description	Reference Standard
Roof Insulation and type	<p>Both metal sheets shall have an under insulation of minimum 70 mm thick PUF with density 40 +/- kg/m<sup>3</sup> and thermal conductivity 0.019-2.2 W/(m.K) at 10°C with gutters and down take pipes along with Flashing &amp; Top cap of required size and colour complete with all necessary hardware.</p> <p>Roof shall be projected at-least 300 mm from the wall. Stiffening ribs / subtle fluting for effective water shedding and special male / female ends with full return legs on side laps for purlin support and</p>	
Wall Insulation	<p>All voids of external and internal metallised walls shall have an under insulation of minimum 60 mm thick PUF with density 40 +/- kg/m<sup>3</sup> and thermal conductivity 0.019-2.2 W/(m.K) at 10°C with proper supports etc. as approved.</p> <p>Both the walls should be separated</p>	

16.3. The Design and drawings shall be submitted for approval prior to fabrication and installation.

#### 17. Flooring, Skirting and Dado

##### 17.1. Store area, Equipment Area

40 mm thick Cement concrete (IPS) flooring (1:2:4), aggregate size 10 mm down, conforming to IS 2571 with 2mm thick Heavy-duty epoxy coating (Industrial grade) of approved make on top as per manufacturer specifications and 10mm thick matching skirting of 100mm height.

##### 17.2. SCADA Room, Control cum Office Room, Supervisor Room and Lobby 1200 mm X 1200 mm thick Heavy duty vitrified tile (8mm thick or more) flooring with matching skirting of 100mm height.

##### 17.3. Battery Area/Room

Acid/ Alkali resistant tile flooring and 2100 height dado, Floor and dado tiles - 20mm and 12 mm thick respectively. However, in case of maintenance free batteries, vitrified tile (8mm thick) flooring and dado shall be provided.

##### 17.4. Toilet

- 40 mm thick Ceramic tile (8mm thick) flooring and glazed tile (6mm thick) 2100 height dado.
- 20mm thick Granite stone finish over platform for wash basin.

##### 17.5. Pantry

40 mm thick heavy duty vitrified tile (8 mm thick) flooring and glazed tile (6mm thick) 2100 mm height dado, 20mm thick Granite stone finish over service platform.

##### 17.6. Passage/ Corridor

40 mm thick Heavy duty vitrified tile (8mm thick) flooring with matching skirting of 100mm height.

##### 17.7. Steps

Kota stone (20 thick) or 50 thick cement concrete (IPS) flooring conforming to IS 2571.

##### 17.8. All items shall be of reputed make. Only Items with approved samples by the Engineer shall be used.

#### 18. Doors and Windows

18.1. Doors, windows, louvers and ventilators shall be made of AL sections (minimum average thickness 2.5mm), industrial grade, anodized (grade AC25, min. thickness 25 micron conforming to IS: 1868) or with polyester powder coating (Total DFT 50 microns conforming to IS: 13871) and shall be of approved make & colour shade. All sections, fittings and fixtures shall be anodized (min. thickness of coating 20 micron). The window and door shutters shall be of clear float/ wired/

ground glass as per design/ functional requirements. The doors in toilet area shall be of steel frame with solid core (MDF) flush shutter, 35mm thick, with laminated finish on both sides conforming to IS: 2202.

- 18.2. AL Louvers, duct/ ventilation openings shall be provided as per functional requirement.
- 18.3. All doors, windows and ventilators shall be provided with all necessary fittings and fixtures like handles, tower bolts, wind stays, hinges etc. of heavy duty anodized AL. All doors shall be provided with hydraulic door closure of required capacity.
- 18.4. All windows shall be provided with suitable AL grill of anodized sections with adequate thickness for security purposes.
- 18.5. Clear float glass for window and door shutter shall be of min 4mm and 6mm thickness respectively. Wired/ ground glass where provided shall be of min thickness 6mm.
- 18.6. Entrance door and door in passage shall be min. 1.5m wide (double leaf) x 2.1 m height while door for Conference room and Store room shall be min. 1.2m wide x 2.1m height. All other doors shall be min. 1.0m wide x 2.1m height except for WC which may be of 0.8m width.
- 18.7. Rolling shutters shall be of required size and shall be made of cold rolled steel strips with adequate gauge thickness (min. 18 gauge) and shall conform to IS 6248. Rolling shutter shall be provided with all fixture, accessories, paintings etc. all complete and shall be mechanically operated type.

#### 19. Roofing

- 19.1. The roof of all buildings shall be provided with min. slope of 1:100 for effective drainage of rain water. The slope shall be achieved either by application of screed concrete of grade 1:2:4 (with 12.5mm down coarse aggregate) with min. 25mm thick CM 1:4 layer on top to achieve smooth surface to facilitate application of water proofing treatment.
- 19.2. The water proofing treatment shall be in situ five course water proofing treatment with APP (Atactic Polypropylene) modified Polymeric membrane over roof consisting of first coat of bitumen primer @ 0.40Kg per sqm, 2nd & 4th courses of bonding material @ 1.20 kg/sqm, which shall consist of blown type bitumen of grade 85/25 conforming to IS : 702, 3rd layer of roofing membrane APP modified Polymeric membrane 2.0 mm thick of 3.00 Kg/sqm weight consisting of five layers prefabricated with centre core as 100 micron HMHDPE film sandwiched on both sides with polymeric mix and the polymeric mix is protected on both sides with 20 micron HMHDPE film. The top most layer (5th layer) shall be finished with brick tiles of class designation 10 grouted with cement mortar 1:3 (1 cement: 3 fine sand) mixed with 2% integral water proofing compound by weight of cement over a 12 mm layer of cement mortar 1:3 (1 cement: 3 fine sand) and finished neat. The water proofing treatment shall be extended over golla/ fillet and inner face of the parapet up to 450mm height.
- 19.3. The corners at parapet wall and slab shall be provided with 50 thick fillet/ golla in CM 1:3 with neat finish.
- 19.4. Required no. of rain water down take pipes min. 100mm dia. PVC pipes (UV resistant), with 450x450mmx15mm deep khurra and MS grill at inlet shall be provided for rain water disposal.

#### 20. Plinth protection and drain

- 20.1. 750mm wide plinth protection with min. 75mm thickness of PCC (1:3:6) over 75 mm thick bed of dry brick ballast, 40mm nominal size well rammed and consolidated and grouted with fine sand, shall be provided around all the buildings.
- 20.2. A peripheral drain (except for Security room/ cabin) of min. internal size 250mm x 250mm with brick walls in CM 1:6 over 75mm thick PCC (1:3:6) bedding with 12mm thick plaster in CM 1:5 and 25thk PCC (1:3:6) coping at top shall be provided along the periphery of the plinth protection for collection and disposal of rain water from building roof.

#### 21. Plinth filling for buildings

Plinth beam, when provided, shall be taken minimum 200mm below FGL. The plinth filling below Ground floor (GF) for all buildings shall be provided with following specifications.

- i. Well compacted sub-grade
- ii. Well compacted boulder soling with interstices filled with sand over compacted sub-grade.
- iii. 75mm thick PCC 1:3:6 over (ii)
- iv. 100mm thick PCC 1:2:4 over (iii)
- v. 40mm thick floor finish over (iv)

#### 22. Anti- termite Treatment

In case of presence of termites at the project site, an anti-termite treatment shall be provided for all foundation pits and building plinth in MCR building conforming to IS: 6313 to control entry of termites

## 23. Plumbing & Sanitary Works

23.1. Toilet block shall have following min. fittings:

- Wall mounted WC (Western type) 390 mm high with toilet paper roll holder, low height flushing tank and all fittings
- A set of 2 wall mounted Urinals (430 x 260 x 350 mm size) with flushing tank and all fittings (Gent's wash room only)
- Wash basin (550 x 400 mm) over concrete platform with all fittings including 2-pillar cocks
- Wall mirror (600 x 450 x 6 mm thick clear float glass) with hard board backing
- CP brass towel rail (600 x 20 mm) with C.P. brass brackets – one each in common area and bathroom (bathroom if applicable)
- Soap holder and liquid soap dispenser one each in common area and bathroom (bathroom if applicable)
- Shower and mixer for hot and cold water in bathroom (if applicable)
- Ventilators – Mechanical exhaust facility of adequate capacity
- Overhead PVC water storage tank – Capacity 1000 litres (common for both wash rooms) (2000 litres in case bathroom is to be provided)

23.2. Pantry room shall be provided with kitchen sink cum drain board and provision for installation of Water Cooler.

23.3. One toilet room with provision of WC and Wash basin shall be provided at Security Room near main gate.

23.4. Necessary plumbing lines for MCR building and Security Room near main gate.

23.5. All sanitary ware, fittings and fixtures shall be of reputed Make and Type and approved by the Engineer. All fittings, fastener, grating shall be of CP brass conforming to relevant BIS standards.

## 24. Painting & Other Finishes

Painting and white wash/ colour wash for the buildings shall conform to relevant BIS standards. The make and colour shade of the finish shall be as advised and approved by the Engineer

Internal Walls except toilets & battery room	Acrylic emulsion (for MCR) & Oil bound distemper (for LCR/ Security Room)
Battery room	deleted
Toilet	Oil bound distemper
External Walls	All weather proof cement based acrylic emulsion paint, exterior grade
MMS foundations/ Earth pit Enclosure	Cement paint
Underside of roof slab	White wash
Air-conditioned areas	Underside of roof slab- Under deck insulation with 50mm thick mineral wool, min. density 45 kg/ m <sup>3</sup> and Gypsum board false ceiling with GI grid/ Gypsum tile (600x600 mm x 12 thick) false ceiling with AL grid as per manufacturer's details
Structural steel work	2 coats of synthetic enamel paint over 2 coats of suitable primer

## 25. Air conditioning & Ventilation for MCR and Other Buildings

25.1. All buildings shall be equipped with appropriate numbers of fans for effective heat dissipation.

25.2. In MCR building, the supervisor room, Conference room and SCADA room shall have split type air conditioning units.

**26. Fire Extinguishers**

26.1. All buildings shall be installed with required no. of fire extinguishers as per relevant BIS standard and NBC. LiquefiedCO<sub>2</sub>/ foam/ ABC type fire extinguisher shall be upright type of capacity 10kg conforming to IS: 2171, IS: 10658.

26.2. The fire extinguisher shall be suitable for fighting fire of Oils, Solvents, Gases, Paints, Varnishes, Electrical Wiring, Live Machinery Fires, and all Flammable Liquid & Gas.

**27. Sand buckets**

27.1. Sand buckets shall be wall mounted made from at least 24SWG sheet with bracket fixing on wall conforming to IS: 2546.

27.2. All buildings shall be provided with required no. of sand buckets as per relevant BIS standard and NBC. 4 No. of Bucket stands with four buckets on each stand shall be provided in the Transformer Yard.

**28. Sign Boards and Danger Boards**

28.1. The sign board containing brief description of major components of the power plant as well as the complete power plant in general shall be installed at appropriate locations of the power plant as approved by Engineer

28.2. The Signboard shall be made of steel plate of not less than 3 mm. Letters on the board shall be with appropriate illumination arrangements.

28.3. Safety signs, building evacuation plan and direction signs, assembly points shall also be placed at strategic locations.

28.4. The Contractor shall provide to the Engineer, detailed specifications of the sign boards.

**29. Masonry Work**

29.1. The masonry work shall be of bricks, laterite blocks (as per site conditions) or concrete blocks.

29.2. All external walls of buildings shall be 230mm and internal walls shall be 230mm or 115mm as per requirements.

29.3. All concrete block masonry walls shall be min. 200mm thick.

29.4. Brick work shall be in cement mortar (CM) 1:6 & 1:4 for 230 mm and 115 mm thick brick wall respectively unless specified.

29.5. Unless otherwise specified elsewhere, Bricks shall be of class designation 7.5 conforming to IS: 1077, IS: 2212 & IS: 3495.

29.6. All concrete blocks shall be of min. compressive strength of 7.5 N/mm<sup>2</sup> and shall be of Grade-A conforming to IS: 2185.

29.7. The laterite blocks shall conform to IS: 3620.

29.8. All buildings shall be provided with suitable damp-proof course (DPC). The DPC shall be with PCC (1:2:4) using 6 down coarse aggregate and water proofing admixture. The min. thickness of DPC shall be 40mm.

29.9. The construction of brick masonry shall conform to IS: 2212. Construction of Concrete block masonry shall conform to IS: 2572.

**30. Plastering, Pointing & Coping Works**

30.1. All brick masonry work shall be provided with plaster.

30.2. Wall and ceiling plaster shall be in cement mortar (CM) 1:6 and 1:3 respectively.

30.3. Thickness of plaster shall be 18mm and 12mm respectively for rough and smooth surface of the masonry wall. The ceiling plaster shall be 6mm thick.

30.4. All joints in stone masonry shall be raked and pointed in cement mortar (CM) 1:3 except specified otherwise.

30.5. Exposed top surface of brick or stone masonry shall be provided with 25 mm thick plain cement concrete (PCC) coping (1:2:4) with trawl finish. All exposed coping shall be provided with suitable slope and projection for easy drainage of water.

30.6. All door and window chajja shall be provided with 10mm wide drip course.

**31. Building Water Supply & Plumbing Works**

31.1. C-PVC pipes shall be used for all internal building water supply works while all external water supply pipes shall be UPVC conforming to relevant BIS standard.

31.2. Rain water pipe shall be of PVC conforming to relevant BIS standard.

31.3. All sewerage, waste water and ventilation pipes shall be of HDPE conforming to relevant BIS standard.

31.4. MCR building and Security room shall be connected to Sewage treatment facility including all associated works like Manholes etc.

**32. Sewage Treatment facility**

32.1.The Contractor shall design & provide soak pit and RCC Septic tank for treatment of sewage and waste water from MCR building and Security room. The septic shall be designed as liquid retaining structure conforming to IS:3370 for design loads as specified under Cl. No. 35. However, in case of ground water within 1.5m of finished grade level or the soil strata being of low permeability (permeability  $\leq$  10-6 m/s) where septic tank and soak pit arrangement is not effective, suitable packaged sewage treatment plant of reputed make/manufacture shall be provided. The sewage treatment facility shall be of required capacity and of proven design suitable for total of 15 people.

32.2.The design and drawings shall be submitted for approval prior to execution.

33. Pipe & Cable Trenches

33.1.All trenches inside the building and transformer area shall be of RCC. The min. wall and base slab thickness shall be 100mm for depth  $\leq$  850mm and 150mm for depths  $>$  850mm.

33.2.The trench shall be designed for loads as specified under 'Design Loads'. External trenches shall be kept min. 100mm above FGL to avoid entry of rain water. In case of straight length of the trench being more than 40m, suitable expansion joints with PVC water stop shall be provided.

33.3.Internal trenches (inside buildings) shall be provided with chequered plate (min. 8mm thick with stiffening angle ISA 50x50x6 @ 750 mm c/c for trench width greater than 800 mm) covers while external trench shall have precast concrete covers.

33.4.Min. thickness of precast cover shall be 50mm. Both bearing edges of the cable trench and all edges of pre-cast concrete covers shall be provided with min. 50x50x6 mm edge protection angle with lugs.

33.5.The trench cover (chequered or pre – cast both) shall be provided with suitable lifting hooks.

33.6.As required suitable MS insert plates shall be provided on trench wall to support the cable rack/ pipe.

33.7.The trench bed shall have a slope of approx. 1(V):250(H) along and 1(V):50(H) across the length of the trench. The cable trench shall have a dewatering sump (s) of size 450x450x450 mm depth at suitable location to facilitate collection & pumping out of rain water from the trench.

33.8.The external buried cables shall be laid in excavated trench as specified under specifications for Electrical works. The sand for filling shall be of Grade – IV conforming to IS: 383.

34. Transformer Yard Civil Works

34.1.Transformer and equipment foundations shall be founded on piles/isolated spread footings or block foundation depending on the final geotechnical investigation report and functional requirements.

34.2.In case of transformer oil tank capacity  $\geq$  2000 litres, the transformer foundation shall have its own soak pit which would cover the area of the transformer and cooler banks, so as to collect any spillage of oil in case of emergency. The retention capacity of the soak pit shall be equal to volume of the transformer oil (excluding free space above gravel) and it shall be filled with granite stone gravel of size 40mm, uniformly graded, with 200 mm free space above gravel fill.

34.3.In case of transformer oil tank capacity more  $\geq$  20000 litres, the soak pit shall be connected to a separate burnt oil pit through discharge pipe (300 mm dia) and shall be suitably sized to accommodate full oil volume (excluding free board above inlet pipe) of the transformer connected to it, without backflow. In this case the capacity of the soak pit may be reduced to min. 1/3rd of the total transformer oil volume. The burnt oil pit shall be further connected to oily water drainage system. The water shall be discharged into the nearest drain by gravity flow or pumping after suitable treatment as per statutory and code provisions.

34.4.Both, the transformer soak including side walls and the burnt oil pit shall be of RCC and shall be provided with sump (min. 500 mm x 500 mm x 400mm deep) and slope of 1:50 in concrete screed of 1:1 – 1/2:3 to the floor slab towards the sump pit. The oil collection pit shall be provided with 20mm dia. MS rung ladder with 2 coats of epoxy paint over 2 coats of primer, a manhole & removable RCC cover. The inside of oil collection pit shall be plastered with 6 mm thick CM 1:6 and painted with 2 coats of epoxy paint over 2 coats of primer.

34.5.The area around the transformer and equipment shall be covered with uniformly graded granite stone gravel of size 40mm.

34.6.The area shall be provided with galvanized chain link fence of height min 1.8m with 3.5m wide gate. The specifications for fencing shall be similar to those specified under Cl. No. 31.3 except fence post which shall be of MS angle (ISA 65x65x6) spaced at 2.5 m c/c.

34.7.The Gate of size 3.5m shall be of MS pipe (medium class conforming to IS: 1161) frame with hard drawn steel wire fabric mesh (50x50mmx3mm thick conforming to IS: 1566) including all accessories and fittings. MS angle posts shall conform to IS 2062.

- 34.8.In addition to main gate a wicket gate of MS pipe (medium class conforming to IS: 1161) frame with 1.0 m width with hard drawn steel wire fabric (50x50x3mm thick conforming to IS: 1566) shall be provided for man entry for maintenance purpose.
- 34.9.The transformer yard fencing work shall conform to CEIG requirements.
- 34.10.The requirement of fire barrier wall between transformers shall be as per Electricity Rules and IS: 1646 recommendations. Minimum wall thickness shall be 230mm for RCC wall and 300mm for masonry wall.
35. Potable Water Supply & PV Module Cleaning System
- 35.1.The contractor shall design and install the effective module cleaning system.
- 35.2.A regular supply of suitable quantity of water shall be ensured by the contractor to cater day-to-day requirement of drinking water and for cleaning of PV modules during entire O&M period.
- 35.3.The Contractor shall estimate the water requirements for cleaning the photovoltaic modules at least once in two week or at closer frequency as per the soiling conditions prevailing at site, in order to operate the plant at its guaranteed plant performance. Also, the contractor is required to plan the water storage accordingly with provision of a tank of suitable capacity for this purpose. However, min. consumption of 2 Ltr / Sqm of surface area of SPV module shall be considered in estimation of required quantity of water storage.
- 35.4.Water used for drinking & PV module cleaning purpose shall generally be of potable quality and fit for cleaning the modules with TDS generally not more than 75 PPM. In case of higher salt contents, the water shall be thoroughly squeezed off to prevent salt deposition over module surface. However, water with TDS more than 200 PPM shall not be used directly for module cleaning without suitable treatment to control the TDS within acceptable limits. The water must be free from any grit and any physical contaminants that could damage the panel surface.
- 35.5.If required, for settlement of any grit/ unacceptable suspended particles in the water a settling tank shall be installed before the inlet of the storage tank. Suitable arrangement for discharge/ disposal of sediment/ slush shall be provided in silting chamber by gravity disposal in surface drain or with provision of sludge sump and pump of adequate capacity.
- 35.6.The module cleaning system shall include construction of RCC tank or supply and installation of Ground mounted PVC tank (s) of required storage capacity, pumps (including 1 No. standby pump), water supply mains and flexible hose pipes, taps, valves (NRV, Butterfly valve, Ball valve, Gate valve, PRV, scour valve etc.), Water hammer arrester(s), pressure gauge, flow meter etc. as per the planning & design.
- 35.7.In case of over ground water storage tank, the contractor shall check its effect on plant performance through shadow analysis. The PVC storage tank shall conform to IS: 12701. The valves shall conform to IS: 778. A suitable metal sheet canopy for protection from direct sunlight shall be provided over the tank area.
- 35.8.The water supply mains could be either of GI, uPVC or HDPE, however, the vertical pipe connecting supply main to the discharge point shall be of GI.
- 35.9.Masonry chamber shall be provided for Main gate valve at pump end. Whereas, as per requirements, at other locations either a masonry or GI/ HDPE pipe chamber may be provided.
- 35.10.Module cleaning procedure and pressure requirement at discharge point shall be as per the recommendation of PV module manufacturer. However, discharge pressure at outlet shall not be less than 50kg/cm<sup>2</sup> (5 MPa)
- 35.11.All the pipes thus laid shall be buried in ground at least 150mm below FGL or laid above ground clamping on suitable concrete support blocks. In case of above ground piping only GI pipes shall be used.
36. Underground Water Tank
- 36.1.The top of the UG tank shall be 250 mm above FGL.
- 36.2.The tank shall have clear free board of 300mm above MWL.
- 36.3.The tank bottom shall have a slope of 1:100 towards drainage sump (500x500x500 mm deep). The slope shall be provided either in structural slab or in screed concrete (1:2:4) trawl finished. 1000x1000 mm size Manhole in roof slab and 20 mm MS rung ladder shall be provided for easy access to the storage tank and silting chamber for periodic cleaning. The manhole shall be covered with RCC precast cover. 50x50x6 mm MS angle with lugs shall be provided around precast cover and tank slab opening for edge protection. Rungs shall be painted with 2 coats of epoxy paint over 2 coats of primer.
- 36.4.The underground RCC tank shall be designed for following load conditions:
- External earth pressure + hydrostatic pressure due to ground water table (to be considered at FGL for design purposes) + Surcharge of 20 kN/ Sqm and Tank Empty.

- Tank full up to MWL and no external loads
- 36.5. The design shall conform to IS: 3370 with maximum crack width of 0.1mm for wall, bottom slab and roof slab. Min. grade of concrete shall be M30 (M35 in coastal areas, marshy and saturated soils) conforming to IS: 456. Suitable construction joints shall be provided as per provisions of IS: 3370 (Part 1). Water proofing admixture conforming to relevant BIS standard and of approved make shall be added to concrete as per manufacturer's recommendations.
- 36.6. The underground water tank shall be tested for water tightness as per the provisions of IS 3370 (Part-4). In case any leakage is noticed the same shall be repaired by injection of cement grout installing suitable nozzles around affected areas. Outside face of water tank in contact with water and soil and underside of roof slab shall be painted with 2 coats of epoxy paint.
37. Transmission Line Structures
- 37.1. Galvanized 220 kV and 132 kV Transmission Line towers, Tower extensions & accessories and 11 kV, 22kV, 22KV & 33 kV transmission poles, towers & accessories shall be designed following latest guidelines of respective SEB (State electricity board)/ STU (State transmission utility) and get approved from them before execution. In absence of SEB/ STU guidelines REC (Rural Electrification Corporation) standards may be followed. Support at corner with angle > 100 shall be provided with a 4-pole structure or a lattice tower structure. Use of PCC spun pole and RCC pole is not acceptable.
- 37.2. Approved copies of these designs & drawings shall be submitted to the employer for reference and record.
38. Miscellaneous structures
- 38.1. Support structure for weather monitoring device
- 38.1.1. Weather monitoring device shall be mounted on tubular steel pole of required height. The pole shall conform to IS: 2713.
- 38.1.2. The pole shall be secured to an independent RCC foundation structure through Base plate and Anchor bolt assembly.
- 38.1.3. 200 long 20 dia. rods shall be welded to the pole at 300 mm C/c for access to the device for maintenance purpose.
- 38.1.4. The support structure shall be hot dip galvanized.
- 38.2. Support structures for SMU
- 38.2.1. SMU shall not be supported from MMS and shall have an independent structural steel supporting frame of galvanized ISMC 75 with transverse diagonal bracings of ISA 65x65x6 to each column post.
- 38.2.2. Column post and bracings shall be supported with 300 mm (min.) diameter and 850 mm (min.) deep below GL piles in cement concrete (nominal mix 1:1:2). The column post and bracings shall be extended into the piles upto 800 mm with 50mm cover at the bottom.
- 38.2.3. The pile shall project 200 mm above GL.
- 38.2.4. The support structure shall hot-dip galvanized and of adequate height to ensure min. ground clearance of .8 m to SMU unit.
- 38.3. LA Mast and Foundation
- 38.3.1. The LA mast shall be a self-supporting structure with GI tubular pole of required height. The pole shall confirm to IS: 2713.
- 38.3.2. The pole shall be supported on RCC pedestal and foundation structure through Base plate & Anchor bolt assembly.
- 38.3.3. 200 mm long, 20 dia rods shall be welded to the pole at 300 mm c/c for access to the device for maintenance purposes.
- 38.3.4. The support structure shall be hot-dip galvanized. Min depth of foundations shall be 1000 mm below GL.

#### **4. Quality Assurance and Inspection of Civil Works**

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-B.
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.

<b>Equipment</b>	<b>UOM</b>	<b>Approx. Qty.</b>
Cube moulds for cement testing	nos.	4

<b>Equipment</b>	<b>UOM</b>	<b>Approx. Qty.</b>
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, Quality control & Quality Assurance Work plan shall be finalized by the contractor and the same shall be submitted to Engineer for acceptance/approval.

### 4. Battery Energy Storage System (Excluding all variants of Lead Acid Batteries)

#### 1. Scope of Works

The Scope of Work covered under this specification shall be but not limited to the following.

##### 1.1. Initial Design and Fabrication

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

- Design, fabricate, and assemble a fully functional, transportable BESS that meets the requirements delineated herein. This shall include a control system that provides standard input/output channels and appropriate control actions for all required operational and protective features.
- Fully document the design and expected performance of the BESS by means of documents, drawings, reports, data, and other submittals, as required herein.
- Perform factory acceptance testing of the BESS.
- Conduct design review meetings during initial design and fabrication, in Consultation with the Employer with special reference to the geographical/climatic conditions of the Project site.

- Obtain site-specific data in preparation for developing installation implementation plans.
  - Develop site installation/construction drawings, specifications, and calculations.
  - Supply any special equipment and tools required for maintenance of the BESS.
  - Supply an initial complement of spare parts (at a to-be-determined level).
  - Provide warranty for the entire BESS and its constituent equipment.
- 1.2. Transportation and Site Setup

Interconnection of the BESS with the grid is at the point of common connection (PCC). The Contractor shall be responsible for all equipment and installation activities up to the system side of the PCC. The Contractor will be responsible for completing the necessary work for interconnection point.

1.3. Installation/Interconnection

For installation/interconnection, the Contractor shall

- Develop drawings, specifications, and calculations for Contractor's scope of installation equipment and services (that is, up to the BESS side of the PCC).
- Develop detailed start-up and site acceptance test (SAT) plans.
- Obtain all permits necessary to transport the BESS to the site.
- Ship the BESS to the project site.
- Assemble BESS components on site to produce a functional system (as required).
- Perform start-up testing and SAT of the BESS.
- Provide on-site Contractor representative during installation and/or interconnection activities by the Employer and during start-up and SAT of the BESS by Contractor.
- Obtain permits necessary to prepare the site and to install and interconnect the BESS to the grid.
- Provide a complete set of as-built drawings.
- Provide a training class for the Employer's officials, technicians and maintenance personnel.

1.4. Operation and Maintenance

Employer intends to entrust the operation and maintenance (O&M) of the BESS on comprehensive basis to the Contractor on turnkey for the O&M Period as specified in this Document. The rates quoted by bidder for Comprehensive O&M of the Plant Facilities on yearly basis for the O&M period shall be inclusive of the replacement costs if any.

1.5. Definitions

- PCC – Point of common connection, the electrical boundary between the Solar PV Power Plant and the electrical network of the utility.
- Unit battery – A unit battery is the minimum field-replaceable stored energy component or assembly. It may consist of one or more electrochemical cells, electrically interconnected in any series and/or series-parallel configuration. A unit battery has one (and not more than one) set of positive and negative terminals, by which it is interconnected with the rest of the storage system.
- PCS – Power Conditioning System - A switching power supply unit that enables bidirectional power conversion between AC and DC. It is the interface between the DC battery system and the AC system and provides for charging and discharging of the battery.
- FAT – Factory Acceptance Test
- BESS should be excluding all variants of lead acid batteries – Transportable, containerized energy storage system based on commercially available electrochemical storage solutions, capable of receiving, storing and delivering electrical energy at specified rate(s) suitable for the application laid out in the specifications herein. It comprises of unit batteries, battery management system (BMS), auxiliaries, such as HVAC and fire suppression systems, step-up transformers to match utility grid, ac switchgear, Control Systems etc.
- BMS - or Battery Management System, is any electronic system that manages a rechargeable battery (cell or battery pack), including protecting the battery from operating outside its Safe Operating Area, monitoring its state, calculating secondary

data, reporting that data, controlling its environment, authenticating it and / or balancing it.

## 2. Site-Specific Implementation Requirements

### 2.1. Procurement-Specific Location and Site Characteristics for Design

Item	Characteristic
Location	Balasamudra village, PavagadaTulak at PavagadaSolarpark of KSPDCL
<b>Site characteristics:</b>	
Annual Temperature Range	14.5°C to 40.4°C Annual Average Temperature: 26.59°C
Precipitation	600 -900 mm
Seismic Zone	Zone – II (Least Active)
Design elevation	646 m above sea level
Electrical infrastructure: AC system interconnection requirement at Point of Connection (PCC)	11 kV / 415 V, 50 Hz, 3 phase The BESS will be coupled with the PV System at the AC coupling 33kV/415V or 690V.

### 2.2. Grid Characteristics

The BESS shall be capable of continuous operation under variable voltage, frequency and phase imbalance conditions at the PCC. Information on available fault current and other characteristics of the utility grid will be provided by the Transmission/Distribution Utility. The Contractor shall confirm that this information has been received and understood during the site-specific engineering phase.

### 2.3. Codes and Standards

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

Standard	Description	Certification Requirements
IEC 61427- 2/IS 16270	Secondary cells and batteries for renewable energy storage for On grid applications - General requirements and methods of test	Required for Cells and Battery Modules excluding all variants of lead acid batteries.
IEC 62485-2	Safety requirements for secondary batteries and battery installations - to meet requirements on safety aspects associated with the erection, use, inspection, maintenance and disposal: Applicable for Lead Acid and NiCd / NiMH batteries	Applicable only for Lead Acid and NiCd / NiMH batteries
UL 1642 or UL 1973, Appendix E (cell) or IEC 62619 (cell) + IEC 63056 (cell)	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications	Required for Cell

<b>Standard</b>	<b>Description</b>	<b>Certification Requirements</b>
UL 1973 (battery) or (IEC 62619 (battery) + IEC 63056 (battery))	Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications / Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications	Either UL 1642 or UL1973 or (IEC 62619 + IEC 63056) is required for the Battery level
IEC 62281 / UN 38.3	Safety of primary and secondary lithium cells and batteries during transport: Applicable for storage systems using Lithium Ion chemistries	Required for both Battery and Cell.
IEC 61850/ DNP3	Communications networks and management systems. (BESS control system communication)	
UL 9540 or (IEC TS 62933-5-1 + IEC 62933-5- 2)	Electrical energy storage (EES) systems - Part 5-1: Safety considerations for grid-integrated EES systems – General specification / Standard for Energy Storage Systems and Equipment	Either UL9540 or (IEC 62933-5-1 + IEC 62933-5- 2) is required for BESS system level
UL9540A	Standard for Thermal runaway	Required for BESS system level

3. Technical Specification of Battery Energy Storage System

3.1. Procurement-Specific Ratings and Requirements

Table 2 below specifies project-specific BESS capabilities and ratings for this Project.

Table 2: Supply-Specific Ratings and Requirements

<b>Item Description</b>	<b>Requirement</b>
Battery Technology	Any battery technology excluding all variants of lead acid batteries with totally maintenance free characteristic suitable for operation in site-specific climatic conditions
Rated No of Cycles (Minimum)	4380 cycles at 25° C at the time of commissioning and overall, with an assumption of C/3 rate of discharge per day (at package level) during the O &M Period (i.e., 12 years).
Power rating	2 MW
Energy Rating	4.5 MWh (1 <sup>st</sup> year)

<b>Item Description</b>	<b>Requirement</b>																
Watt-hour rating (dispatchable capacity)	<p>Watt-Hour Rating (Dispatchable Capacity) 4.5MWh, Dispatchable at the beginning of life (i.e. at the time of Commissioning) and minimum throughput capacity at the end of each year of operation as per below table:</p> <table> <thead> <tr> <th>Year of Operation</th> <th>Dispatchable Capacity</th> </tr> </thead> <tbody> <tr> <td>Year 1:</td> <td>4.5 MWh</td> </tr> <tr> <td>Year 2:</td> <td>Dispatchable Capacity in Year 1 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)</td> </tr> <tr> <td>Year 3:</td> <td>Dispatchable Capacity in Year 2 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)</td> </tr> <tr> <td>.....</td> <td></td> </tr> <tr> <td>Year 10:</td> <td>Dispatchable Capacity in Year 9 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)</td> </tr> <tr> <td>Year 11:</td> <td>Dispatchable Capacity in Year 10 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)</td> </tr> <tr> <td>Year 12:</td> <td>Dispatchable Capacity in Year 11 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)</td> </tr> </tbody> </table> <p>The quantum of energy (MWh) discharged from the BESS from Year 2 onwards shall be equivalent to the energy discharge rating of the BESS with normative annual degradation and the discharge duration shall be equivalent to the BESS Energy Discharge Duration (C rate). At the beginning of every year, Contractor shall inform the Employer about its BESS discharge rating capacity (after nominal degradation), for the purpose of planning the schedule with buying ESCOM.</p>	Year of Operation	Dispatchable Capacity	Year 1:	4.5 MWh	Year 2:	Dispatchable Capacity in Year 1 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)	Year 3:	Dispatchable Capacity in Year 2 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)	.....		Year 10:	Dispatchable Capacity in Year 9 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)	Year 11:	Dispatchable Capacity in Year 10 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)	Year 12:	Dispatchable Capacity in Year 11 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)
Year of Operation	Dispatchable Capacity																
Year 1:	4.5 MWh																
Year 2:	Dispatchable Capacity in Year 1 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)																
Year 3:	Dispatchable Capacity in Year 2 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)																
.....																	
Year 10:	Dispatchable Capacity in Year 9 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)																
Year 11:	Dispatchable Capacity in Year 10 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)																
Year 12:	Dispatchable Capacity in Year 11 – Normative Degradation factor as defined in Section-I: Scope of Work (Volume-II)																
BESS Degradation above Nominal Value	In case of degradation above nominal value, the Contractor shall compensate such degradation with augmentation of BESS at its own cost.																
BESS System efficiency*	Equal and/or above 85%																
Use case requirements	Peak Management																
Peak Management	In the Peak Management Use Cases scenario, power generated during the early and/or midday periods shall be stored in the BESS and discharged after solar hours after solar generation hours i.e. utilizing the stored energy during Evening Peak Hours (i.e., between 6:00 pm and 10:00 pm) or as per the requirement of buying ESCOM.																
Charge – Discharge Cycles	One discharge cycle per day is envisaged overall																
Ventilation System inside the Container	Should be such as to maintain minimum and maximum Temperature as recommended by the manufacturer for optimum performance of the batteries on continuous basis.																
Grid Charging	No																
VAR Capacity	0.4 INR per kVARh																

Item Description	Requirement
*To be verified as per the procedure described in Annexure-F (Annexure-F: Plant Documentation, Commissioning and Test Procedure) to this Section for Performance Guarantee Tests and to be verified on annual basis as per Schedule. All measurement instruments for conducting the tests shall be maintained by the Contractor.	

3.1.1. Deleted.

### 3.2. Nameplate Ratings

#### 3.2.1. Overall System Real Power and Energy Ratings

During discharge, the BESS shall be rated to supply at the PCC the continuous net ac real power and ac energy output specified in Table 2: Supply-Specific Ratings and Requirements above. These ratings shall be referred to in all project documentation, including this specification, as the nameplate watt rating and the nameplate watt-hour rating. All nameplate ratings shall be achievable over the End of Battery life, as specified in Clause 4.5.1. The nameplate watt rating and nameplate watt-hour rating shall be achievable during discharge for the full range of stated environmental conditions, provided that the battery is fully charged and the HVAC system (if incorporated in the BESS) has stabilized. In any case, the BESS shall be capable of being discharged at reduced power levels from that specified above. However, in no case will the energy discharged from the battery be greater than the nameplate watt-hour rating. The Contractor shall clearly state in its O&M manual as well as during design review the expected efficiencies of the major subsystems (battery, PCS) as well as the expected losses from auxiliaries.

Note: The real power level attainable during charging shall be at the Contractor's discretion, so long as the other charging/discharging requirements in this specification are met.

#### 3.2.2. Overall System Reactive Power Rating

In accordance with the VAR-related control modes identified in this specification, the BESS shall be capable of dispatching both leading and lagging reactive power at the PCC, up to the rated VAR capacity specified in Table 2, regardless of whether the battery is being simultaneously discharged or charged. This rating shall be referred to in all project documentation, including this specification, as the nameplate VAR rating. The BESS shall be capable of simultaneously producing real and reactive power as long as no nameplate rating is exceeded. That is, the combination of operation at full nameplate watt rating and full nameplate VAR rating shall not exceed the nameplate VA rating.

## 4. Design, Fabrication, and Construction Requirements of BESS

### 4.1. General

The methods and materials specified in this technical specification are intended to represent minimum requirements. Reliance thereon shall not diminish the responsibility for meeting performance and other requirements stated in this technical specification. The design of the BESS shall incorporate the principle of modularity, with a view to reducing life-cycle costs and ease of replenishment of storage capacity while facilitating ease of maintenance, space requirements, and reliability. The design should also facilitate rapid and easy replacement of the unit batteries without significant downtime. Overall, the design philosophy shall be to minimize and optimize all costs to the Employer, not simply initial capital costs or low maintenance costs.

Life-cycle costs include the following: initial system cost, unit battery replacement cost, periodic equipment upgrades, maintenance costs, auxiliary system energy consumption, charging energy costs (that is, costs due to overall battery and PCS losses), and any other contributors to life-cycle energy cost.

### 4.2. System-Level Design and Performance Requirements

4.2.1. The major equipment items shall include a battery, battery management system (BMS), PCS, output/isolation transformer, and SCADA which is to be integrated with the solar plant SCADA system defined elsewhere in this document. Additional equipment shall include HVAC, wiring, connectors, protective devices, grounding, junction boxes and enclosures, instrumentation, enclosures, and all other items needed for a fully functional, grid-interactive BESS to meet the requirements set forth in this specification. All systems and components of systems—including electrical storage unit, switching devices in the PCS, components of monitoring and control systems, and components of auxiliary systems—must use proven and previously demonstrated technology. Electrochemical cells, PCS switching devices, and control system hardware and software must be commercially available and in use for other

markets. Electrochemical cells must be replaceable (in small orders) with a maximum six-week lead time under normal business conditions. Designs using experimental or otherwise undocumented components are not permitted.

4.2.2. The BESS shall be IEEE 1547 (Standard for Interconnecting Distributed Resources with Electric Power Systems)-compliant, where possible.

4.2.3. The prudent design of the BESS should include careful consideration of resonance and Ferro-resonance.

#### 4.3. Containerization and Transportability

4.3.1. The BESS shall be containerized, using either standard International Organization for Standardization (ISO) 668 shipping containers or custom-designed power equipment centres. The container or containers shall be designed to be drop-shipped onto a properly prepared pad or foundation (such as compacted soil, concrete pad or platform, and so on). When fully installed, all BESS components—including battery racks all auxiliaries, such as HVAC and fire suppression systems, step-up transformers to match grid, ac switchgear, and so on—and tools shall be enclosed in (or on) the containers, even if certain components must be separately shipped and installed at the site.

4.3.2. Containers shall be designed and constructed to meet IP54 requirements. The design and installation of Containers shall meet relevant regulatory requirements for occupational safety and health under national and state legislations.

4.3.3. All containers and packaging of separately shipped components shall be suitable for land or sea transport, including offering suitable protection of the equipment inside against damage from weather and vibration or shock from transportation.

4.3.4. The containers and their contents shall be designed to be easily prepared for transport, shipped, connected and operated at site. The Contractor shall ensure that all required bracing and shipping stabilization equipment to enable transport is either kept at hand or brought to the site in a timely manner before transport.

#### 4.4. Additional transportability requirements and/or clarifications

4.4.1. In designing for transportability of the lithium-ion batteries, the Contractor shall follow the relevant guidelines (Sub-section 38.3) set forth in the United Nations document "Recommendations on the Transport of Dangerous Goods—Manual of Tests and Criteria" (ST/SG/AC.10/11/Rev.5), with specific reference to obtaining UN38.3 and UN3480 certifications at the battery module and/or container level.

4.4.2. The BESS container or containers shall be of a size and weight to be capable of being transported to project sites with due consideration for the load bearing restrictions imposed by bridges, if any, and rarefied atmospheric conditions in the region.

4.4.3. Containers shall incorporate standard lugs or other means for lifting by crane or shall be properly palletized for movement with forklift trucks, or both.

#### 4.5. Design Life and Life-Cycle Costs

4.5.1. End of battery life – End of battery life is that point in time when the BESS can no longer meet the power and/or energy discharge requirements of this Specification due to age or non-repairable malfunction of the battery subsystem, and/or non-replaceable components. When the system is no longer able to provide these requirements, the system has reached its end of life. Battery End of life shall be not less than 12 years from the date of Commissioning. Necessary augmentation foreextending the life of the battery shall be performed by the Contractor at their own cost and risk.

4.5.2. It shall be the responsibility of the Contractor to make periodic replacements/replenishments of unit batteries, if and when required, up to the End of Battery Life as described above. Outage time as a result of replacement will also be counted as an "Accountable BESS Outage" for the purpose of computing BESS Availability.

#### 4.6. Reliability, Availability, and Operability of the BESS

The BESS shall be designed for high reliability, defined in the following terms:

Starting reliability: (99% starting reliability means that the unit shall start in 99 of 100 attempts)

Mean-time-to-repair- The time taken from the time of notification of a need for repair to the time of completion of repairs (that is, inclusive of time for arrival of spare parts and repair personnel at the location of the BESS).

Availability

Availability is the percentage of hours that the BESS is available during the year. The availability guarantee shall begin upon facility commissioning. Annual availability shall be calculated as follows:

$$\left[ 1 - \left( \frac{\sum \text{accountable BESS outage duration in Hours} * We}{8760} \right) \right] * 100$$

Where:

- We, Weightage is  $\frac{\text{Outage Capacity}}{\text{Rated Capacity}}$ , where Outage and Rated Capacity shall be in Energy terms i.e. MWh. Rated Capacity in a given year shall correspond to the daily throughput capacity guarantee for the beginning of the year as per Clause 3.1.
- Accountable BESS outages are outages caused or necessitated by the BESS equipment that result in reduced capacity or loss of essential function of the BESS. These outages may be initiated by failure of components, loss of battery capacity (to the extent that End of Battery Life is not reached), operation of protective devices, alarms, or manual action. Such outages include both forced outages due to equipment problems and scheduled outages for BESS maintenance.
- 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.
- The Procurement specific nameplate ratings shall be as defined in Clause 3.1 above. The BESS shall be considered to be under an accountable outage if any of those ratings cannot be met. The BESS shall also be considered to be under an accountable outage if a scheduled (or required) charge cycle cannot be completed.
- The data required for assessment of the availability of the BESS shall be collected through the Plant's integrated SCADA system.
- Grid outage hours shall be subtracted from total no. of hours in the year.
- If the Plane of Array solar irradiation/insolation is less than  $2\text{kWh/m}^2$  on a day, the day (i.e. 24 hours) shall be excluded.

4.6.1. It shall be possible to fully remove, repair, and replace in the field any failed or poorly performing component, assuming that spare parts, test equipment, and maintenance personnel are on the site. This capability shall be demonstrated in the factory acceptance test (FAT) for unit batteries and other key components.

4.6.2. The BESS shall be capable of unattended operation, with provision of remote monitoring and control.

#### 4.7. Planned Maintenance Outage

The Contractor shall provide a guarantee for the maximum length of time required for this type of maintenance operation.

#### 4.8. Battery Subsystem Design Requirements

##### 4.8.1. Electrochemical Cells

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

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

##### 4.8.2. Electrochemical Storage System

- 4.8.2.1. The storage system may consist of one or more unit batteries. If the storage system consists of more than one unit battery, these may be electrically interconnected in any desirable series and parallel configuration to achieve the overall system storage and power rating requirements.
- 4.8.2.2. Each electrically series-connected string of unit batteries shall include a means of disconnecting the string from the rest of the system and of providing over-current protection (during a fault). The means of disconnect shall provide for a physical interruption of the string electrical circuit, which shall be visible to anyone servicing the individual unit batteries in the string and shall be capable of being locked or secured in an open position.
- 4.8.2.3. If the disconnect means consists of removal of a unit battery, the storage system shall be designed to allow maintenance personnel to determine that there is no current flowing in the string and provisions to ensure that the PCS is off before the unit battery is removed. Procedures for maintenance and/or field replacement of unit batteries shall neither require nor recommend removal of the unit battery without first ensuring that no current is flowing in the string circuit.
- 4.8.2.4. Over-current protection, whether on the ac or dc side, in paralleled unit battery strings shall be sized and coordinated so that currents from other strings do not contribute to a fault in any unit battery string.
- 4.8.2.5. Where appropriate, dc wiring shall be braced for available fault currents. Protection shall include a dc breaker, fuse, or other current-limiting device on the battery bus. This protection shall be coordinated with the PCS capabilities and battery string protection. The Contractor shall produce a fault analysis and protection coordination study for the battery dc subsystem during final design. The Employer reserves the right to withhold permission to ship the BESS until the fault analysis has been satisfactorily completed.
- 4.8.2.6. Cells, wiring, switch gear, and all dc electrical components shall be insulated for the maximum expected voltages plus a suitable factor of safety.
- 4.8.2.7. The battery system shall include a system to detect and alarm excessive ground leakage current levels. Ground fault detection shall be enabled for the container or, if more than one electrical series string is installed in the container, for each series string. The detection/trip level shall be field adjustable. The Contractor shall have overall responsibility for the safety of the electrical design and installation of the battery, as well as all aspects of the BESS.
- 4.8.2.8. The battery system shall include a monitoring/alarm system and/or prescribed maintenance procedures to detect abnormal unit battery conditions and notify proper personnel of their occurrence.
- 4.8.2.9. Abnormal conditions shall include but not be limited to (1) weak unit batteries that could reasonably be expected to fail to provide rated capacity upon full discharge, (2) high-resistance or open-unit batteries, (3) high-resistance or open external unit battery connections, (4) unit batteries with temperatures exceeding operating thresholds, and (5) internally shorted unit batteries. Unit battery monitoring, whether automatic or manual, should be specified to alert the proper personnel in a timely manner that an abnormal unit battery condition exists or may exist. All alarms shall be part of the control system and shall include remote display or annunciation capability.
- 4.8.2.10. The unit batteries shall be racked or shall be housed in stackable modules. The unit batteries or cells shall be arranged and installed to permit easy access for equipment and personnel. The moveable units shall be arranged and installed to permit easy access for equipment and personnel to carry out unit removal and replacement activities. For all systems, it shall be possible to remove and replace a prematurely failed unit battery or cell (as appropriate), when system performance specifications cannot be met. The lengths and widths of all aisles and spaces into which personnel may enter in the field for operations and/or routine or unscheduled maintenance purposes, as well as egress routes from these aisles and spaces, shall conform to applicable codes and standards. All racks and metallic conductive members of stackable modules shall be grounded to earth. Racks shall meet the seismic load and road vibration requirements and shall include means to restrain cell movement during seismic events and transport. The Contractor shall furnish analyses and/or other data

that show that the rack and cell designs are designed to meet all potential seismic and transport vibration requirements.

4.8.2.11. Provision shall be made for future Augmentation/Replacement by keeping Spare Racks for accommodating Battery Stack Modules capacity as per Annexure – D: Mandatory Spares.

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

#### 4.8.3. Cell/Battery Auxiliary Systems

The cells and battery system shall be supplied with all required and/or recommended accessories. This includes inter-cell connectors and monitoring devices for cell temperature and cell voltage, if required.

### 4.9. Power Conditioning System Design Requirements

#### 4.9.1. General

##### 4.9.1.1. Standards and Codes

Power Conditioning Unit (PCU) shall comply with the specified edition of the following standards and codes.

Standard	Description
IEC 61683 Ed. 1	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IEC 62109-1 Ed. 1	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
IEC 62109-2 Ed. 1	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
IEC 61000-6-2 Ed. 2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
IEC 61000-6-4 Ed. 2.1	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
IEC 62116 Ed. 2	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC 60068-2-1:2007	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2:2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat
IEC 60068-2-14:2009	Environmental testing - Part 2-14: Tests - Test N: Change of temperature
IEC 60068-2-30:2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)

4.9.1.2. The PCS may consist of one or more parallel units. Paralleling may be at the DC or AC terminals. The PCS circuit topology shall be voltage source (that is, the PCS at its AC

terminals shall appear to the grid as a voltage source rather than as a current source and, at its DC terminals, shall be capable of reversing current flow in the battery without reversing the polarity of the DC bus).

4.9.1.3. All load-carrying cables within the PCS subsystem shall have a suitable load factor of safety.

4.9.1.4. The PCS shall be housed within one or more appropriate weatherproof and dustproof enclosures, with provisions to prevent moisture condensation and to prevent the entrance of water, airborne salt or dust, rodents, insects, and/or similar materials or pests into air intake/exhaust ports.

#### 4.9.2. Power Conditioning System Rating

The PCS shall be capable of delivering Real power as specified in Table 2. This rating shall be referred to in all project documentation, including this specification, as the nameplate VA rating. To account for losses in the PCS, the DC input power to the PCS will be higher than the rated PCS output power. The available DC input power will be the BESS nameplate watt rating divided by the PCS full load efficiency (as specified in the datasheet) during discharge.

#### 4.9.3. Power Conditioning System Protection and Control

4.9.3.1. The PCS, in conjunction with the control system, shall be capable of completely automatic, unattended operation, including self-protection, synchronizing and paralleling with the grid, and disconnect. The control of the PCS shall be integrated with the overall BESS controls.

4.9.3.2. The PCS shall include all necessary self-protective and self-diagnostic features to protect itself from damage in the event of component failure or the excursion of operating parameters beyond a safe or expected range. This includes excursions due to internal or external causes. The self-protective features shall prevent the PCS from being operated in a manner that may be unsafe or damaging. Faults due to malfunctions within the PCS, including commutation failures, shall be cleared by the PCS over-current protection device(s).

#### 4.9.4. Power Conditioning System AC Interface with AC bus

4.9.4.1. The BESS must meet applicable harmonic current and voltage specifications in accordance with applicable standards. Harmonic suppression may be included with the PCS or at the BESS AC system level. However, the Contractor shall design the BESS electrical system to preclude unacceptable harmonic levels in the BESS auxiliary power system.

4.9.4.2. In addition to interconnection standards specified in this document, there may be specific requirements for interconnection, which need to be ascertained by the Contractor in co-ordination with the transmission/distribution utility at each site.

4.9.4.3. The PCS transformer may be used to aid in harmonic cancellation and may include tertiary windings to supply BESS auxiliary power requirements. The transformer may be dry type or oil type. The PCS shall include provisions for disconnect on both its AC and DC terminals for maintenance work. Conductor separation must be clearly visible. The detailed maintenance procedure shall be addressed in the O&M manual.

#### 4.9.4.4. Electromagnetic Interference

The PCS shall not produce electromagnetic interference (EMI) that will cause misoperation of instrumentation, communications, or similar electronic equipment within the BESS.

#### 4.9.4.5. Islanding

The PCS design shall include provisions to limit run-on and islanding as per applicable standards upon the loss of grid. This capability shall be demonstrated to the Employer's satisfaction during the FAT.

### 4.10. AC System

The BESS AC system includes all switch gear, bus work, cable, connectors, transformers, and protective relaying required for connecting the BESS at the PCC. The Contractor shall design, procure, ship, and assemble on-site all ac interconnection equipment on the BESS side of the PCC. The Contractor shall design, fabricate, ship and install all cabling required for connecting the BESS to the PCC. The BESS AC system shall include potential transformers, current transformers, and any other metering equipment so that the performance monitoring and documentation

requirements of this specification can be met. Metering accuracy shall meet applicable standards.

#### 4.11. Protection and Control

4.11.1. The power system (PCS), AC and DC switchgear/protective devices) shall be designed to provide safe, reliable operation with minimum interruption. Reliable operation shall be supported by a sensitive and properly coordinated protection system. The protection system shall be capable of monitoring significant operating parameters and sensing all abnormal operations or fault conditions. It shall isolate the faulted circuits or components without causing damage to other circuits and components of the system. The protection system shall also provide adequate indications and/or alarms for identification of the faulted circuits, components, and abnormal conditions, allowing preventive action and rapid restoration of service.

4.11.2. The BESS shall have at least following protection mechanisms for battery.

- Reverse Polarity
- Over/ Under Voltage
- Over Temp
- Over Charge

4.11.3. The grid may have its own protective schemes at the point of common connection (PCC) that will be the responsibility of the Contractor to fulfil.

4.11.4. Protection shall not be interlocked with the position of any isolating/interrupting devices.

4.11.5. The BESS shall be capable of interrupting line-to-line fault currents and line-to ground fault currents available at the PCC and flowing in the equipment in either direction for faults on either side of the PCC. Faults due to malfunctions within the BESS shall be cleared by the BESS protective devices.

4.11.6. The BESS must have low-voltage ride-through capabilities according to extant Technical guidelines on connectivity.

4.11.7. BESS should be disconnected from the system and the system operators must be notified if any of the following occur:

- The BESS local interconnection protection system fails
- The interrupting device fails.
- The dc supply is lost

4.11.8. The BESS shall include provisions to protect against transient voltage surges from switching, lightning, and similar causes, in accordance with applicable standards. The overall PCS design shall also limit surges on the dc bus to twice the normal maximum DC bus voltage.

#### 4.12. Auxiliary Power

The BESS shall include an auxiliary power system (separate or same as the Solar Plant auxiliary system) derived from the utility AC bus, the PCS transformer low-side bus, PCS transformer tertiary winding, or similar means with metering. The auxiliary power system shall include all step-down transformers, breakers, fuses, motor starters, relaying, panels, enclosures, junction boxes, conduits, raceways, wiring, and similar equipment, as required for the BESS operation. The auxiliary power system shall include separate potential transformers and current transformers, so that auxiliary power consumption can be measured and electronically recorded in real time, independently of operation of the PCS or of net power flows to and from the battery. The auxiliary power system and/or control system design shall provide for whatever emergency power is necessary for an orderly system shutdown during abnormal conditions such as a loss of grid power. The auxiliary power system and/or control system design shall also provide for the capability to restart automatically after BESS shutdowns of several days.

### 5. Control and Communication

#### 5.1. Control System General Requirements

The control system shall be designed to provide for automatic, unattended operation. The control system design shall provide for local manual operation and remote operation or dispatch from a remotely located computer. The control system shall be programmable for establishing or adjusting all parameters, set points, algorithms, limits, and so on that are required for effective operation as described in this specification. The control system shall be designed to prevent externally supplied, control panel or local signals from causing the BESS to operate in an unsafe manner or in a manner that may damage the BESS.

## 5.2. Control Functions and Protocols

5.2.1. To the extent possible, all BESS control functions, and operating modes shall be in accordance with standard functionalities for smart distributed resources, as documented in the IEC 61850-90-7.

5.2.2. The communication protocol for the BESS shall be according to IEEE 1815-2010, Standard for Electric Power Communications—Distributed Network Protocol (DNP3) or IEC 61850.

5.2.3. If data points and/or control functions outside the standard point definitions in DNP3 AN2011-001/IEC 61850 are created by the Contractor, the Contractor shall maintain a systematic log of the same for the purpose of maintaining/facilitating interoperability with future standards/protocols for distributed energy resources.

## 5.3. Additional Control System Functions

### 5.3.1. Shutdown/Startup/Standy

The start and stop controls shall be as per DNP3 AN2011-001 standard specifications or IEC 61850. The control system shall use these controls for an orderly and safe shutdown, even in the absence of grid power. The control system shall also use these controls for an orderly startup sequence, which shall provide for a safe system reset from any standby or operating condition so that the unit goes through a normal startup sequence in the same way it would when being powered up after loss of power or being in a shutdown state. The control system shall include provisions for a standby state (that is, BESS but not charging or discharging), which shall be the end result of a normal startup sequence. It shall also be possible to enter the standby state from any of the other operating states except connect/disconnect.

### 5.3.2. Initiation of Shutdown

The control system shall initiate shutdown under the following conditions and shall remain in the shutdown state until a reset signal, either local or remote, is initiated. An appropriate alarm shall be set.

- Emergency trip switch
- Loss of the low-voltage AC or utility grid voltage
- An AC circuit breaker trip (either side of transformer)
- Door interlock: Initiate shutdown when the door is opened (with appropriate provision for maintenance work). Interlocks shall be self-resetting.
- Smoke/fire alarm
- Control logic trouble
- A DC ground fault (field-adjustable setting)
- Remote disable (no reset required)
- Grid system faults (balanced and unbalanced; line-to-ground, line-to-line, and three-phase)
- Abnormal frequency
- Abnormal voltage
- Islanding condition
- Protection or control scheme failures, including the following:
  - Failure of local interconnection protection system
  - Failure of critical breaker trip coil or interrupting device - Loss of DC supply

### 5.3.3. Reset Alarms

For all system-generated alarms, the control system shall provide for the resetting of those alarms. This function is intended for alarms that, after they are set (for example, by a fault condition, as listed above and elsewhere in this specification), must be cleared by operator intervention to allow normal operation to be restored.

### 5.3.4. Modify Storage Settings

The control system shall provide for modification of various set points and fixed operation/control settings associated with the various control functions.

### 5.3.5. Event/History Logging

The control system shall provide for the automatic logging of the following information:

- All errors or failures
- All startup and shutdown actions
- All control actions
- All responses to control actions

- All limit violations, including returns within limits

#### 5.3.6. Status Reporting

The control system shall provide for reading and reporting of various BESS- supplied status information in accordance with the data collection and reporting requirements specified in this technical specification.

#### 5.3.7. Time Synchronization

The control system shall provide for synchronization of its real-time clock with a standard time source.

#### 5.3.8. Change Operational Mode

The control system shall support activating/deactivating control functions. The control functions are expected to be executed by command from a remote host, but may also be scheduled.

#### 5.3.9. Perform Self Diagnostics

The control system shall provide for self-diagnostic functions.

### 5.4. Control System Hardware Requirements

All local control and monitoring system components shall be housed in appropriate controlled environment enclosures either as separate arrangement or in conjunction with Solar Plant SCADA system.

### 5.5. Control System Self-Protection and Self-Diagnostic Features

5.5.1. The BESS shall include appropriate self-protective and self-diagnostic features to protect itself and the battery from damage in the event of BESS component failure or from parameters beyond the BESS's safe operating range due to internal or external causes. The self-protective features shall not allow local or remote signals to cause the BESS to be operated in a manner that may be unsafe or damaging to the BESS. All protective operations resulting in a shutdown shall be carried out in an orderly and safe manner, even in the absence of utility power.

5.5.2. Temperature sensors shall be incorporated in critical components within the BESS. The BESS shall alarm and go to standby/fault mode when an over-temperature condition is detected.

5.5.3. The BESS shall alarm upon detection of a DC ground fault. The alarm trip level shall be field adjustable.

5.5.4. Door interlock switches shall be provided for all BESS container doors. The BESS shall alarm and go to shutdown mode when a BESS door is opened. Doors shall be fitted with provisions for external locks.

5.5.5. The BESS shall alarm and go to shutdown mode upon detection of smoke.

5.5.6. Surge-protection devices shall be provided at the input and output terminals of the BESS.

### 5.6. Control Panel

- The BESS shall include a local control panel or console, which is easily accessible, on or within the BESS container. As a minimum, the following operator controls shall be located on the control panel:
  - Trip/reset for the BESS AC circuit breaker or contactor.
  - Trip/reset for DC circuit breaker(s)/contactor(s).
  - PCS on/off.
  - Reset toggle or push button. When reset is initiated, the control system shall resume control and proceed to the appropriate operating mode.
  - Reset cut-out selector switch to disable remote or local reset signals.
  - A selector switch to manually set the operating state (that is, the shutdown, disconnect, or operate state) and to have the control system set the operating state automatically.
  - A selector switch to manually set the operating mode and to have the control system set the operating mode automatically.
  - The control panel or console shall also include meters, indicators, and displays.

### 5.7. Performance Monitoring and Data Acquisition

5.7.1. The BESS shall include a (Data Acquisition System) DAS to provide continuous monitoring and display of key operational parameters, as well as permanent archival of all measured

parameters. The DAS shall include sensors, transducers, wiring, signal isolation and conditioning circuitry, and data acquisition and analysis hardware and software as required to perform the functions described in this section. The DAS shall be of standard commercial manufacture and shall use hardened components suitable for operation in the climatic conditions prevailing at site.

5.7.2. The DAS shall measure operational data, as described in this Clause, and shall record all data points to fixed and removable non-volatile memory. The DAS shall be capable of making all monitored data and events available through the DNP3 / IEC 61850 communication interface and shall permit display of current values and recent historical trends on a local screen for all recorded points. In addition, the DAS shall provide panel meter displays of certain operational parameters, as prescribed below.

5.7.3. Provision of monitoring and event data via the communication interface shall adhere to DNP3 AN2011-001 / IEC 61850 to the extent possible and capture at least the following data points:

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

5.7.4. Digital displays, on the BESS Control Panel, shall update at least once per second. The DAS shall be integrated with the Solar PV SCADA described elsewhere in this Technical Specification either as addendum or within an overall Energy Management System Interface. The DAS shall, at a minimum, provide remote data inquiry from personal computer-based platforms and data file export capabilities in ASCII format on independent media (such as a universal serial bus drive) that are readable on personal computer-based systems.

5.7.5. The DAS shall continuously measure or calculate the data points identified in Clause 5.7.3 and shall make them available via the communication network as specified. All measured parameters shall also be permanently archived in all modes of operation. For continuously varying quantities, the Contractor shall propose for Employer's review and approval an approach to data archiving that is suitable for each quantity measured. The final approach will be decided during product design.

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

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

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

5.7.7. The BESS shall include provisions for determining and storing in non-volatile memory the sequence of abnormal events, trips, and/or alarms that cause the BESS to go to the disconnect or shutdown state. It is preferable that this function be implemented separately from the normal operations data acquisition function of the DAS so that failures in the latter (hardware/software failures or power interruptions) will not prevent the permanent logging of abnormal event sequences. The BESS shall include provisions to transmit, at a minimum, the data displayed on the panel meters and the alarm/status indicators to the remote computer.

## 6. Grounding

A suitable equipment grounding system shall be designed and installed for the BESS as per relevant Codes and Standards for grounding/earthing. This system shall be designed to be tied to an existing site grounding system. The system also shall be adequate for the detection and clearing of ground faults. All exposed non-current-carrying metal parts shall be solidly grounded. Particular attention shall be given to prevention of corrosion at the connection of dissimilar materials such as aluminum and steel.

## 7. Wiring

- 7.1. All wiring shall be continuous for each wiring run; splices are not acceptable.
- 7.2. Wiring that may be exposed to mechanical damage shall be placed in conduit or armored.
- 7.3. Wires shall have identifying labels or markings on both ends. The labels or markings shall be permanent and durable. Stick-on labels will not be allowed. All field wiring between separate equipment items supplied by the Contractor shall be color-coded according to appropriate standards.
- 7.4. In general and where practicable, control and instrumentation wiring shall be separated from power and high-voltage wiring by use of separate compartments or enclosures or by use of separate wireways and appropriate barrier strips within a common enclosure.
- 7.5. BESS and PCS control and instrumentation system wiring shall be bundled, laced, and otherwise laid in an orderly manner. Wires shall be of sufficient length to preclude mechanical stress on terminals. Wiring around hinged panels or doors shall be extra flexible and shall include loops to prevent mechanical stress or fatigue on the wires.
- 7.6. Insulation and jackets shall be flame retardant and self-extinguishing.
- 7.7. Wiring to terminal blocks shall be arranged as marked on wiring diagrams. Terminal groupings shall be in accordance with external circuit requirements.
- 7.8. Raceway and cable systems shall not block access to equipment by personnel. There shall be no exposed current-carrying or voltage-bearing parts.

## 8. Civil/Structural

### 8.1. General Requirements

- 8.1.1. Soil bearing stresses shall not exceed the allowable stresses for the soil parameters, as determined by the Contractor. A minimum safety factor of 1.5 shall be provided against uplift, sliding, and overturning loads. Soil stresses shall be calculated using unfactored loads.
- 8.1.2. All structures and foundation designs must include suitable evidence to show that their design is commensurate with a minimum of 25-year life.
- 8.1.3. Unless specifically stated otherwise, the design of all structures, equipment, and foundations shall be based on applicable portions of IS codes, these specifications, and industry standards.
- 8.1.4. All components shall be painted, coated, or otherwise protected in a manner commensurate with at least 25-year design life. Particular attention shall be given to prevention of corrosion at the connections between dissimilar materials such as aluminum and steel, and steel and concrete.
- 8.1.5. All structures and foundations shall be designed to resist dead, live, wind, and seismic loads.

### 8.2. Requirements for Installation

- 8.2.1. The Contractor shall be responsible for obtaining all required permits and ensuring that all inspections by local authorities are completed as required.
- 8.2.2. Calculations based on applicable standards shall be supplied to show that the design of the entire BESS will withstand wind speed and/or gusts and other loads specific to the site and that the design meets all applicable structural and transportation codes.
- 8.2.3. Excavation spoils shall be disposed of as directed by the Employer.
- 8.2.4. All reinforced concrete work shall be in accordance with relevant Indian Standards. All other materials and installation requirements shall be subject to Employer approval.

#### 9. Mechanical

- 9.1. All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed, and painted or otherwise suitably protected to survive outdoor conditions for at least 25-year design life of the system.
- 9.2. Outdoor enclosures shall be weatherproof and capable of surviving intact under the site environmental conditions specified. Outdoor enclosures shall be equipped to prevent condensation.
- 9.3. Components mounted inside enclosures shall be clearly identified with suitable permanent designations that also shall serve to identify the items on drawings provided.
- 9.4. The site temperatures and the effect of temperature on component life shall be considered in developing the thermal design for all components, including the battery and PCS. Irrespective of the heat-removal system design the final rejection of all waste heat from the BESS shall be to the ambient air. Air-handling systems shall include filters to prevent dust intrusion into the BESS.
- 9.5. The BESS shall include an HVAC or ventilation system designed to maintain battery temperatures at levels acceptable to the Contractor's normal battery warranty conditions, conducive to acceptable battery life, and as required to maintain battery capacity for all seasons/climatic conditions at the site. The air handling/distribution system shall be designed to promote temperature uniformity within the battery.

#### 10. Other Design Requirements

##### 10.1. Noise Levels

The Contractor shall provide for and maintain noise mitigation devices like Noise mufflers at site, if required.

##### 10.2. Fire Protection

The Contractor shall design and install a fire protection system that conforms to good engineering practice and CEA guidelines. The fire protection system design and associated alarms shall take into account that the BESS will be unattended. If required by the type of fire protection system provided, the Contractor shall calculate and take into account the heat content of the battery cell materials in designing an appropriate fire protection system. Separate fire protection systems may be used in the battery, PCS, and control areas.

##### 10.3. Toxic Materials

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

##### 10.4. Spare Parts and Equipment

The Contractor shall evaluate the design with regard to expected failure rates, modes, and effects; overall BESS reliability; and planned mode of servicing. Based on this evaluation, the Contractor shall recommend and furnish an initial complement of spare parts that are not readily available. For example, these spare parts may include spare unit batteries and a small rectifier to maintain the unit batteries, as well as fuses, printed circuit boards, and switching devices (gate turnoff thyristors [GTOs], silicon-controlled rectifiers [SCRs], insulated gate bipolar transistors [IGBTs], and so on).

#### 11. Maintenance and Repair

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

#### 12. Factory Acceptance Testing of BESS

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

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

12.3.After the Contractor determines that the BESS is fully operational, the Contractor shall conduct a FAT, witnessed by the Employer and/or the Employer's representative. The FAT shall consist of the Contractor demonstrating to the Employer that the BESS is fully operational and performs as specified. This includes but is not limited to the following:

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

12.4.During the FAT, the BESS shall meet the following:

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

Note: The methodology for measurement of procurement specifications is provided in the Annexure-G to this Section.

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

12.6.Factory testing shall demonstrate operation at expected temperature extremes at the Employer's site. If this is not possible for the full BESS at the manufacturing facility, independent laboratory certification of operation of critical components and subsystems in the battery, PCS, and control systems shall be submitted at the time of the FAT. The Contractor shall submit to the Employer for approval, 90 days before the FAT, a list of components and subsystems for which independent lab testing certification will be sought.

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

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

### 13. Commissioning and Functional Guarantee test procedure

13.1.The Contractor shall develop and submit to the Employer for its review and approval a comprehensive SAT plan that shall demonstrate to the Employer that the BESS will perform as specified at the Employer's site. The Employer shall have the right to request reasonable changes to the test plan.

13.2. The Contractor shall develop and perform SAT procedures to ensure that the BESS will perform as designed and that the system meets the performance criteria specified elsewhere in these specifications. The SAT plan shall include procedures to test operating scenarios described in the specification. These procedures may involve special requirements and/or witnessing by the local independent system operator. To the extent achievable, all use cases and operating modes described in the specification shall be tested.

13.3. After the Contractor has determined that the BESS is fully operational, the Contractor shall conduct the SAT, witnessed by the Employer and/or the Employer's representative. The tests shall include, as a minimum, the following:

- Verification of sensors, metering, and alarms
- Verification of all control functions, including automatic, local, and remote control
- Verification that the performance criteria in the specification can be met or exceeded
- Demonstration of all of the intended uses
- Demonstration of interface protection circuits and functions and control interfaces

13.4. Tests shall demonstrate that the BESS capabilities, efficiencies, response, and features are as proposed by the Contractor.

13.5. Testing shall include, as a minimum, measurement of harmonic content and power factor at full and partial power levels for both charge and discharge.

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

13.7. The SAT shall also specifically address discovery of problems or failures that may have occurred during or as a result of shipment.

13.8. The Contractor shall perform any required modifications and repairs identified by the testing, before acceptance by the Employer.

13.9. The Employer will not accept the BESS for commissioning until all acceptance tests have been successfully completed and all provisions of the contract have been met.

#### 13.10. Functional Guarantee - Actual Operating Experience

Since it may not be possible, due to system constraints, to test all facets of the BESS function as part of the performance verification tests specified in the preceding sections the actual operating experience of the BESS during the performance guarantee period after initial startup shall be deemed an extension of the performance verification tests. The performance guarantee period shall not be construed as a substitute for the warranty requirements, as specified in the subsequent Clause. Actual operating experience will be documented through Contractor-furnished records, and other system monitoring equipment and associated BESS performance. Documented failure or malfunctions of any BESS component during the performance guarantee period shall be deemed a failure of the system commissioning test. The Contractor shall, at no cost to the Employer, make the necessary repairs, replacements, modifications, or adjustments to prevent the same failure or malfunction from occurring again. The replacement of certain BESS components in response to a system failure may necessitate, at the discretion of the Employer, the duplication of certain performance verification tests, which shall be performed at the Contractor's expense.

### 14. Warranty

14.1. The Contractor shall provide a warranty for the entire BESS and its constituent equipment.

14.2. At a minimum, the Contractor shall provide an unconditional, 5 (five) -year parts and labour warranty on all BESS equipment except battery (unit or racks). For the battery storage, the warranty shall cover parts warranty including battery nominal capacity ratings in order to meet the End of battery Life condition described in this specification.

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

14.4. The warranty shall guarantee the availability of battery replacements delivered to the site within 2 weeks of notification during the battery warranty period. This period, shall, however, not be considered part of the Accountable Outage period for assessing BESS availability.

14.5. Additional warranty requirements are as follows:

- The warranty shall specify the terms and conditions of the warranty, including operating conditions requirements, procedures that must be followed, and all maintenance

requirements. The warranty terms shall be easy to understand and shall be clearly stated.

- The warranty shall provide an explicit statement as to the warranted cycle life and the warranted calendar life of the battery.
  - The warranty shall include a simple and easy to understand proration formula, if any, to be used in crediting the Employer for unused life or capacity of equipment replaced or repaired.
  - The warranty shall specify the scope of service associated with software updates.
  - The warranty shall specify the scope of service included in replacement or repair of the equipment.
  - The warranty shall specify all labour, materials, shipping charges, and other Employer expenses not included in the warranty.
  - The warranty shall specify the estimated time to complete the repairs/replacement required to restore the BESS to the warranted performance level. The time shall be given as the number of working days from the time of Employer's notice to the Contractor that the BESS has failed to meet the performance requirements.
15. Documentation and Submittals
- 15.1. The Contractor shall furnish complete documentation that will be used for determination of contract compliance, as well as O&M of the BESS.
  - 15.2. Review and acceptance of submittals shall not encumber the Employer or the Host Utility with responsibility for the adequacy or safety of the Contractor's design.
  - 15.3. Titles shall clearly indicate the function of the document, the Employer and location of the facility.
  - 15.4. At a minimum, Contractor's documentation shall consist of the following:
    - Construction and installation drawings
    - Construction materials submittal
    - Equipment drawings and specifications
    - Operation and maintenance manual
    - Maintenance schedule
    - Critical path method project schedule
    - Master test plan and procedures
    - Quality assurance manual
    - Software documentation
    - Study reports
    - Test reports
    - Training manuals

## 5. EMS (Energy Management System)

### 1. General Requirements

- 1.1. Energy Management System (EMS) system shall be a controller based system along with required accessories and communication links for integrated, real-time monitoring, efficient operation and control of active power, reactive power as well as voltage at the interconnection point of PV arrays and BESS.
- 1.2. EMS shall be integrated with the SCADA described under Sub-section 2: Electrical System of Section II : Technical Specifications (Volume II) to acquire/monitor real time data of various equipment of Plant facilities and have in built logic/programming to monitor, control, and optimize the performance of Plant facilities as per specification. Contractor shall provide complete EMS system with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation of entire Plant facilities and its auxiliary systems. Contractor shall include in his proposal all the Industrial Grade Hardware, Software, Panels, Power Supply, HMI, Gateway, Networking equipment and associated Cable etc. needed for the completeness even if the same are not specifically appearing in this specification.

### 1.3. EMS functionality for the BESS Control

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

- Automatic mode: This means that a part of the power quantity of the BESS behaves according to the selected operation mode.
- HMI mode or manual mode: in this mode, the operator has the possibility to:
  - Select the operation point

- Direct control of active and reactive set points of the PCS.
  - Command of the balance of plants
- OFF-mode: A BESS is not producing any power. The system is disconnected from the grid.
- STANDBY-mode: the BESS is connected to the grid, but the IGBT's in the PCS system are in an off-state (i.e. open switching)

Also, the performance of every application mode will be controlled and adaptable by this system. This energy management strategy will be operated by the SCADA in Main Control Room. Any failure in the process or the control system including instrumentation must be detected and logged. This means that the instrumentation, electronic and electrical equipment shall include those failure detections.

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

- Change the operation mode of each BESS independently
- Start/Stop each application mode appointed to a BESS.
- Change the application mode of each BESS (multiple modes can be selected together)
- Select the amount of power dedicated to each selected application mode.
- Specifically, for following use cases considered for the Project:
  - Power ramp rate control
  - Power Curtailment
  - Change the set points for the SOC management
  - Direct control of active and reactive set point of a PCS
- Adapt the parameters needed for the operation of every application mode

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

## 6. EMS functionality for the Plant Control

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

The EMS shall perform following functionality to Control the Plant facilities.

- Communication with grid or SCADA
- Communications with PV Inverters, BESS and other power units
- Measuring and processing of the electrical magnitudes at EMS (voltage, current, PF)
- Control capability of PV Inverters, BESS and other power units
- The EMS shall allow following operation modes for the Plant facilities.
  - Reactive Control (Q Control, setting point of reactive power Q at EMS)
  - Power Factor Control (PF Control, setting point of cos(L) at EMS)
  - Voltage Control (V closed loop control, setting point of V at EMS)
  - Voltage Droop (Reactive power vs Voltage programmable curve or droop)
  - Apparent Power Control (S Lim, setting point of S Lim at EMS)
  - Active Power Limitation (P Lim, setting point of P Lim at EMS)
  - Power Ramp Rate Control (setting point of maximum %Pn/min)
  - Frequency Regulation (Power vs Frequency programmable curve or droop)
- 2. In addition to these operating modes, the EMS shall be prepared to work under voltage dips, allowing the inverters to inject the corresponding reactive power to provide the corresponding voltage support at the EMS. The EMS can receive the target values specified by grid operators using a standard protocol (i.e. Modbus TCP/IP) and over different communication media

## 7. Measurements

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

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

#### 1. Control & Power Supply Scheme

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

#### 2. Software Documentation & Listings

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

## 8. Performance Measurement Procedure

### 8.1. Performance Ratio (PR)

Performance Ratio (PR) test for Operational Acceptance of the plant shall be performed as per the procedure attached in Annexure-C.

### 8.2. Capacity Utilization Factor (CUF)

Capacity Utilization Factor of the plant shall be calculated as per the procedure attached in Annexure-C.

# Section III: Special Technical Specifications

1. The Contractor is advised to inspect the site and study the nature of soil, topography and other conditions to decide the extent of scope of area grading, ground compaction, and foundation system to be provided before submission of the Bid. The Employer shall not be responsible for any variations in soil characteristics and other conditions, between those observed during preliminary site visit (before bid submission) and detailed investigations to be carried out by the Contractor during contract execution.
  2. For geotechnical investigation of the site, there shall be min. one bore hole for every 10 acres of the area. The depth of the boreholes shall be min. 5 m. The collection of soil samples and SPT observations shall be made at every alternate 1.5 m interval; SPT observations beginning at 0.5 m depth. The trial pits shall be min. three in number and of min. size 1.5 m x 1.5 m x 1.5 m. The boreholes and trial pits will be distributed properly for adequate and representative coverage of the area. CBR tests may be waived.
  3. The borehole drilling shall be done using DTH and there shall also be provision for rock drilling wherever necessary.
  4. The Contractor is advised to ascertain the availability of good quality ground water at site for construction, drinking and module cleaning purpose. In case of non-availability of ground water source, the contractor shall explore the option of supply of water through water tankers. In case the water quality is not suitable for drinking or module cleaning purpose, the Contractor shall install suitable water treatment facilities.
5. Design Considerations
- The basic wind speed 'Vb' = [ ]m/sec  
Seismic Zone – II (Least Active)  
Average annual rainfall at site is 600 mm – 900 mm.
6. Design Loads:
    - Primary Load (dead load, live load, wind load, seismic load, snow load, temperature load, profitability factor or risk coefficient, terrain roughness and height factor, topography, importance factor for cyclonic region, area averaging factor, combination factor, wind directionality factor, seismic load, snow load, temperature load)
    - Design load combination [for MMS Design (N-S orientation at design tilt angle; E-W orientation, vertically facing); RCC and steel structures except MMS]

### 6.3. Module Mounting Structure

- 6.3.1. Structural steel of grade designation E350 quality 'C' conforming to IS 2062: 2011 shall be used as a material for MMS members. The contractor can also propose extruded structural aluminum sections, which shall be of minimum class designation 64430 and 65032 conforming to IS: 733 with minimum thickness of 4 mm. The structural design using aluminum shall conform to IS: 8147.
- 6.3.2. For structural steel, MMS structure shall be hot dip galvanized with minimum GSM 400 kg/m<sup>2</sup> and/or minimum coating thickness of 60 microns for protection against corrosion. Galvanization shall conform to IS-2629, 4759 & 4736 as applicable. If aluminum is used, the members shall be painted with 2 coats of PVDF paint of black color after suitable pre-treatment of surface, which shall be done after cutting of members and punching of holes.
- 6.3.3. The structural design of the MMS shall be done by Working Stress Method with no increase in permissible stresses. To avoid brittle failure of steel under low temperatures, a reserve strength of 15% shall be kept under the permissible strength by limiting the 'utilization ratio' as commonly termed by structural design software to 0.85.
- 6.3.4. Low-Hydrogen electrodes shall be used in welding to minimize brittle connections. All welds shall be shop welds, executed prior to the delivery of the assembly to the site.
- 6.3.5. The MMS shall comprise of purlins and rafters supported over columns spanning along the lower and upper sides (w.r.t the tilt) of the MMS with transverse and longitudinal bracings as necessary to satisfy the necessity of a lateral load resisting system. However, the contractor may propose an alternate structural configuration if

found to be optimum and the minimum clearance of the lower tip of the module from the ground (Finished or Natural Ground Level as applicable) shall be at least 1.0 m to utilize albedo radiation.

6.3.6. MMS structure shall be supported on precast RCC sleepers to be designed to withstand the loads coming from MMS and effectively transfer them to the ground.

6.3.7. Basic design philosophy of sleeper design shall be to counter the resultant uplift by its self-weight plus weight of the superstructure and modules while ensuring soil pressure at foundation level within safe bearing capacity under critical design load combination(s) ensuring required factor of safety as per IS 456: 2000.

6.3.8. The founding level (top of mud mat) of the sleeper at 350mm below EGL. The sleeper shall be supported on PCC (1:3:6) mud mat of 100 mm thickness over a 300 mm layer of gravel with interstices filled with sand to ensure fairly sound base foundation.

6.3.9. The grade of precast RCC sleeper shall be min. M35. The sleepers shall be shop manufactured (or at a properly established casting yard near the project site) with proper casting and curing facilities and shall conform to approved design and shall be transported to site for installation. Due care shall be taken during transport that there shall not be any damage to the sleeper units. Any sleeper observed to be damaged shall not be used.

#### 6.3.10. Permissible Stresses

- i. The ratio of maximum permissible stress to the yield stress of steel shall be limited to 0.85 % of Fy for all purposes of structural design. Accordingly, term 'Fy' shall be replaced by '0.85 Fy' while referring IS:801 or IS:800 in structural design.
- ii. The design of the structure shall be done using Working Stress Method (WSD) and no increase shall be allowed in permissible stresses except for combinations with Temperature load where it may be increased by 25%.

#### 6.3.11. Material Properties

- i. The sections used in the MMS shall conform to the following Indian Standards:
  - a) IS 808: Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections
  - b) IS 811: Cold Form Light Gauge Structural Steel Sections
  - c) IS 1161: Steel Tubes for Structural Purposes
  - d) IS 4923: Hollow Steel Sections for Structural Use
- ii. The steel used shall be of Grade Designation E350 Quality – C (killed) conforming to IS 2062.
- iii. Extruded structural aluminum sections, of minimum class designation 64430 and 65032 conforming to IS: 733 with minimum thickness of 4 mm may also be used. In such case, the structural design using aluminum shall conform to IS: 8147.
- iv. The MMS structure, if made of structural steel, shall be hot dip galvanized with minimum GSM 400 kg/ sqm and/or minimum coating thickness of 60 microns for protection against corrosion. Galvanization shall conform to IS-2629, 4759 & 4736 as applicable.

### 6.4. Main Control Room (MCR) Building, Inverter Station/Local Control Room

6.4.1. The MCR and LCR buildings shall be made of a RCC framed structure with plinth and shallow foundations.

6.4.2. The infill walls shall be made of locally available stones with sufficient insulation properties.

6.4.3. The grade of concrete shall be M30 or above.

6.4.4. Reinforcing steel used in RCC works shall be of minimum grade Fe500S. However, steel of grade ASTM A615-60 or an equivalent grade suitable for sub-zero temperatures can also be used subject to approval of the engineer-in-charge.

- 6.4.5. During the design stage, the stress in the reinforcing steel shall be ensured to have a reserve strength of 15% below the design stress by applying appropriate factor of safety to eliminate failure of steel in brittle mode under low temperatures.
- 6.4.6. The roof of the structure shall employ mono/dual sloped gable RCC roof system with adequate slope and the ridge line aligned with the predominant wind direction to minimize snow accumulation.
- 6.4.7. The windows and doors of the buildings shall employ hermetically sealed double glass panes with adequate thickness for strength against pressure difference due to wind effects as well as insulation.
- 6.4.8. The MCR and LCR buildings shall be provided with adequate HVAC facilities to maintain working temperature conditions inside the entire building during all seasons of the year.
- 6.4.9. A water tank made of RCC of suitable capacity (minimum 1000 liters) shall be provided for the MCR building with adequate heating facilities for winter applications.

#### 6.5. Module Cleaning System

- 6.5.1. All water storage tanks used in the Module Cleaning System shall be underground and made of RCC with insulation provided using 30 mm thick polyurethane boards around the walls of the water tank.
- 6.5.2. The supply main and branch/distribution pipes shall be made of HDPE pre-insulated with 50 mm thick layer of polyurethane. UPVC and GI pipes shall not be used anywhere. Vertical pipe connecting supply main to discharge point shall be made of steel of grade ASTM A333 Grade 6.
- 6.5.3. Chambers provided for housing various valves shall be made of masonry using locally available stones with adequate insulation properties. Such chambers shall be filled with insulating foam.
- 6.6. The possibility of encountering weakened bridges that may limit the quantum of transport, in addition to the consideration of navigating through sharp turns and narrow valleys in their logistics strategy as regards to vehicle type and weight transported, shall also be considered by the EPC contractor.
- 6.7. Internal road carriageway shall be constituted by interlocked concrete paver blocks of M60 grade laid over well compacted and cleaned natural ground compacted for a depth of 300 mm and brought to desired gradient.
- 6.8. Entire plant boundary shall be fenced using chain link fence.
- 6.9. Main Entry gate for each plot shall be provided by the Contractor.

# Section IV: Annexure

# Annexure A

Pre-dispatch Inspection Protocol for Crystalline PV Modules by Employer or Employer Deputed Agency

## **Pre-Dispatch Inspection Procedure**

### **1. Objective:**

The objective of this document is to establish General inspection protocol with objectivity for verification of Quality Parameters of Solar Modules by the customer (or its authorized inspection agency) prior to dispatch. The decision rules and procedure specified herein seek to uphold quality standards based on industry best practices and technical specifications laid out in tender documents as well as to control risks associated with item procurement.

### **2. Standards and Codes:**

- i. Sampling for determining Acceptance Quality Level (AQL) shall follow ISO 2859-1: 1999.
- ii. IEC TS 60904-1-2:2019 - Photovoltaic devices - Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices

### **3. Definitions:**

- i. Lot: All products/items manufactured in one batch.  
Notwithstanding the definition, the customer or authorized inspection agency can lay down alternate/additional criteria for determining a lot.
- ii. Major Defect: A defect that reduces the usability or causes the product to fail to fulfil its nominal characteristic function.
- iii. Minor Defect: A defect that does not reduce the usability of the product but does not meet the quality standard.

### **4. Inspection Schedule:**

Customer representative shall propose the schedule for Pre-dispatch Inspection of Finished Goods to the Customer well in advance, and in no case less than 3 working days prior to commencement of Inspection at a location within India.

### **5. Scope of Inspection:**

Supplier representative will accompany the Inspector while doing the inspection which shall typically consist of 2 steps for clearance of each Lot:

BOM verification: To be conducted prior to the commencement of production.

The details of materials used will be verified from the ERP/Manufacturing data and corroborated with the Construction Data Form (CDF). This shall include verification of following:

<b>Item</b>	<b>Method of Verification</b>
Shelf life of the following BOM items: <ul style="list-style-type: none"><li>• EVA</li><li>• PV Module Back sheet</li></ul> Sealant and potting material (Silicone)	Verify the expiry date/shelf life and storage conditions The PV Module manufacturer shall submit all required information to prove that materials being used are within their shelf life.

Note: Supplier shall provide the necessary documents for approval of BOM as per IEC standards and tender Technical Specifications.

Witness Tests:

Manufacturer shall assist the Inspecting agency to witness following checks, the details of which are provided elsewhere in this document:

- i. Flash test- As per sampling Plan  
For Bifacial Modules, Measurement of current-voltage characteristics shall be done as per IEC TS 60904-1-2:2019 - Photovoltaic devices - Part 1-2
- ii. Visual Inspection- As per sampling Plan
- iii. EL Inspection-As per Sampling Plan
- iv. Electrical Characteristics (Other than Flash Test)- As per Sampling Plan

Note: The Supplier shall furnish soft and hard copy of the Production Quality Plan prior to commencement of the Inspection.

## 6. Sampling Process:

- a) Supplier shall provide the list of modules in a lot ready for dispatch, along with flash test data (Measured Electrical Data,  $P_{max}$ ) prior to commencement of Inspection tests. Note: Smallest lot size for Inspection: 20% of the capacity as per the PO.
- b) Supplier will arrange to move the PV Modules from FG to Inspection area.
- c) Same samples shall be used for all Witness Tests stated at Clause 5 above.
- d) Inspector shall commence Inspection process by randomly selecting samples from the list of serial nos. (pallet-wise) provided by Supplier as per ISO 2859: Single Sampling Plan for Normal Inspection, General Inspection plan level However, the Inspector shall reserve the right to switch to tightened or reduced level of Inspection as per the lot quality.

## 7. Decision Rules for Acceptance/Rejection

Following is a summary of Decision Rules for Acceptance/Rejection of a given Sample in a lot offered for Inspection:

Table 1: AQL Levels

Defect Type	AQL (%)
Major (Ma)	2.5
Minor (Mi)	4

Table 2: Inspection Levels

Inspection steps	Inspection item	Inspection level
1	Flash Test	General inspection level I
2	Visual	General inspection level I
3	EL	General inspection level I
4	EC (Other than Flash Test)	10 Nos. per lot

## 8. Inspection Process

- a) Electrical Inspection – Flash Tests  
For Electrical inspection following preparation will be done:
  - Module Temp Stabilization: Modules will be kept in controlled environmental condition till it reaches  $25 \pm 20C$
  - Calibration of Sun-simulator: Sun-simulator will be calibrated as per Calibration Reference. Reference should calibrate against Calibration Reference tested from

reputed testing lab TUV / Fraunhofer etc. Testing of modules will be done at STC condition, AM=1.5

Note:

- i. All modules selected for sampling inspection will be re-tested in the sun-simulator. A  $P_{max}$  retest (repeatability test) variation of  $\pm 2\%$  on actual flash  $P_{max}$  value will be acceptable.
- ii. The Supplier shall provide a valid calibration certificate of the apparatus used.

b) Visual Inspection:

- Customer representative will verify the module visual characteristics as per the Visual Acceptance norms.
- The Visual Inspection shall be carried out in a well-lit room. It shall be the responsibility of the Supplier to ensure adequate brightness in the room.

c) Electroluminescence (EL) Inspection:

- The EL image shall have sufficient resolution for analysis of defects.
- Hi-pot test shall be done as per IEC procedure. The Supplier shall provide a valid calibration certificate of the apparatus used.

## **9. Re-inspection and review**

In case of minor non-conformities like cleaning issues, label mismatch, etc. which can be easily reworked, Supplier shall rework/replace the modules and offer them for re-inspection to Inspector.

## **10. Inspection Summary:**

Once the inspection is completed Customer Representative will compile his Inspection Summary Report and share with Supplier and give necessary recommendation on dispatch depending upon the audit findings based on the observations made. This report shall be provided within same day of inspection (Format Attached).

## **11. Disclaimer:**

Inspection by KREDL/ Employer does not absolve the responsibility of the Supplier/vendor to ensure quality during production of the material and its transport to site. Any damages during transport/handling shall be replaced before erection at site as directed by Engineer-in-charge without any extra cost to the purchaser.

## Sampling Plan

(Sampling Plan as Per ISO 2859) -1

Table 1: Sample size code letter

Lot size	Special inspection levels				General inspection levels		
	S-1	S-2	S-3	S-4	I	II	III
2 to 8	A	A	A	A	A	A	B
9 to 15	A	A	A	A	A	B	C
16 to 25	A	A	B	B	B	C	D
26 to 50	A	B	B	C	C	D	E
51 to 90	B	B	C	C	C	E	F
91 to 150	B	B	C	D	D	F	G
151 to 280	B	C	D	E	E	G	H
281 to 500	B	C	D	E	F	H	J
501 to 1 200	C	C	E	F	G	J	K
1 201 to 3 200	C	D	E	G	H	K	L
3 201 to 10 000	C	D	F	G	J	L	M
10 001 to 35 000	C	D	F	H	K	M	N
35 001 to 150 000	D	E	G	J	L	N	P
150 001 to 500 000	D	E	G	J	M	P	Q
500 001 and over	D	E	H	K	N	Q	R

(Sampling Plan as Per ISO 2859) – 2 – Normal, Tightened and Reduced)

**Table 2-A — Single sampling plans for normal inspection (Master table)**

Sample size code letter	Sample size	Acceptance quality limit, AQL, in percent nonconforming items and nonconformities per 100 items (normal inspection)																										
		0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10	15	25	40	65	100	150	250	400	650	1 000	
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	
A	2																											
B	3																											
C	5																											
D	8																											
E	13																											
F	20																											
G	32																											
H	50																											
J	80																											
K	125																											
L	200																											
M	315																											
N	500																											
P	800																											
Q	1 250	0 1																										
R	2 000	↑																										

↓ = Use the first sampling plan below the arrow. If sample size equals, or exceeds, lot size, carry out 100 % inspection.

↑ = Use the first sampling plan above the arrow.

Ac = Acceptance number

Re = Rejection number

**Table 2-B — Single sampling plans for tightened inspection (Master table)**

Sample size code letter	Sample size	Acceptance quality limit, AQL, in percent nonconforming items and nonconformities per 100 items (tightened inspection)																										
		0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10	15	25	40	65	100	150	250	400	650	1 000	
Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	
A	2																0 1		0 1	1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	
B	3																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	
C	5																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	
D	8																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	
E	13																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	
F	20																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	
G	32																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
H	50																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	
J	80																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
K	125																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
L	200																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
M	315																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
N	500																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
P	800																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
Q	1 250																0 1		1 2	2 3	3 4	5 6	8 9	12 13	18 19			
R	2 000	0 1															1 2	2 3	3 4	5 6	8 9	12 13	18 19					
S	3 150																1 2											

↓ = Use the first sampling plan below the arrow. If sample size equals, or exceeds, lot size, carry out 100 % inspection.

↑ = Use the first sampling plan above the arrow.

Ac = Acceptance number

Re = Rejection number

**Table 2-C — Single sampling plans for reduced inspection (Master table)**

Sample size code letter	Sample size	Acceptance quality limit, AQL, in percent nonconforming items and nonconformities per 100 items (reduced inspection)																										
		0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10	15	25	40	65	100	150	250	400	650	1 000	
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	
A	2																											
B	2																											
C	2																											
D	3																											
E	5																											
F	8																											
G	13																											
H	20																											
J	32																											
K	50																											
L	80																											
M	125																											
N	200																											
P	315																											
Q	500	0 1																										
R	800	↑																										

↓ = Use the first sampling plan below the arrow. If sample size equals, or exceeds, lot size, carry out 100 % inspection.

↑ = Use the first sampling plan above the arrow.

Ac = Acceptance number

Re = Rejection number

## Customer inspection Report

CUSTOMER INSPECTION REPORT			
Ref. No. & Date:			
Client:	PMC: KREDL	EPC Contractor: PO Ref. No.:	
Place of Inspection:	Date of inspection:	Lot Size	Sample Quantity
Problem Quantity: Detail: Inspection Result (OK/Not OK):			
Visual Inspection Problem Quantity: Detail:			
Flash Test Problem Quantity: Detail:			
EL Inspection: Problem Quantity: Detail:			
EC Inspection (Hipot,DCContinuity,IR): Problem Quantity: Detail:			
Any Other Criteria/Remarks:			
Is the shipment qualified to be released?   Yes   No			
From Client	From EPC Contractor	KREDL	

Enclosed: Test Details, Flash Test Report, EL test, EC Test Report

Disclaimer: *This Inspection by KREDL/ Employer does not absolve the responsibility of the vendor to ensure quality during production of the material and its transport to site. Any damages during transport/ handling shall be replaced before erection at site as directed by Engineer-in-charge without any extra cost to the purchaser.*

**Details:**

Lot:				Date
Sr. No.	Defect	Module Id	Type (Ma/Mi)	Details
1				
2				
....				



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 thereafter	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 thereafter	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 & experienced 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	Measur ement	100%	Tech. Specs, Construction Drawings	SR	√	x	x	x	
14 15	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	Measur ement	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 correlate with MTC	IS:456,IS:269,IS:8112, IS:12269,IS: 1489, Tech. Specs	Manufacturer's 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 essentially included by EPC vendor in QA documentation)	Checking Agency			Remarks		
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner				
23	i	Determination 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				One test at Lab for each source/ on every change of source									
25	iii	Crushing Value, Impact value, Abrasion value				√			x	x	x	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	Fine Aggregate (FA)											
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 thereof 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
32		Moisture Content											
33	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							
34	iii	Water absorption (for design mix concretes only)											
35	iv	Presence of deleterious materials											
36	D	Concrete Admixture											
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.
38	ii	Physical & Chemical properties			Review of MTC		IS: 9103, Manufacturer's Brochure						Each lot/ batch of admixture shall accompany the Manufacturer's Brochure and shall be correlated with MTC
39	iii	Suitability											
40	E	Bricks											
41	i	Dimensional Tolerance, shape	Measurement/ Physical			As per relevant IS code/ one sample for 30,000 nos. or part thereof	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	Water																		
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	x	Water to be used for concrete shall be of potable quality and shall meet requirements specified in IS: 456							
47	ii	Chemical Tests to ascertain the suitability for construction purposes - pH Value, Sulphate & Chloride content																		
48	F	Reinforcement Steel																		
49	i	Identification & Size	Major	Visual	Each batch of delivery	IS:432,IS:1786,IS:1852, Tech Specs	SR	√	x	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															
51	iii	Tensile Test	Critical	Review of MTC	Each batch of delivery	IS:432,IS:1566,IS:1786, Tech Specs	Manufacturer's Test Certificate (MTC's)	√	x	x	x	x								
52	iv	Yield stress/proof stress																		
53	v	Percentage Elongation																		
54	vi	Bend/Rebend Test			IS:432, Tec. Specs															
55 56	vii	Reverse Bend Test for HDS wire																		

57	3	Structural Steel Work {Example: Chequered plate cover, Panel supports, Rungs, Cat lader, Inserts, Fencing gate (MS) etc.}											
58	i	Structural 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	Manufacturer's Test Certificate (MTC's)	√	x	x	x	MTC to be correlated
59	ii	Dimensional Check - Section dimensions, thickness		Critical	Measurement	10% of total quantity at Random			√	x	x	x	For Fencing gate - dimensional check 100%

	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 vendor in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner	
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	Manufacturer's 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 quantity at Random			✓	x	x	x	MTC to be correlated
62 63	v	Acceptance of Structural steel works		Major	Physical / Acceptance	Random	Tech. Specs, Construction Drawings	SR	✓	x	x	x	
64	4	Foundation System											

65	A	Bored Cast in-situ Concrete Piling (for MMS support)											
66	a	Execution											
67	i	Ensuring correctness of layout		Critical	Physical	100%	Tech. Specs, Construction Drawings	SR	√	x	x	x	
68	ii	Checking of pile making as per drawing	Total Station	Major	Visual								
69	iii	Checking of Centre line of Pile Group	Total Station	Critical	Physical		IS 2911, Tech Specs, Construction Drawings	SR	√	x	x	x	1. During boring of pile, record SPT/ core recovery to ensure socketing length in the hard strata equivalent in terms of pile diameter in hard rock zone as per tech Specs and approved construction drawings. 2. In case of collapse of pile bore during drilling temporary MS lining shall be used. 3. Lines and levels to be checked 4. Each bore shall be cleaned of any loose material by pressure jet washing/ cleaning by air jet 5. The column section shall be placed and held in position in true vertical alignment using template/ tripod till initial setting of concrete 6. Concrete grade - as per Construction Drawing
70	iv	Check Pile Location	Total Station										
71	v	GL, Pile depth, diameter and alignment	As required		Measur ement								
72	vi	Cleaning/ flushing of pile bore	As required	Major	Visual								
73	vii	Insertion & positioning of Column post in the bore hole (in case of embedded col. Leg) Placement of reinforcement and foundation bolts with template (incase of fixing of col. with base plate & foundation bolt assembly)	As required	Critical	Visual/ Measur ement								

74	viii	Acceptance of Pile casting - Shape, reinforcement or col. leg embedment (as applicable), concreting, compacting with use of needle vibrator etc.	As required / Agreed	Major	Visual								
75	ix	Grouting u/s of base plate	As required / Agreed	Critical	Visual	100%	Tech. Specs & Construction drawings	SR	√	x	x	x	The type, grade and thickness of grout shall be as per approved drawing
76	b	Testing											
77	i	Initial pile load test - Compression (Vertical), Lateral (Horizontal), & Pull out (Tension)	Calibrated dial gauges, jack of required capacity , datum bars etc.	Critical	Physical	100% for 3 no. for each type of test or as specified in Tech Specs, Approved test pile layout	IS 2911, Tech Specs, Construction Drawings	Test Report	√	x	x	x	1. The R/F details shall be as per approved drawing for test pile (if applicable), 2. The test load shall be up to 2.5 times of required pile capacity in case of Compression and Lateral load and 2 times in case of Pull out test as per IS: 2911 (Pt. 4), 3. The location shall be as per approved pile test programme/ layout drawing 4. The test shall be carried out as per approved methodology 5. Test report along with test records shall be submitted in standard format as per IS:2911

78	ii	Routine pile tests - Pull out and Lateral		Critical	Physical	100% for 0.5% of total no. of working piles for each type of test	IS 2911, Tech Specs, Construction Drawings	Test Report					1. The piles for routine tests shall be selected at Random to represent total no. of job piles installed 2. The test load for vertical and pull out shall be 1.5 times the required pile capacity 3. The test shall be carried out as per approved methodology. 4. The Test report along with test records shall be submitted in standard format as per IS:2971 (Pt. 4)
----	----	---	--	----------	----------	---	--	-------------	--	--	--	--	---

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	S r. N o. .	Activity & Operation	Instrum ents	Class of Check	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Record s iden tifie d with (√) shall be essentia lly includ ed by EPC vender in QA docume ntation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub- Contract or	EPC Contractor	KREDL 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 / Measur ement	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 88	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 embedment's											
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 accessories, 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 5	iv	Acceptance of foundation bolt assembly / inserts in position												
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 tolerances		Major	Visual/ Measurement	100%	Tech. Specs, Construction Drawings	SR	√	x	x	x		
100 1	iv	Proper sealing of joints, Acceptance of formwork before concreting		Major	Physical / Visual	Before start of concreting	As per provisions, tolerances, Tech. Specs, Construction drawings		√	x	x	x		
102	7	Placement of Reinforcement 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								

	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 Document s & Acceptanc e Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vendor in QA documentation)	Checking Agency			Remarks
2									SR - Site Register KREDL- SPV-QA- F-XXX KREDL- SPV-QA- T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contractor	EPC Contractor	KR ED L or Ow ner	
106	iv	Check for proper cover,spacing of bars, spacers & chairs after the reinforcement cage has been put inside the foundation			Visual								

107 108	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 materials
111	ii	Minimum cement content (as applicable in MMS piling and 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, sulphate 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 absorption according to mix design recommendations may be carried out during trial mix

113	iv	Mixing of concrete- check for quantities 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/ Batcher 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 &transportation	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	
117 118	viii	Curing	As required	major	Physical	At Random	IS: 456	SR		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:199, 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:199, Tech Specs, Construction Drawings	Test Results/SR	√	x	x	x	MMS Pile - 6 cubes (3 for 7 day test & 3 for 28 day strength) per sample for each 5 cum or part there off 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 tolerances	Major	Visual/ Measurement	100%		Joint Protocol between Civil Contractor, EPC Vendor and KREDL/ Owner where applicable/ SR	√	x	x	x	
123													
124	10	Acceptance of Hardened Concrete											
125	i	Dimensional check (dimensions, levels etc), workmanship, finishing after removal of shuttering	As required & dimensional tolerances	Major	Visual/ Measurement	At Random			√	x	x	x	

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr. No .	Activity & Operation	Inst rum ent s	Class of Chec k	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vendor in QA documentation)	Cheking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contra ctor	KREDL or Owner	
126 127	ii	Water tightness test for liquid retaining structures/ tanks	As required	Critic al	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 thereof 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
139 140	iv	Degree of compaction - Dry density by proctor needle penetration Earth filling - In-situ Dry density (core cutter or sand replacement method) or Sand Filling - In-situ Relative density (Density Index)		Critical	Physical	For foundation fill/backfill - One for every 10 foundations at Random for each compacted layer For area grading/filling - one every 1000 sqm area for each compacted	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	
146 147	v	Curing		Major	Visual	100%	IS: 2250 / As per Tech. Specification	SR		x	x	x	
148	12	Cement Plaster											

	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 vendor in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	KRE DL or Own er	
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 deleterious materials, Grading shall conform to Table-I of IS: 2116
150	ii	Plaster & grooves - Thickness, Evenness & Finishing, Trueness ospalstering 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	
152 153	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 KREDL/ 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	
158 159	iv	Application and Acceptance of painted surface	As required	Major	Physical	Each surface at Random							
160	15	Floor finishes &Alied works											
161	i	Preparation 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 applicable to Fill/ Back fill

163	iii	Check providing shuttering, reinforcement (if applicable)			Physical	At Random for each building	Tech. Specs, Construction Drawings			x	x	x	Quality Checks as applicable to Shuttering/ Reinforcement placement
164	iv	Checking the Panel size (as applicable)			Physical	At Random for each building	IS: 5491, Tech. Specs, Construction 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, Construction 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 &KREDL/ 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 applicable 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 concreti ng or part thereof for each days concreti ng (one sample consists of min 3 test cubes for 28 days strength )	IS:456, IS:516,IS:11 99 and Design specification	Lab Test Reports						
170	x	Tiled flooring/ dado												

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr.N o.	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)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contractor	EPC Contract or	KREDL or Owner		
17 1	a	Material - Glazed ceramic Tiles, Vitrified Ceramic Tiles, Mosaic Tailes, 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
17 2	b	Finishing & Acceptance		Major	Physical	100%	IS: 1443, Tech Specs, Construction Drawings						

17 3	xi	IPS with or without IRONITE (as applicable)		Major	Physical	At Random per shift	IS: 5491, Tech. Specs, Construction Drawings	SR	√	x	x	x	
17 4	xi	Fixing of Panel Dividers for finishing course (3 mm Thk Glass/ 2mm ThkAluminum strip) (if applicable)		Major	Physical	At Random per shift	Tech Specs, Construction Drawings	SR	√	x	x	x	
17 5	xii	Anti abrasion/ anti wearing epoxy coating (if applicable)											
17 6	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
17 7	b	Finishing & Acceptance		Major	Physical	100%	Tech Specs, Construction Drawings	SR	√	x	x	x	

17 8	xiv	Kota stone flooring and skirting (as applicable)											
17 9	a	Material	Quality, Texture, Thickness, Colour for approved source	Major	Physical	Each batch of delivery	Tech Specs, Construction Drawings	SR	√	x	x	x	
18 0	b	Finishing & Acceptance		Major	Physical	100%	Tech Specs, Construction Drawings	SR	√	x	x	x	
18 1	xv	Acid/ Alkali resistant tile flooring/ dado											
18 2	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 and dado shall be provided in battery room as per approved Arch finishing details
18 3	b	Finishing & Acceptance	Workmanshiip	Major	Physical	100%	Tech Specs, Construction Drawings	SR	√	x	x	x	
18 4	xvi	Interlocking Blocks											

18 5	a	Materials	Size/ Shape, colour shade, Grade of Concrete	Critic al	Approve d source, Review of MTC/ Test Report	Each batch of delivery	BS: 6717, Tech Specs, Construction Drawings	SR	√	x	x	x	
18 6 18 7	b	Final finishing & Acceptance	As agreed/ required	Major	Physical	100%	BS: 7533 (Pt.3), Tech Specs, Construction Drawings	SR	√	x	x	x	
18 8	16	Damp Proof Course											
18 9	i	Material - Hot bitumen & water proofing materials etc.	As agreed/ required	Critic al	Review of MTC	Each batch of delivery	IS: 702, Tech. Specs, Construction Drawings	SR	√	x	x	x	
19 0 19 1	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	

19 2	17	Grouting of pockets/ underside of base plate											
19 3	i	Material	As required/ Agreed	Critical	Review of MTC/ Physical	Each batch of delivery	Tech. specs, Construction Drawings, Manufacturer's catalogue	SR	√	x	x	x	In case of ready mixed grout MTC to be correlated with Manufacturer 's catalogue
19 4	ii	Type of Mix	Anti shrink cement grout/ Ready mixed - Fluid mix, stiff mix as required	Major	Physical	At Random per 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/ Construction Drawing
19 5	iii	Mixing, placement, application	As required	Major	Visual	At Random per shift of grout application	Tech. Specs, Construction Drawings	SR	√	x	x	x	
19 6	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	

	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 vendor in QA documentation )	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test		M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner	
19 7 19 8	v	Acceptance of Grouting	Thickness, Finished level etc.	Major	Physical	!00% of 20 % of grout work at Random	Tech. Specs, Construction Drawings	SR	✓	x	x	x	
19 9	18	Precast Concrete											
20 0	a	Bought Out Units (Precast boundary wall units - Slab Panels, Column etc., Trench Covers , Manhole											

20 1	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
20 2	ii	Workmanship , dimensions, 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
20 3	b	Cast at site (if applicable)											
20 4	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
20 5	ii	Workmanship , dimensions, R/F	As required/agreed	Major	Physical	At Random	Tech Specs, Construction Drawings	SR		x	x	x	
20 6	c	Acceptance of pre-cast concrete units											

20 7	i	Bought Out Units - Check for any breakage, damage during handing & transport, erection at site (levels) etc.	As required/ Agreed	Major	Visual	At Random	Tech Specs, Construction Drawings	SR	√	x	x	x	
20 8 20 9	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	
21 0	19	Joints In concrete											
21 1	i	Joint Material - Bitumen impregnated fiber board, PVC water stop, Sealing compound - Bitumastic/polysulphide, Hydrophilic strip, Expanded polystyrene (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	

21 2 21 3	ii	Acceptance of installation	As agreed/ required	Major	Physical	Each installation at Random	Tech. Specs and Construction Drawings	SR	√	x	x	x	
21	20	Underdeck											
21 5	i	Insulation material - Mineral/ Glass wool, galvanized wire neting, Aluminium foil, fasteners	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
6 21 7	ii	Acceptance of installation	As agreed/ required	Major	Physical	Each installation	Tech. Specs and Construction Drawings	SR	√	x	x	x	
21 8	21	False Ceiling											
21 9	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

22 0 22 1	ii	Acceptance of Installation	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR		x	x	x	
22 2	22	Doors, Windows, Ventilators, Glass/ Glazing and Grill											

	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 vendor in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner		
22 3	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	
22 4	a	Steel Doors											
22 5	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

22 6	ii	Finishing & Acceptance - Surface preparation for painting, primer & finishing coat, DFT	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR	✓	x	x	x	
22 7	b	Flush Doors											
22 8	i	Shutters, Teak beading	As agreed/ required	Critical	Review of MTC/ Test Report	Each lot received at site	IS:2202, Tech. Specs and Construction Drawings	MTC/ Lab Test Report/ SR	✓	x	x	x	
22 9	ii	Acceptance	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Construction Drawings	SR		x	x	x	
23 0	c	Aluminium doors and Partition works											

23 1	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 Constructio n Drawings	SR/ Lab Test Reports	√	x	x	x	Review of Test Report For anodization check as per Tech. Specs and Constructio n Drawings Power coating, colour shade as applicable as per Tech. Specs and Constructio n Drawings
23 2	ii	Finishing & Acceptance - fabrication & erection, fitting etc..	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Constructio n Drawings	SR		x	x	x	
23 3	d	Grill											
23 4	i	Materials - Aluminium, MS, Anodization in case of aluminium	As agreed/ required	Critical	Visual/Physica l/ Review of Test Report	Each lot received at site	Tech. Specs and Constructio n Drawings	SR/ Lab Test Reports	√	x	x	x	Review of Test Reports
23 5	ii	Finishing & Acceptance - erection, fitting, painting in case of MS grill etc.	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Constructio n Drawings	SR		x	x	x	

23 6	e	Rolling Shutters											
23 7	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 & Constructio n Drawings	SR	✓	x	x	x	
23 8	ii	Finishing and Acceptance - Painting , DFT	As agreed/ required	Major	Visual/ Physical	Random	Tech. Specs and Constructio n Drawings	SR		x	x	x	
23 9	f	Glass and Glazing											
24 0	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 Constructio n Drawings	SR	✓	x	x	x	
24 1 24 2	ii	Installation, finishing and acceptance	As agreed/ required	Major	Visual/ Physical	Random	Tech Specs and Constructio n Drawings	SR	✓	x	x	x	
24 3	23	Precast Concrete Boundary Wall											
24 4 24 5		Acceptance of boundary wall- Finising, Alignment Dimensions etc.	As agreed/ required	Major	Physical		Tech Specs and Constructio n Drawings	SR		x	x	x	For inspection of precast concrete units -refer S.No. 18

24 6	24	Roof Water Proofing											
24 7	i	Methodology for the application of water proofing system	As required	Critica l	Review	for each type of treatmen t	Tech Specs and Const. Drawings						
24	a	Materials											

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr.No	Activity & Operation	Instrument s	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 )	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner	
24 9	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	√				
25 0	b	Roof											
25 1	i	Graded under bed - Slope/ Level	As agreed / required	Major	Physical	100%	Tech Specs and Construction Drawings	SR	x	x	x		

25 2	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	
25 3	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
25 4 25 5	c	Acceptance of Water proofing treatment	As agreed/ required	Major	Visual/ Physical	100%	Tech Specs and Construction Drawings	SR		x	x	x	
25 6	25	Water Supply and Sanitary Installations											
25 7	a	Water Supply Fittings and Fixtures											

25 8	i	Materials - GI/ MS/ C-PVC/ uPVC/PPR/HDP E 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	
25 9	ii	Disinfection - Before use	As agreed / required	Major	Physical	Each installation	IS:2065, Tech specs and construction Drawings	SR		x	x	x	
26 0	iii	Hydraulic test - Before use/ Leakage	As agreed / required	Critical	Physical	Each installation	Tech Specs and Construction Drawings	SR		x	x	x	
26 1	iv	Acceptance & Working	As agreed / required	Major	Physical	Random	Tech Specs and Construction Drawings	SR		x	x	x	
26 2	b	Sand Cast Iron/ Cast iron Pipes											
26 3	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	

26 4	ii	Acceptance and leakage	As agreed / required	Major	Physical	Random	Tech Specs and Construction	SR		x	x	x	
26 5	c	HDPE Pipes for Sewerage											
26 6	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	
26 7	ii	Acceptance & leakage	As agreed / required	Major	Physical	Random	Tech Specs and Const. Drawings	SR		x	x	x	
26 8	d	HDPE Pipes for Rain water Downcommer											
26 9	i	HDPE pipes and fittings/ joints	As agreed/ required	Critical	Review of MTC/ test reports		IS:4984, Tech. Specs	MTC/SR	✓	x	x	x	
27 0	ii	Acceptance & leakage	As agreed / required	Major	Physical	Random	Tech Specs and Const. Drawings	SR		x	x	x	
27 1	e	Sanitary fitting and fixtures											

27 2	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	
---------	---	--	----------------------	-------	-----------------------------	--	--------------------------------	----------------------	---	---	---	---	--

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	S r. N o.	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 vendor in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)		M'fr/ Supplier or Sub-Contractor	EPC Contractor	KRE DL or Own er	
27 3	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	
27 4	f	RCC Pipes											
27 5	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	

27 6	ii	Acceptance and leakage	As agreed / required	Major	Physical	Random	Tech Specs and Const. Drawings	SR		x	x	x	
27 7	g	Water Storage Tank											
27 8	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	
27 9 28 0	ii	Acceptance and leakage	As agreed / required	Major	Acceptance	Random	IS:12701, Tech Specs and Const. Drawings	SR		x	x	x	
28 1	2 6	Special Items (Switch Yard)											
28 2	a	Earthing Mat (Grounding System)											
28 3	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	
28 4	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.

28 5	iii	D P test	DP test Kit	Critical	Physical	10% at random	Tech Specs and Const. Drawings	TR	√	x	x	x	
28 6	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	
28 7	b	Anti Weed Treatment											
28 8	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	
28 9 29 0	ii	Execution of treatment	As agreed / required	Major	Physical	Random check for each treatment	Tech Specs and Const. Drawings	SR		x	x	x	
29 1	2 7	Road Work											
29 2	a	Construction of Sub-Grade and earthen/hard shoulders											
29 3	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

29 4	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
29 5	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.
29 6	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

	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	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	EPC vender in QA documentation)	M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner	
297	b	Water Bound Macadam (Non-Bituminous) for base course and sub-base course											
298	i	Aggregate Impact value	Aggregate Impact value Test Apparatus	Critical	Physical	One test per 200 cum of Test aggregate	As per Tech 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 per Tech 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 aggregate	As per Tech 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 per Tech Specs and Const. Drawings, Section 900 of MORTH specification	SR	√	x	x	x	
302	v	Atterberg Limits of portion of aggregate passing 425 micron sieve	Atterberg limits determination	Critical	Physical	One test per 100cum of aggregate	As per Tech 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	Initialy 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	Initialy 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	

	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 essentiall y included by EPC vender in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner		
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	Thermo meter	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	Penetro metre 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 Value Test 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 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	
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	

	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 vendor in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner		
32 6	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	
32 7	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	

32 8	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	
32 9	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	
33 0	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	
33 1	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	
33 2	d	Tack Coat/ Prime coat/ fog coat											
33 3	i	Quality of binder	Penetrometer 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	

33 4	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	
33 5	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	
33 6	e	Alignment, Level, Surface regularity and rectification											
33 7	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	
33 8 33 9	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	
34 2	28	Geotechnical Investigations											
34 1	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	

34 2	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	
34 3	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	
34 4	iv	Conducting field 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	

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr.No .	Activity & Operation	Instrument s	Class of Chec k	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vendor in QA documentation)	Checking Agency			Remark s
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contract or	EPC Contract or	KRED L or Owner		
34 5	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	
36 4	vi	Submission of laboratory test schedule and selection of samples for laboratory testing	As required / agreed	Critic al	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	

34 7 34 8	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	
34 9	29	Topographical Survey Works											
35 0	i	Deployment of approved Topographical Surveying Agency - Equipment's, Manpower etc	As required / agreed	Critical	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	✓	x	x	x	
35 1	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	
35 2	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	
35 3	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	

35 4 5	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	
35 6	30	Internal Switchyard - Site Leveling & Grading											
35 7	i	Leveling Switchyard area	As required / agreed	Major	Visual / Physical	100%	As per Tech. Specification and Approved Drawing	SR		x	x	x	
35 8 35 9	ii	Grading of 20/40mm stone / Gravel Spreading in switchyard area	As required / agreed	Major	Physical	100%	As per Tech. Specification & Approved Drawing	SR		x	x	x	
36 0	31	Plant Boundary Fencing (if applicable) & Gate (Also refer S.No. 3 for Steel works as applicable)											
36 1	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

36 2	ii	Barbed wire - Dia. of line wire and barb wire, Grade of galvanization etc, Tensile strength etc.	As agreed/ Required	Critic al	Physical/ Measuremen t/ Review of MTC				✓	x	x	x	
36 3	iii	Tie wire - Diameter, Galvanization- Grade, tensile strength etc.	As agreed/ Required	Critic al	Physical/ Measuremen t/				✓	x	x	x	
36 4	iv	Blade barbed/ Concertina Wire - Thickness/ Diameter, galvanization, Diameter of concertina coil, Tensile strength etc.	As agreed/ Required	Critic al	Review of C Physical/ Measuremen t/ Review of MTC				✓	x	x	x	

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr.No.	Activity & Operation	Instrument s	Class of Check	Type of Check	Quantum of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Record s identified with (√) shall be essentially included by EPC vendor in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	M'fr/ Supplier or Sub-Contractor	EPC Contractor	KREDL or Owner		
36 5	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	
36 6	vi	MS Gate - Caster wheels, ball & bearings, Fixtures & fasteners etc.	As agreed/ Required	Major	Visual	100%	Tech. Specs & Construction Drawings	SR		x	x	x	

36 7 36 8	vi	Acceptance of Boundary Fence and gate	As agreed/ Required	Major	Physical	100%	Tech. Specs & Construction Drawings	SR		x	x	x	
36 9	32	Transformer Yard Fencing & Gate (Also refer S.No. 3 for Steel Works as applicable)											
37 0	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
37 1	ii	Tie wire (as applicable) - Diameter, Galvanization, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC				√	x	x	x	
37 2	iii	Fence Fabric (chain link/ welded wire as applicable)- Mesh size, Wire Diameter, Galvanization, Selvage, Knuckling, Tensile strength etc.	As agreed/ Required	Critical	Physical/ Measurement/ Review of MTC				√	x	x	x	
37 3	iv	MS Gate - Fixtures and fasteners	As agreed/ Required	Major	Visual	100%	Tech Specs and Approved Drawings	SR		x	x	x	

37 4 5	v	Acceptance of Fence & Gate	As agreed/ Required	Major	Physical	100%	Tech Specs and Approved Drawings	SR		x	x	x	
37 6	33	Installation of Pre Engineered Building (PEB) - Security Cabin											
37 7	a	Receipt											
37 8	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	
37 9	iii	Dimensional Check	As agreed/ Required	Major	Measuremen t	100%			√	x	x	x	
38 0	iv	Visual checks for damages, rusting, pitting etc.	As agreed/ Required	Major	Visual	100%				x	x	x	
38 1	v	Visual checks for defects, primer coating and painting/galvanising as applicable.	As agreed/ Required	Major	Visual	100%				x	x	x	
38 2	vi	Nut/Bolt/Washers Checks	As agreed/ Required	Major	Visual	100%				x	x	x	
38 3	b	Pre-Installation											
38 4	i	Check that the work area is ready and safe to start installation	As agreed/ Required	Major	Visual / Dimension					x	x	x	
38 5	ii	Check readiness of Foundations	As agreed/ Required	Major		100%				x	x	x	

38 6	c	Installation (as applicable)																	
38 7	i	Readiness of concrete platform, foundations for installation- Size, Location, Level etc.	As agreed/ Required	Major	Visual						x	x	x						
38 8	ii	Check PUF side walls/ roof are installed properly	As agreed/ Required	Major	Physical						x	x	x						
38 9 90	iii	Check tightening of all Nut/Washers/Bolts	As agreed/ Required	Major	Physical						x	x	x						
39 1	34	Structural Work for Module Mounting Structure (MMS)						Tech. Specification , Approved Drawing & Method Statement											
43 7	a	Manufacturing																	

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr.No	Activity & Operation	Instrument s	Class of Check	Type of Check	Quantu m 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 KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test		M'fr/ Supplier or Sub-Contractor	EPC Contractor	KRED L or Owner	
43 8		Structural Steel (Raw Material) Hot rolled & cold formed sections - Angle, Channel, Z-section, Box section, Plate, rod & bar											

43 9	i	Ultimate Tensile Strength (UTS), Yield Strength (YS), Percentage Elongation, Bend Test, Chemical Composition, Section dimensions	As agreed/ Required	Critical	Chemical composition, Mechanical, Measurement	1 Sample per 50 MT or part thereoff/ for every heat no.	IS 2062, IS 513, IS 811, IS 1079, IS 808, IS 1852, IS 1730 -Part I	MTC	√				Raw material to be procured from reputed manufacturers - like SAIL, RINL, JSPL, JSW, TISCO, ISSAR
44 0	ii	Visual Examination - Cracks, Scaling, Rust, Pitting, Lamination etc.	As agreed/ Required	Major	Visual	10% IS 2500, Level II, AQL 1.5	IS 2062, IS 513, IS 811, IS 1079, IS 808, IS 1852, IS 1730-Part I	SR	√	x	x	x	Material shall be free from surface defects like cracks, lamination, roughness, imperfect edges, rust, pitting & other harmful defects. Removal of minor surface defects as per IS:2062 is acceptable. Witness for 10% sample. Record review for every material

44 1		Bought out Items (Hardware - Nuts, Bolts and Washers - plain, spring)										
44 2	i	Mechanical & Chemical Properties	As agreed/ Required	Critical	Chemical composition, Mechanical	1 sample per 5 MT or part thereof	IS 1327 (Part 17) eq./ ASTM standard	MTC/ Lab test Report	√	x	x	x
44 3	ii	Dimensional check (Dia., Thickness, Total stem length & Threaded length etc.)	As agreed/ Required	Major	Measurement	IS 1327 (part 17) eq 10 pieces per lot per member type	IS 6639, IS 2016, IS 6610 & IS 3063 / ASTM standard	Vendor Records	√	x	x	x
44 4	iii	Galvanizing - Mass per Sqm, Thickness (DFT)	As agreed/ Required Alcometer	Major	Visual, Measurement	IS 1327 (part 17) eq 10 pieces per lot per member type	For Hot dip galvanizing should be maintained 43 microns (min) and average 54 microns as per IS 1367 (part XIII) eq.	Vendor Records	√	x	x	x
44 5	b	In Process Inspection										
44 6		Structural Item Fabrication										

44 7	i	Straightening	As agreed/ Required	Major	Visual	100%	0.2% of total length	Vendor Records	√	x	x	x	Record review
44 8	ii	Cropping (Cutting)	As agreed/ Required	Major	Visual	100%	Approved drawing	Vendor Records	√	x	x	x	Record review
44 9	iii	Identification/ Marking	As agreed/ Required	Major	Visual	100%	Approved drawing Marking Shall be done with the help of permanent paint marker using stencil as per Drawing	Vendor Records	√	x	x	x	Record review Random sample inspection
45 0	iv	Punching/ Drilling of Holes	As agreed/ Required	Critica l	Measuremen t	1 piece per 25 pieces	IS 802/ Approved drawing	Vendor Records	√	x	x	x	Record review
45 1		Edge Security							√	x	x	x	
45 2	v	Overall Length	As agreed/ Required	Major	Measuremen t	1 piece per 25 pieces	IS 802/ Approved drawing	Vendor Records	√	x	x	x	Record review Random sample measurement
45 3	vi	Bending	As agreed/ Required	Critica l	Measuremen t	100%	IS 801, 811/ Approved drawing	Vendor Records	√	x	x	x	
45 4		Cross Section Dimensions							√	x	x	x	Record review

45 5	vii	Welding	As agreed/ Required	Major	Visual	100%	Approved Welding Procedure & Welder Qualification	Vendor Records	√	x	x	x	Record review Random sample inspection
45 6	viii	Visual Examination - Black spots, Porosity, Spatter, Rust bleed points, Weld dimensions	As agreed/ Required	major	Visual	100%	Tech. Specification , Approved Drawing	Vendor Records	√	x	x	x	Record review Radom sample inspection (The fabricated material shall be free from error)
45 7	ix	DP Test (as necessary)	As agreed/ Required	Major	Chemical	Shift wise/ random	As and when required	Vendor Records	√	x	x	x	
45 8	x	Final Inspection of Fabricated Parts - Cross section dimensions, Thickness (before galvanization )	As agreed/ Required	Critica l		10 % in lot size of 100 nos.	IS- 802, IS 807, IS 811 and relevant applicable eq. standards , approved drawings, Tech spec	Vendor Records	√	x	x	x	
45 9		Galvanizing											

46 0	i	Zinc - Ingots, Molten metal in galvanizing bath	As agreed/ Required	Critical	Chemical	1 sample from each batch of ingot supply	IS 2629	MTC Lab test report	✓	x	x	x	Purity of Zn 98.5%, MTC to be correlated. Molten metal in the galvanizing bath ≥ 98.5 % by mass of zinc.
46 1		Pre Galvanizing											

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sr.N o.	Activity & Operation	Instrumen ts	Class of Chec k	Type of Check	Quantu m of Check	Reference Documents & Acceptance Standard	Format of Record	D* (Records identified with (√) shall be essentially included by EPC vendor in QA documentation)	Checking Agency			Remarks
2								SR - Site Register KREDL-SPV-QA-F-XXX KREDL-SPV-QA-T-XXX (XXX - Inspection record form No. or Test report format no.)	√	M'fr/ Supplier or Sub-Contract or	EPC Contract or	KRED L or Owner	
46 2	i	Degreasing	Acid base cold degreaser	Major	Chemical	One sample daily	Sp. Gravity 1.1 to 1.2, ph Value 2 to 3	Vendor Records	√	x	x	x	Record review
46 3	ii	Pickling - Acid & Iron content	Lab test	Major	Chemical	One sample daily	Acid Content-Concentration 18% to 4% min, Sp. Gravity 1 to 1.3 Iron Content -120g/litre (max)	Vendor Records	√	x	x	x	Record review
46 4	iii	Rinsing	pH meter	Major	Chemical	One sample daily	Rinsing water ph value 5 to 7	Vendor Records	√	x	x	x	Record review

46 5	iv	Pre-fluxing in ZnCl solution - Specific gravity, pH	pH meter	Major	Measurement	One sample daily	Sp Gr - 1.10 to 1.26 pH - 3 to 5	Vendor Records	√	x	x	x	Record review
46 6	v	Pre-heating	Pyrometer	Major	Measurement	One sample daily	Above 50° C	Vendor Records	√	x	x	x	Record review
46 7	vi	Dipping - Zinc bath temperature, Immersion&withdrawal time	Continuous recording & verification by Pyrometer	Major	Measurement	Hourly check	Zn bath temp - 440° C to 460° C Article to be immersed till reaction	Vendor Records	√	x	x	x	Record review
46 8	vii	Quenching	Plain water	Minor			Bath in plain water for cooling & Cleaning. Temp. Below 65°	Vendor Records	√	x	x	x	Record review
46 9	viii	Di-chromating	Di-chromate solution	Major	Chemical	One sample daily	strength of the solution to be maintained as 0.7 to 1% of sodium dichromate, temperature of solution should be less than 65°	Vendor Records	√	x	x	x	Record review
47 0		Post Galvanizing											

47 1	i	Surface Defects/Finish - Dross, Pimples, Black marks, Ash deposition	As agreed/ Required	Major	Visual	100%	IS 2633	Vendor Records	√	x	x	x	Record review Random samples to be inspected during factory visit by Owner/PMC
47 2	ii	Thickness of Zinc Coating	Alcometer	Critical	Measurement	3 samples per dip	As Per IS 4759 , 6745 , Minimum 80micron or as per spec.	Vendor Records	√	x	x	x	Record review Random samples to be measured during factory visit by Owner/PMC
47 3	iii	Mass of Zinc Coating		Critical	Chemical	1 sample per shift	As Per IS 6745	Vendor Records	√	x	x	x	Record review
47 4	iv	Uniformity of Zinc Coating (Preece Test)		Major	Chemical	1 sample per shift	No red stains after 4 dippings	Vendor Records	√	x	x	x	Record review/ Sample test if deemed necessary
47 5	v	Adhesion of Zinc Coating (Pivot Hammer Test/ Knife Test)		Major	Physical	1 sample per hour	No Removal or lifting in areas between hammer impression/coating should not peel off. As per IS 2629	Vendor Records	√	x	x	x	Record review Random samples to be inspected during factory visit by Owner/PMC. Sample test if deemed necessary

47 6		Proto Assembly											
47 7	i	Proto Assembly check - Fitment, Dimensions, Alignment, Overall Stability	Prototype of one mounting table with	Critical	Physical/ Measurement	100%	Cut lengths of all members, Fitment (dia. of holes, end security, c/c distance between holes etc. shall be checked for correctness wrt permissible tolerance through in position inspection of assembled proto), Fasteners (bolts, nuts and washers), Cleats, Gussete plates shall be as per Approved drawing/ specifications. The proto assembly shall be checked for overall stability for design verification of various connections and col. support system.	IR	√	x	x	x	The general quality of fabrication and galvanization of members, straightness of members, overall stability of prototype etc. shall be checked for design verification. Any suggestions for design changes etc. shall be properly recorded in the inspection report for implementation in mass production of MMS members
47 8		Marking/ Packaging											

47 9	i	Marking	As agreed/ Required	Major	Visual	100%	Approved drawing/ marking scheme	IR	✓	x	x	x	Record review Random sample shall be checked during factory visit by Vendor and KREDL/ Owner representative
---------	---	---------	------------------------	-------	--------	------	-------------------------------------	----	---	---	---	---	--

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

480	ii	Packaging, Storing, Bundling, Handling	As agreed/ Required	Major	Visual	100%	As per IS-802. Packing of Column. Bracing, Rafters and Purlins shall be done by strapping. Packing of smaller items by wires or in gunny bags/ or as per approved procedure	IR	√	x	x	x	Separate packaging for different type of members like Col, Purlin, Rafter, Front/ rear/ diagonal bracings, fasteners, cleats etc. Small members shall be bundled with wire. Damage to galvanization and form (shape) of the member during handling and trasporting shall be controlled
481		Site Installation								x	x	x	
482	i	Receipt of materials and Checking as per packing list	As agreed/ Required	Critical	Visual	Random	Tech. Specification, Approved Drawing & Method Statement.		√	x	x	x	
483	ii	Fabricated members - Dimensional Check	As agreed/ Required	Major	Visual	100%				x	x	x	

484	iii	Visual checks for defects/damages, rusting, pitting, galvanising etc.	As agreed/ Required	Major	Visual	Random				x	x	x	
485	iv	Nut/Bolt/Washers	As agreed/ Required	Major	Measuremen t	100%			x	x	x		
486	v	Mounting of structures & Accessories - Coordinates, Levels, Fitment, Alignment etc.	As agreed/ Required	Critical	Visual /Measuremente nt	100%		✓	x	x	x		
487 8	vi	Torque Checking - Daily calibration check, Bolt installation	As agreed/ Required	Major	Measuremen t	100%			x	x	x		
489	35	Module Mounting - Pre Installation Check			Visual	100%							
490	i	Check for site physical layout as per drawing / Design Specification		Major	Physical	100%			x	x	x		
491 492	ii	Check for Structure, Mounting readiness		Major	Physical				x	x	x		

493	36	String Combiner Boxes (SCB) - Mounting - Pre Installation Check											
449 5	i	Check for foundation readiness - location & coordinates, dimensions & levels, foundation bolts etc.		Major	Physical	100%			x	x	x		
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	
501	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		

LEGEND: D \* Records, identified with "Tick" (✓) shall be essentially included by supplier in QA documentation.

Legend to be used:

Class # : A = Critical, B=Major, C=Minor

Format of Record # : SR=Site Register, TR=Lab Test Report, IR=Inspection Report, MTC=Manufacturer's Test Certificate

All MTC's shall be correlated with batch of material supply, Tech specs and drawings

Category 'A' - Sub-contractor/ sub-vendor, EPC Vendor, KREDL/ Owner

Category 'B' - Sub-Contractor/ Sub-Vendor, EPC Vendor, KREDL

Category 'C' - Sub-Contractor/ Sub-Vendor

This document shall be read in conjunction with Tech. Specifications and Drawings

Reviewed By	Approved By	Approval Seal

# Annexure C

## PG Test Procedure

## 1. INTRODUCTION

This document lays down the procedures and requirements for conducting Functional Guarantee tests including scope of the tests, procedures for the tests, reporting formats and process for determining test results in accordance with the Tender Specifications, applicable standards and industry best practices.

## 2. FUNCTIONAL GUARANTEE TESTS FOR SOLAR PV PLANT

Functional Guarantee for Solar PV Plant shall comprise of following Guarantees:

1. Performance Ratio Guarantee test for operational acceptance.
2. BESS Performance Assessment as per Annexure G.

### 2.1. PERFORMANCE RATIO GUARANTEE TEST

A Performance Ratio Guarantee test shall be commenced within 60 days of the commissioning of Plant Facilities to demonstrate that the plant has achieved the Guaranteed Performance Ratio in line with requirements under Section II: Technical Specification (Volume II) of the bidding document. This will be one of the pre-conditions for the Plant Operational Acceptance. Performance Ratio (PR) test period would be continuous measurement of 15 consecutive days. The test shall be conducted in accordance with the IEC-61724 as per the methodology described in Technical Specifications under section II (Volume II) of the bidding document. The procedure of PR test is described further in Section 2.3.4. The report shall contain all the measured energy and Met data values, calculations, results and conclusions.

#### 2.1.1. Performance Ratio

The Performance Ratio (PR) of the PV Plant is calculated as follows (according to IEC 61724 Ed.2)

$$PR = \frac{E_{out}}{\sum_k \left( \frac{(C_k * P_o) * (G_i,k * \tau_k)}{G_{i,ref}} \right)}$$

Where

PR: Temperature Corrected Performance Ratio

$E_{out}$ : Cumulative AC energy measured at the Plant End (ABT meter) over the duration of reporting period (kWh)

$\tau_k$  Duration of the kth recording interval, i.e. (1/60) hour

$\sum_k$  Summation over all recording intervals in the reporting period, (1/4) hour

$C_k$ : Power rating temperature adjustment factor and can be calculated as below

$$C_k = 1 + \gamma \times (T_{avg\_mod,k} - T_{ref})$$

$\gamma$ : Temperature coefficient of power with negative sign ( $^{\circ}\text{C}-1$ )

$T_{avg\_mod,k}$  Average PV Module temperature measured at the commencement of time interval " ( $^{\circ}\text{C}$ )

$T_{ref}$ : PV Module temperature at which  $P_o$  is determined, i.e. 25°C

$P_o$ : Installed nominal peak power of PV modules, i.e. Nameplate rating at STC (kWp)

$G_{i,k}$ : Average irradiance measured at the Plane of Array (POA) at the commencement of time interval  $\tau_k$  ( $\text{kW/m}^2$ ) ( average of all Pyranometers in various sites)

$G_{i,ref}$ : Irradiance value at which  $P_o$  is determined, i.e. 1  $\text{kW/m}^2$

#### 2.1.2. General Requirement

- The Functional Guarantee shall comprise of a set of visual/mechanical/Electrical checks followed by a Performance Ratio (PR) test of the Plant Facilities.
- The PR test shall be carried out for a period of 15 consecutive days at site by the Contractor in presence of the Employer/ Employer's Representative/ Owner's Engineer.
- These tests shall be binding on both the parties to the contract to determine compliance of the equipment with the guaranteed performance parameters.
- The test will consist of guaranteeing the correct operation of the Plant Facilities, by way of the performance ratio based on the reading of the energy produced and delivered to the grid (ABT meter) and the Plane of Array incident solar radiation.
- PR is calculated as per the formula given in Clause no. 2.1 and recorded as per the format provided at Annexure 1.
- The filled-in format shall be signed by both the parties (EPC Contractor and KREDL) and each party will keep one copy for record. The same will be recorded for 15 consecutive days.
- The Functional Guarantee condition for the purpose of Provisional Acceptance of the Plant Facilities shall be considered to have been met if the guaranteed Performance Ratio (PR) is achieved on a daily basis for 15 consecutive days\* as per Clause 2.3.4 of this document.
- During this PR test, equipment failure/interruption of any kind, except for SCADA communication failures, will not be accountable. In case of a breakdown, the test may be resumed once the complete system is rectified and working properly.
- Interruptions due to communication breakdown only may be exempted based on specific approval to the effect that generation is not affected and equipment failure (Refer Clause 2.3.4) is not attributable. In such case, the test shall be extended for affected no. of days (up to 5 days)

## **2.2. PRE-PR TEST**

**2.2.1.** The EPC Contractor shall perform start-up tests after completion of Commissioning and Test Procedure as per Annexure F: Plant Documentation, Commissioning and Test Procedure and recording of punch points.

**2.2.2.** Functional Guarantee Test shall commence immediately after all issues arising from the functional/startup test have been rectified.

Note:

- a) All measurement(s) procedure should be carried out taking proper safety precaution.
- b) Also, it should be ensured that to avoid any loose connection at the terminal points for which measurement procedure is conducted.
- c) Ensure proper functioning (e.g. Multimeters shall be calibrated) of all measuring instruments before conducting above measurement procedure.
- d) The above test procedure shall be conducted in presence of site in-charge.

## **2.3. PR TEST PROCEDURE**

The date of commencement of the PR Test shall be communicated in advance and agreed upon by both parties i.e. KREDL and EPC Contractor. Any consecutive 15 days period (excluding interruptions that last entire day on account of grid outage or as per hindrance record maintained at site only) for the purpose of conducting PR test shall be mutually discussed and agreed between KREDL and EPC Contractor. It shall comprise of the following procedures.

### **2.3.1. Pre-test Procedure**

1. Before the commencement of Performance Ratio (PR) test, the plant shall have achieved visual/mechanical/Electrical completion as per Clause 2.2 above and SCADA system and WMS shall be fully commissioned and functional.
2. Trial Run: The PG Test for Plant Facilities shall commence with a trial run for 7 consecutive days. The EPC Contractor shall provide the data in requisite formats (specified elsewhere in the document) to KREDL. KREDL shall vet the data for any discrepancies and systemic errors and revert within 3 working days. Post the trial run period, the 15 days PR test will commence after communication from KREDL in this regard.

3. Pyranometer Tilt Angle & Cleanliness: The pyranometers & Tilt Angle shall be verified before the test commences and then visually inspected at regular intervals for cleanliness during the tests.
4. The average POA radiation of all the Pyranometers ( $G_{i,k}$ ) shall be considered for the calculation of PR. The average of module temperatures recorded by all the temperature sensors shall be used for calculation of PR. The Pyranometers and Temperature sensors used for the purpose of the PR Test shall have valid calibration certificates.

2.3.2. Following the completion of the pre-test procedures, Performance Ratio Test of plant shall commence in accordance with the procedures, conditions and requirements provided in the next section.

#### 2.3.3. General Procedure for the PR Test

The PR Test Procedure shall include the following components:

1. **Data Collection:** PV Power Plant test related parameters are collected in one-minute and 15 intervals for the 15 (Fifteen) days (consecutive) reference period. The data shall consist of the following at a minimum:
  - Irradiance at Collector's (i.e. PV Module) POA; (Source: SCADA, Temporal Resolution: 1 minute) Average values from all the sites will be considered
  - Other Met Data received from installed WMS; (Source: SCADA, Temporal Resolution: 1 minute)
  - Energy generated at Plant (kWh) (Source: Plant TVM Meter from SCADA, Temporal Resolution: 1 minute)
  - Energy injected into grid (kWh) (Source: Plant End ABT Meter, Temporal Resolution: 15 minute)
  - PV Module Temperature recorded from the temperature Sensors ( $^{\circ}\text{C}$ ) (Source: SCADA, Temporal Resolution: 1 minute)
2. **Data Filtering:** The data shall be filtered so that the data set is free of nuisance data points and bad data that exhibit a high degree of error (such as errors caused by faulty instrumentation). The EPC Contractor shall document data which is to be eliminated along with reasons. The following criteria shall be excluded from the dataset used for this test:
  - **Nuisance or bad data** – Nuisance data points or bad data that clearly exhibit a high degree of error including required meteorological measurement equipment that is identified as being out of calibration or requiring adjustment. A 15-minute time-block shall be explicitly flagged through a flag parameter on account of this factor after recording reasons thereof (**Note:** no filtration shall be done at site level). The same shall be corroborated/verified by KREDL.
  - Time blocks with insufficient (less than equal to 10) 1-minute records.
  - **Grid Interruptions** – Time periods (in 15-minute time blocks) of the grid interruptions at the utility substation, recorded manually jointly by EPC Contractor and KREDL representatives shall be eliminated. Grid outage period, if any, shall be verified from SCADA.
  - Any Force majeure conditions
  - **Radiation Criteria** – Radiation on Plane of Array (POA) less than 200 W/m<sup>2</sup>
  - Shutdown explicitly demanded by the Owner/DISCOM/STU/CTU.
  - As per the hindrance record maintained at site.

Note: Minimum 24 Nos of 15-minute time blocks shall be considered to account the day for PR measurement. Otherwise the PR test shall be extended to another day.

#### 2.3.4. Determination of PR Test

Daily PR shall be calculated as the average of the PR calculated for valid 15-minute time blocks (Refer Clause 2.3.3) for the 15-day duration. If the ABT Meter data is not available on daily basis, PR shall be calculated based on the MFM data and shared for record. However, at the end of the PR test period, the daily PR shall be re-calculated with the ABT Meter data for sign-off.

If the EPC Contractor is not able to demonstrate guaranteed PR during this period, two more chances shall be given to demonstrate the same after incorporation of suitable corrective measures. In case the contractor fails to achieve guaranteed PR even after the two more chances, further action shall be taken as per the provisions of contract.

The test shall be repeated for 15 days in case of any outage of following equipment (as applicable) for more than 7 days.

- Power Transformer/Inverter Duty Transformer
- Power Conditioning Unit
- HT Switchgear Panel
- SCADA and data logger combined
- Tilted pyranometer
- Other WMS sensors.

### 2.3.5. Raw Data Formats and Reports

The EPC Contractor shall submit to KREDL the raw data from the Plant SCADA on daily basis in the following format.

#### Temporal Resolution: 1 Minute

Date & Time dd/mm/yyyy:hh:mm:ss format	Wind speed (m/s)	Module Temp (°C)	Ambient Temp (°C)	Horizontal Irradiance (W/m <sup>2</sup> )	POA Irradiance (W/m <sup>2</sup> )	POA Radiation (KW/hm <sup>2</sup> )	Humidity (%)	Wind Direction (°)	Generation (KWh) Source (TVM)

#### Temporal Resolution: 15 Minute (Every 15th Min record from the 1 Min Data)

Date & Time dd/mm/yyyy:hh:mm:ss format	Wind speed (m/s)	Module Temp (°C)	Ambient Temp (°C)	Horizontal Irradiance (W/m <sup>2</sup> )	POA Irradiance (W/m <sup>2</sup> )	POA Radiation (KW/hm <sup>2</sup> )	Humidity (%)	Wind Direction (°)	Generation (KWh) Source (TVM)	Explicit Removal Flag*	Remarks

\* Explicit Removal Flag: 0 indicates time block considered; 1 indicates time block not considered.

PR Test Report shall be generated from the Raw Data (Sample Report provided in the Annexure) after data filtering as per criteria laid out in (2). The Report shall contain the signature of both representatives (KREDL/Employer & EPC Contractor).

**Note:** In case of multiple pyranometers/temperature sensors, the radiation and temperature data for the purpose of calculation of PR shall be derived from the average values from tilted pyranometer /temperature sensors.

### 2.4. CAPACITY UTILIZATION FACTOR (CUF)

Capacity Utilization Factor for Solar Plant shall be calculated as per the following formula.

$$\text{CUF} = \frac{\text{Eac}}{8760 \times \text{Pac} \times (1 - \text{DF} \times (N-1)) \times \text{RCF}}$$

where,

- Eac is the number of units recorded at the meter installed at 220 kV side of 400/220 kV PGCIL substation after factoring the energy loss or Round-trip-Efficiency of BESS, transmission loss till 220 kV side of 220/400 kV PGCIL sub-station and excluding auxiliary consumption, kWh

- 8760 refers to the number of hours in non-leap year. It shall be replaced by 8784 hours during leap year
- $P_{AC}$  is the plant AC capacity, kW
- DF is module degradation factor, 0.55% per year
- N is the number of years of operation after operational acceptance of the plant
- RCF is the Radiation Correction Factor:  $RCF = \frac{Measured\ Irradiation}{Reference\ Irradiation}$

where Reference Irradiation = 1948kWh/m<sup>2</sup> and Measured Irradiation (GHI<sub>mes</sub>) shall be recorded from the Pyranometer installed in horizontal plane at the site location. The radiation data of the Pyranometer shall be compared with the Reference Irradiation mentioned above. The radiation data from the Plant Pyranometer shall be used for computation of CUF, except in case of any discrepancy (i.e. more than  $\pm 10\%$  variation from the Reference Radiation, GHI<sub>ref</sub>), in which case the radiation data from the nearest available Solar Radiation Resource Assessment (SRRA) station data will be used for computation of CUF. Missing data (GHI<sub>mes</sub>) from the Plant Pyranometer shall be substituted by average of GHI measured for the same period in the past three (3) days. The plant Pyranometer has to be under CCTV coverage.

CUF shall be calculated on annual basis from the date of operational acceptance of the plant till the end of O&M period. Module degradation factor will not be considered for first year CUF calculation. It is the Contractor's responsibility to envisage and install extra DC capacity to accommodate any degradation during first year. Module degradation factor, as per above will be considered from second year of operation.

Grid outage hours shall be subtracted from total number of hours in a year. The Contractor shall submit grid outage certification from competent authority of PGCIL/KSPDCL/KREDL.

#### **Liquidated Damages for Shortfall in PR**

For every 0.01 shortfall in PR below the committed PR value, a penalty of 1% of the total Contract Value (i.e., total sum of all the Supply, Service and absolute value of O & M Contract) shall be levied. In case the Contract Performance Security has already been encashed on account of any default/delays, the penalty amount will be recovered from any due payments to the contractor. The plant shall only be accepted by KREDL on demonstration of committed PR value by the contractor post rectifying the PR shortfalls noted during the PR test.

# Annexure D

## Mandatory Spares

### Mandatory Spares

S. No.	Equipment/Material	Quantity (for each type and rating)
1.	PV Module	0.5% of total supply
2.	MC 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	As per OEM recommendations
	ii. String Inverter	1% of total supply
5.	Inverter Transformer	
	i. HV busing with metal parts and gaskets	2 sets
	ii. LV busing with metal parts and gaskets	2 sets
	iii. WTI with contacts	2 sets
	iv. OTI with contacts	2 sets
	v. Buchholz relay	2 sets
	vi. Magnetic Oil Gauge	2 sets
	vii. Complete set of gaskets	2 sets
6.	HT Switchgear	
	i. Vacuum pole	2 sets
	ii. Closing coil	2 sets
	iii. Tripping coil	2 sets
	iv. Spring charging motor	2 sets
	v. Relay	2 sets
	vi. Meter	2 sets
	vii. Current Transformer	2 sets
	viii. MCCB	2 sets
	ix. MCB	2 sets
	x. Fuse	10% of total supply

S. No.	Equipment/Material	Quantity (for each type and rating)
	xi. Indicating lamp	10% of total supply
	xii. Rotary switch	10% of total supply
7.	LT Switchgear	
	i. MCCB	2 sets
	ii. MCB	2 sets
	iii. Fuse	10% of total supply
	iv. Relay	2 sets
	v. Meter	2 sets
	vi. Current Transformer	2 sets
	vii. Voltage Transformer	2 sets
	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
13.	Battery	2% of total supply along with all Cell/ Battery Auxiliary Systems, interconnectors, monitoring devices

Spares, if used, during the O&M period shall be replenished by the Contractor. All the mandatory spares shall be handed over to the Employer in working condition at the end of O&M period. The Contractor Shall Supply Additional One year spares to KREDL for 13<sup>th</sup> year Operations and Maintenance at no cost.



# Annexure E

## Site Coordinates

<b>Particulars</b>	<b>Details</b>
Solar Park	Pavagada Solar Park
Village	Balasamudra village
Taluka	Pavagada Taluk
Land Parcel No.	Survey No:83
Extent of Land	17Acres 38 Gunta acres out of which about 11 acres would be used for developing 2 MW (AC) Solar PV Power Plant (2.2MWp DC) with 4.5 MWh Battery Energy Storage System. However based on the justification by the contractor additional land may be provided.
Co-ordinates of Pavagada Solar Park at Balasamudra	Latitude: 76°11'92.25"N Longitude: 15°78'36.87"E
Sub station	S/S-4 substation
Approx Distance between substation and land parcel	1.5 Km

# Annexure F

Procedure for Plant Testing, Commissioning and Documentation

## 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, IEC 62446 standard (Part 1: Grid connected systems – Documentation, commissioning tests and inspection)- and industry best practices.

## 2. CODES AND STANDARDS

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

- I. IEC 62446 standard (Part 1: Grid connected systems – Documentation, commissioning tests and inspection).
- II. IEC 60364-6:2016 - Low voltage electrical installations - Part 6: Verification.
- III. IEC 61829:2015: Photovoltaic (PV) array - On-site measurement of current-voltage characteristics.
- IV. IEC 60904-4:2019 Photovoltaic devices - Part 4: Reference solar devices - Procedures for establishing calibration traceability
- V. IEC TS 60904-1-2:2019 - Photovoltaic devices - Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices
- VI. IEC 62305-3– Protection against lightning - Part 3: Physical damage to structures and life hazard
- VII. 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. COMMISIONING

### 3.1. GENERAL

#### 3.1.1. Objective

The Commissioning Procedure defined in this document aims to:

- Verify that the power plant is structurally and electrically safe
- Verify that the power plant is structurally and electrically robust to operate for the specified lifetime of a project
- Verify that the power plant operates as designed and its performance is as expected

#### 3.1.2. General Requirements before Starting the Commissioning Process

- The modules shall be stabilized (sufficiently exposed after 200 kWh/m<sup>2</sup> reaching the PV plane)
- The tests shall be conducted under stable weather conditions
- The process shall be witnessed by the Owner or their duly appointed representative.
- Soiling losses shall not be accounted for in the assessment of Results. Therefore, adequate Module cleaning exercise shall be undertaken prior to commencement of Commissioning process.
- The following equipment shall be used during the commissioning process (Refer Section VII B: Technical Specifications for testing instruments):
  - Earth resistance tester
  - IV curve tracer
  - Insulation tester
  - Digital multimeter
  - Clamp meter
  - Infrared camera
  - Digital lux meter
  - Electroluminescence camera, power supply and accessories
- All testing equipment shall possess valid calibration certificate issued from approved laboratories.

## 4. Cold Commissioning

### 4.1. DC COMMISSIONING

#### 4.1.1. Visual Inspection

- The visual inspection shall be conducted on 5% of the system split in subareas equally distributed in the field. Unless otherwise specified, Approved Cat I Drawings shall be referred for correctness/verification. At least following aspects shall be verified visually on the DC side:
- Sizing of the DC fuses for running conditions, for the maximum voltage and the maximum current.
- Sizing of the string cables including overcurrent protection considering the current carrying capacity under operating conditions
- Cables protected against mechanical damage
- Functionality of the main DC switch
- Fixation of the modules to the mounting structure
- Termination of the cables to the inverter
- Where the PV system includes functional earthing of one of the DC conductors, the functional earth connection shall be specified and installed to the requirements of IEC 62548.
- Laying and installation of cables
- Fixation of the grounding electrodes
- Grounding of all conductive parts and connected to the equipotential bonding system of the PV plant
- The torque values in the mounting structure, combiner boxes, bars and joints shall match the manufacturer specifications
- Where protective earthing and/or equipotential bonding conductors are installed, they shall be parallel to and bundled with the DC cables
- Electrical circuits and devices shall be labelled.
- The PV modules shall be in a good condition (no visible serial defects such as yellowing, delamination, scratches, etc.).
- Functioning of fire protection equipment.

#### Acceptance criteria

Each deviation from industrial best practices, norms, standards and good workmanship shall be documented in a punch list. All items shall be categorized as "critical", "important" or "minor".

#### 4.1.2. Pre-Energizing Tests

4.1.2.1. Measuring instruments and monitoring equipment and methods shall be chosen in accordance with the relevant parts of IEC 61557 and IEC 61010. The following tests shall be carried out on the DC circuit forming the PV array in accordance with a Sampling Plan:

- Electrical Continuity test: This test shall be performed on the earthing and/or equipotential bonding conductors, in the PV array field. Connection of such conductors to earthing pit shall also be verified.
- Polarity test: Polarity of DC cables shall be verified. After verifying the correctness of polarity, marking on cable shall be checked for correctness  
Note: Polarity test shall be performed before closing the switches or string overcurrent protective devices are inserted
- Combiner box test: The purpose of this test is to ensure all strings are connected correctly to the combiner box. The test procedure is as follows and shall be performed before any string fuses / connectors are inserted for the first time:
  - I. Select a volt meter with voltage range at least twice the maximum system voltage.
  - II. Insert all negative fuses / connectors so strings share a common negative bus.
  - III. Do not insert any positive fuses / connectors.
  - IV. Measure the open circuit voltage of the first string, positive to negative, and ensure it is an expected value.
  - V. Leave one lead on the positive pole of the first string tested, and put the other lead on the positive pole of the next string. Because the two strings share a common negative reference, the voltage measured should be near-zero, with an acceptable tolerance range of  $\pm 15$  V.
  - VI. Continue measurements on subsequent strings, using the first positive circuit as the meter common connection.
  - VII. A reverse polarity condition will be very evident if it exists – the measured voltage will be twice the system voltage.
- String open circuit voltage test,  $V_{oc}$  (under stable weather conditions): The purpose of this test is to check the modules connection in string as per the design. The  $V_{oc}$  of PV string should be measured using suitable measuring device before closing any switch or string overcurrent protective devices, where fitted.

The measured string  $V_{oc}$  will be assessed to ensure it matches the expected value (typically within 5 %) in one of the following ways:

- a. Compare with the expected value derived from the module datasheet or from a detailed PV model that takes into account the type and number of modules and the module cell temperature.
- b. Measure  $V_{oc}$  on a single module, then use this value to calculate the expected value for the string.
- c. For systems with multiple identical strings, voltages between strings can be compared.
- String circuit current test,  $I_{sc}$  (under stable weather conditions): The purpose of this test to check the correctness of system, operational characteristic and PV array wiring. These tests are not to be taken as a measure of module / array performance. The test procedure will be as follows:
  - i. Ensure that all switching devices and disconnecting means are open and that all PV strings are isolated from each other.
  - ii. Create a temporary short circuit into string under test by using any of the following method:
    - a. use of a test instrument with a short circuit current measurement function (e.g. a specialized PV tester);
    - b. a short circuit cable temporarily connected into a load break switching device already present in the string circuit;
    - c. use of a “short circuit switch test box” – a load break rated device that can be temporarily introduced into the circuit to create a switched short circuit.
  - iii. Measure the short circuit current ( $I_{sc}$ ) using a suitably rated measuring instrument.
  - iv. After taking the reading, interrupt the short circuit using a suitable load break switching device and check the zero value of current before changing any other connections.
  - v. Compare the measure value of  $I_{sc}$  with the expected value. For systems with multiple identical strings, measurements of currents in individual strings shall be compared. These values should be the same (typically within 5 % of the average string current). Note: An I-V curve test can be performed as an alternative to this test (see 4.3).
- Functional tests: The following functional tests shall be performed:
  - i. Switchgear and other control apparatus shall be tested to ensure correct operation and that they are properly mounted and connected.
  - ii. All inverters forming part of the PV system shall be tested to ensure correct operation. The test procedure should be as defined by the inverter manufacturer.

Functional tests that require the AC supply to be present (e.g. inverter tests) shall only be performed once the AC side of the system has been tested.

- Insulation resistance of the DC circuits: Test procedure to conduct this test will be as follows:
  - i. Before commencing the test adopt the following safety measure to avoid any potential shock hazard
    - a) Isolate the testing area.
    - b) Do not touch any metallic surface, module back sheet or the module terminals when performing the insulation test.
    - c) Appropriate personal protective clothing / equipment should be worn for the duration of the test.
  - ii. Isolate the PV array from the inverter (typically at the array switch disconnector)
  - iv. Disconnect any piece of equipment that could have impact on the insulation measurement (i.e. overvoltage protection) in the junction or combiner boxes.
  - v. The insulation resistance test device shall be connected between earth and the array cable(s) or combiner bus bar. Connections can be made between earth and array negative followed by a test between earth and array positive or between earth and short circuited array positive and negative.
  - vi. Follow the IR test device instructions to ensure the test voltage and readings in megaohms. When the system voltage ( $V_{oc}$  at STC X 1.25) is higher than 500V, the test voltage shall be 1,000V and the minimum insulation resistance 1 MΩ.
  - vii. Ensure the system is de-energized before removing test cables or touching any conductive parts.

#### 4.1.2.2. Sampling Plan:

At least 2 strings from 2 SMUs shall be randomly chosen by the Owner connected to each Inverter.

#### Acceptance criteria

The DC commissioning will be passed when the aforementioned verifications are successfully passed in 100% of the sample according to the IEC 62446: 2016 – 5 and IEC 62446:2016 – 6.

## 4.2. AC COMMISSIONING

### 4.2.1. Visual Inspection

The visual inspection shall be conducted on 5% of the system. In general, the requirements specified in the IEC 60364-6 -6.4.2 apply. At least following aspects shall be verified visually on the AC side:

#### 4.2.1.1. General requirements

- Protective requirements against electric shock
- Protection against fire and heat
- Choice, setting, selectivity and coordination of protective and monitoring devices
- Sizing of cables regarding voltage drop and ampacity as per approved Drawings.
- Sizing of protective and monitoring devices as per approved Drawings
- The circuit breakers are correctly located
- Selection, location and installation of suitable isolating, overvoltage protective devices and switching
- The equipment and protective measures are appropriate for the external influences and mechanical stresses
- The diagrams, warning notices or similar information attached to the wall inside the inverter housing or the control room
- Proper fixation of the cables to the collector bars in the AC combiner box
- Proper labelling of all electrical circuits and devices including the neutral conductor and protective conductor as well as correct connection of single pole devices to the phase conductors
- Adequacy of termination and connection of cables and conductors
- The warning labels and technical documentation physically displayed
- Selection and installation of earthing arrangements, protective conductors and their connections
- The existence and correct use of protective conductors and protective equipotential bonding conductors (PEB)
- Measures against electromagnetic disturbances implemented
- Easy access to the operational devices for maintenance
- Any exposed conductive parts connected to the earthing system
- The RCD type has been selected according to the requirements of the IEC 62548
- The isolation means of the inverter on the AC side are functional and correctly sized
- The fire protection requirements according to the approved design shall be given

#### 4.2.1.2 Requirements for the inverter

- Installation as per manufacturer's instructions and compliance with IEC 62548
- Inverters properly fastened to the ground
- Inverter properly earthed
- Inverter incoming/outgoing cables properly isolated, labelled and connected
- The connections for phase sequence L1, L2, L3 and N in the correct order
- All cable terminations properly done
- Nameplate data. The minimum requirements for the production of a name plate are-
  - name and origin of the manufacturer; – o model or type name;
  - serial number;
  - electrical parameters: Vdcmax, Vmppmin, Vmppmax, Idcmax, Pac,r, Vac,r, f r , lacmax;
  - degree of protection;
  - overvoltage category;
  - safety class.
- The displays - check / readout show plausible results

- The filters are clean and properly maintained
- The cooling outputs of the inverters are free from obstruction
- The DC circuit breaker is functional
- The DC insulation monitoring correctly installed
- The fuses at the DC entrance correctly sized
- The location of the inverter(s) in the field matches the approved design
- Protection against self-loosening of clamps and screws
- The string inverter anchored to the mounting structure
- The mechanical assembly is robust
- The inverters are fixed to non-flammable mechanical elements

#### Acceptance criteria

Each deviation from industrial best practices, norms, standards and good workmanship shall be documented in a punch list. The punch list shall represent a maximum budget of 1% of the construction price and all items shall be categorized as “critical”, “important” or “minor”.

#### 4.2.2. Pre-Energizing Tests

Measuring instruments and monitoring equipment and methods shall be chosen in accordance with the relevant parts of IEC 61557 and IEC 61010. The following tests shall be carried out on the AC circuit forming the PV array:

- Continuity of conductors. The requirements in IEC 60364-6:2016 – 6.4.3.2 apply
- Insulation resistance of the electrical installation. The requirements in IEC 60364-6:2016 – 6.4.3.3 apply
- Insulation resistance testing to confirm the effectiveness of protection by SELV, PELV or electrical separation. The requirements in IEC 60364-6:2016 – 6.4.3.4 apply
- Insulation resistance/impedance of floors and walls. The requirements in IEC 60364- 6:2016 - 6.4.3.5 apply
- Polarity test. The requirements in IEC 60364-6:2016 - 6.4.3.6 apply
- Testing to confirm effectiveness of automatic disconnection of supply. The requirements of the IEC 60364-6:2016 – 6.4.3.7 apply
- Testing to confirm the effectiveness of additional protection. The requirements of the IEC 60364-6:2016 – 6.4.3.8 apply.
- Test of phase sequence. The requirements of the IEC 60364-6:2016 – 6.4.3.9 apply
- Functional tests. The requirements of the IEC 60364-6:2016 – 6.4.3.10 apply
- Voltage drop. The requirements of the IEC 60364-6:2016 – 6.4.3.11 apply

#### Acceptance criteria

The AC commissioning will be passed when the aforementioned verifications are successfully passed in 100% of the sample according to the IEC 62446: 2016 – 5 and IEC 60364 – 6.

#### 4.2.3. Additional Pre-Energizing Tests

All of the below tests shall be conducted in accordance with the supplier’s installation/commissioning manuals.

##### 4.2.3.1. Distribution boards and combiner boxes

Site testing on distribution boards shall include:

- Mechanical functional test of all components including mechanical interlocks
- Electrical functional test of all control and protection wiring against the approved switchgear schematics
- Power frequency overvoltage test (flash test) on the switchgear including circuit-breakers in the test circuit
- Low resistance ductor test on the switchgear including circuit-breakers in the test circuit
- Visual inspection
- Verification of earthing

##### 4.2.3.2. Inverters

Site testing on inverters shall include:

- Full test procedure as defined by the inverter manufacturer
- A full mechanical functional test of all components including mechanical interlocks

- Verification that the inverter operational parameters have been programmed to local regulations
- Electrical functional test of all control and protection wiring against the approved switchgear schematics as per approved MOP/FOP
- Insulation resistance test and earth residual current monitoring test
- Anti-islanding functionality
- High Voltage overvoltage test
- SCADA and metering calibration & functionality test

#### 4.2.3.3. HT Switchgear

Site testing on outdoor circuit-breakers shall include:

- Functional check of all wiring, interlocks, auxiliaries and pressure devices
- Timing test and travel curve
- Visual inspection

#### 4.2.3.4. LV/MV transformers

Transformer commissioning shall include:

- Visual inspection, alignment, earthing and labeling
- Functional check of all wiring against the approved transformer schematics
- Testing and calibration of all transformer protection and monitoring devices
- Insulation resistance test
- Functional test of off-circuit/on Circuit tap changer and check of the continuity of all windings
- Substation/Power Transformers
- Ratio measurement on all tap changer settings
- Winding resistance measurement on highest, lowest and nominal tap settings
- Insulation resistance between all windings, and each winding to earth
- Insulation resistance core-to-earth
- Oil sample tests: breakdown strength, moisture content, and dissolved-gas content
- Transformer differential protection scheme testing

Acceptance criteria

The test results shall be aligned with the manufacturer specifications stated in the installation manual.

### 4.3. IV CURVE TESTING

The requirements of the IEC 62446-1:2016 – 7.2 apply. Following normative references shall be considered while performing the IV curve test:

- IEC 61829:2015 Photovoltaic (PV) array - On-site measurement of current-voltage characteristics
- IEC 60891:2009 Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics

2 % of the module strings shall be measured. If  $\Delta P_{stringN} > 5\%$ , all the modules within that string shall be I-V characterized. Modules with  $\Delta PN > 5\%$  shall be replaced. If more than 5% of the measured strings of the first sample show  $\Delta PN > 5\%$ , another 2% shall be inspected. If more than 5% of the measured strings in the second sample show  $\Delta PN > 5\%$ , another 5% shall be inspected. If more than 5% of the measured strings in the third sample show  $\Delta PN > 5\%$ , another 10% shall be inspected. If more than 5% of the measured strings in the fourth sample show  $\Delta PN > 5\%$ , another 10% shall be inspected. The reference power value is the flash list value minus the light induced degradation (LID) value in the datasheet/module warranty.

Acceptance criteria

The power determination analysis will be passed when less than 5% of the modules measured in the last sample show  $\Delta PN < 5\%$ .

## 5. Hot Commissioning

### 5.1. INFRARED INSPECTION

Following normative references apply:

- PV array infrared camera inspection procedure (IEC 62446-1:2016 - 7.3) and IEC 62446- 3 TS Ed.1.0 - Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 3: Outdoor infrared thermography of photovoltaic modules and plants (draft)

- The infrared inspection shall be applied both to the PV modules and the BOS components. The inspection sample will depend on the project size and shall be agreed with the OWNER. The following values serve as an orientation:
- Large scale ground mounted PV plants
  - PV modules: 100%
  - Inverters: 100%
  - Combiner boxes: 100%

#### Acceptance criteria

The following conditions shall be met simultaneously:

- 0.2% or less of the inspected modules show thermal gradients at the cell level of  $T > 10 \text{ K}$
- 0.2% or less of the inspected modules show thermal gradients at the junction box level of  $T > 10 \text{ K}$
- 0.2% or less of the inspected modules show inactive cell strings
- No PID is detected
- All module strings are connected and producing
- All inverters are connected and producing

### 5.2. INVERTER AVAILABILITY TEST

#### 5.2.1. Calculation of the Operation Time

It shall be calculated on inverter level. The operation time starts as soon as the inverter switches on. Therefore, only the logged irradiation values during the operation time of the inverter shall be considered. Irradiation values logged before or after the inverter running time shall be disregarded.

#### 5.2.2. Calculation of the Downtime

The downtime relevant for the availability calculation is any time in which a part or a subpart of the system is not operational. The outage periods shall be considered again on inverter level. Only complete outages shall be taken into consideration. System black-out periods due to following reasons shall not flow into the calculation (i.e. excluded events):

- A failure in the distribution grid or the transformer substation, making it impossible to transmit the generated power
- Solar radiation below the level needed to obtain the minimum operating voltage to start the inverter operation
- Causes of Force Majeure.
- Occurrences of anomalies in the power supply system (frequency differences or voltage surges) that trigger the protective systems of the plant or the limit settings of the inverter. Any forced disconnection shall be documented and recorded.

#### Acceptance criteria

The system availability shall be at least 99% during the testing period.

### 5.3. SINGLE AXIS TRACKER AVAILABILITY TEST (IF APPLICABLE)

The tracker availability test shall be carried out in parallel to the inverter availability test and shall have the same duration. During the test, all trackers shall follow the sun according to the angles established in the tracking mechanism. A loss of availability shall be considered when the angle of inclination of one or more trackers deviates by more than  $2^\circ$  from the theoretical angle. The angles of inclination of each tracker shall be recorded with a resolution of 1min via the SCADA system.

#### Acceptance criteria

The tilt angle of each tracker shall lie within a  $\pm 2^\circ$  range during 99.5% of the operational time.

### 5.4. SCADA AND WEATHER STATION RELIABILITY

#### 5.4.1. Visual Inspection

- Installation of the communication system architecture diagram according to the specifications
- Functional Tests conducted during FAT for Pre-Dispatch Inspection shall be repeated.

- SCADA shall be linked to all protection relays, disturbance recorders and other substation equipment using the communications protocol
- Visual check on the assembly of all joints and on the as-installed condition of all components, including:
  - The irradiation sensor is not shaded and is installed at the correct tilt angle and under CCTV coverage.
  - Ambient temperature and module temperature sensor are installed properly (Reference IEC 61724)
  - Mechanical anchorage of the sensors is robust
- Complete calibration certificates of all the instruments shall be provided

#### Acceptance criteria

Each deviation from industrial best practices, norms, standards and good workmanship shall be documented in a punch list. The punch list shall represent a maximum budget of 1% of the construction price and all items shall be categorized as “critical”, “important” or “minor”.

## 6. Battery Energy Storage System (excluding of all variants of lead acid batteries)

### 6.1. VISUAL INSPECTION

Before energizing the BESS, following visual checks shall be made to check the required design compliance:

- Installation of protective cover for live, hot and cold parts, and the adequate distance from the person;
- Installation of fence, wall, locking system of doors and access panels, and notice boards
- Installation of ventilation system;
- Installation of firefighting system;
- Installation of lightning protections devices.
- Wiring
- All wiring shall be continuous and without splices.
- Wiring that may be exposed to mechanical damage are placed in conduit or armored.
- Wires have permanent and durable identifying labels or markings on both ends.
- Control and instrumentation wiring shall be separated from power and high-voltage wiring by use of separate compartments or enclosures or by use of separate wireways and appropriate barrier strips.
- BESS and PCS control and instrumentation system wiring shall be bundled, laced, and otherwise laid in an orderly manner.
- Cable systems do not block access to equipment by personnel. There are no exposed current-carrying or voltage-bearing parts.

The responsibility of operation and maintenance of BESS including the solar system lies entirely with the successful bidder. Obtaining all safety approvals for installation and commissioning of battery system shall be the responsibility of the successful bidder. KREDL/Owner shall not be held responsible for any untoward accidents occurring due to battery explosion etc.,

### 6.2. CONTINUITY TEST

Continuity of power, control and auxiliary circuit in the system shall be verified through visual inspection, continuity tester and insulation resistance test.

Phase sequence and terminal marking shall also be verified with drawing and design documents.

### 6.3. EARTHING TEST

Following element to be check according to the design and applicable standards:

- Proper connection of the earthing busbar to the local earthing busbar;
- Individual earthing connection of main equipment to the earthing busbar;
- Connection of earthing cables to structures via proper connectors to prevent corrosion from dissimilar metals.

## 6.4. INSULATION TEST

For low-voltage EES systems, the insulation resistance test and withstand voltage test shall be performed according to IEC 60364-6.

For EES systems exceeding 1 kV AC or 1,5 kV DC, the withstand voltage test shall be performed according to IEC 61936-1.

## 6.5. FUNCTIONAL TEST

### 6.5.1. Start and stop test

Check start and stop operation of BESS system with the startup/shutdown command manually and automatically.

### 6.5.2. Alarms Functional Test

- Alarms initiation from the BESS in case of following conditions:
- Emergency trip switch.
- Loss of the low-voltage AC or utility grid voltage.
- An AC circuit breaker trip (either side of transformer).
- Door interlock: Initiate shutdown when the door is opened (with appropriate provision for maintenance work). Interlocks shall be self-resetting.
- Smoke/fire alarm.
- Control logic trouble.
- A DC ground fault (simulated).
- Remote disable (no reset required).
- grid system faults (balanced and unbalanced; line-to-ground, line-to-line, and three-phase).
- Abnormal voltage
- Islanding condition.
- Protection or control scheme failures, including the following:
  - Failure of local interconnection protection system
  - Failure of critical breaker trip coil or interrupting device
  - Loss of DC supply

### 6.5.3. Load tripping test

Check the interlock of BESS with the main

### 6.5.4. Operating cycle test

Check for any abnormalities such as rise in temperature, noise level and vibration in ESS system during rated input and output power operation.

### 6.5.5. Storage Settings

Verification of settings/control points and provision for modification of various set points and fixed operation/control settings associated with the various control functions.

#### Operator Controls:

- Trip/reset for the BESS AC circuit breaker or contactor.
- Trip/reset for DC circuit breaker(s)/contactor(s).
- PCS on/off.
- Reset cut-out selector switch to disable remote or local reset signals.
- A selector switch to manually set the operating state (that is, the shutdown, disconnect, or operate state) and to have the control system set the operating state automatically.
- A selector switch to manually set the operating mode and to have the control system set the operating mode automatically.

### 6.5.6. Communication test

Verified that measuring, alarm, fault indication, message and control and monitoring system operations are correct transmitted and received by the SCADA system.

## 6.6. SYSTEM RATING VERIFICATION

BESS rating including rated power, energy available at rated power, and the performance of the BESS associated with different performance metrics mentioned herein taken at the beginning of life shall be based on a set of ambient operating conditions specified by the BESS Original Equipment Manufacturer (OEM) for the Project site. The Contractor shall also provide an indication of how the performance of the BESS with respect to the metrics is expected to change over time, to account for time and use of the system, and report the same periodically.

An energy capacity test shall be performed at the time of Commissioning, in accordance with procedure mentioned below and is intended to be used to determine the dispatchable energy capacity of the BESS at the time of commencement of Operation. In conducting the energy capacity test, the Contractor shall provide a detailed and documented charging procedure within the specifications of the BESS. The energy capacity tests conducted on the BESS shall be documented to allow for tracking performance degradation.

Available/Dispatchable/Throughput energy shall be tested in accordance with the following procedure under the standard testing conditions specified in IEC 62933-2-1 (Cl. 5.1.3):

Measurement:

- a. System shall be charged to the full available energy level. Subsequently, the BESS (appropriate modular sub-unit thereof) shall be discharged and charged at rated power between the lower and upper SOC\* limit (as recommended by the OEM for current application). Power during charge and discharge shall be recorded at regular intervals of time documented by the OEM to provide a statistically valid resolution. The associated energy input (Ei), including all BESS functional, parasitic and auxiliary consumption and energy output (Eo) of the BESS shall be calculated from the recorded power. Discharged energy should be recorded as per the readings in the ABT Meter(s) at the point of interconnection of the BESS with the Solar PV array,

\* SOC recorded, shall be as reported by the Battery Management System.

The above process shall be repeated multiple times, with minimum rest period between charging and discharging, if so recommended, so as to record data for a specified no. of cycles (n). The reference performance test value for stored energy shall be calculated as the mean of the values of Eo and Ei as measured for discharge and charge respectively.

The procedure shall be repeated (one cycle each) with power levels at 75%, 50%, and 25% of rated power and documented.

Criterion: BESS stored Energy capacity shall be at least total energy dispatchable as specified in the Section II: Technical Specifications (Volume II) at rated Power at the time of commissioning.

- b. Round-trip energy efficiency ( $RtE$ ,  $\eta$ ) shall be determined as a function of the charge and discharge power and calculated using the following formula:

$$\eta_p = \frac{\sum E_o}{\sum E_i}$$

where,

$\sum E_i$  is the sum of Energy input to the BESS over n cycles

$\sum E_o$  is the sum of Energy output from the BESS over n cycles

$\eta_p$  is the RoundTrip Efficiency at charge/discharge Power, P (expressed as a percentage of rated power)

Eo and Ei shall be determined as per point (a.) above.

Criterion:  $\eta_p$ , as determined through the process described above shall be equal and/or greater than 100% at the time of commissioning.

Note: The tests are intended to be carried out over a continuous period. The value of n shall be at least 3 for 100% rated Power and 1 for 25%, 50% and 75% of rated power.

- c. BESS Response time: shall be measured as the sum of the following two entities:

1. The time elapsed between the instant when a command to change set point from rest to discharge is sent to the BESS (T<sub>0</sub>) and the instant when the BESS starts responding to the discharge command signal (T<sub>1</sub>), the BESS being in active standby state and 50% SOC at T<sub>0</sub> i.e., T<sub>1</sub>- T<sub>0</sub>
2. Time elapsed in seconds between the instant the ESS output transitions from no discharge i.e. 0% (T<sub>1</sub>) to discharge and the instant it attains rated power capacity(T<sub>2</sub>) (or from no charge (T<sub>1</sub>) to charge state and the instant it attains rated charge rate(T<sub>2</sub>)) i.e. T<sub>2</sub>- T<sub>1</sub>

$$RT = (T_2 - T_1) + (T_1 - T_0) = T_2 - T_0$$

Where T<sub>0</sub> , T<sub>1</sub> and T<sub>2</sub> are timestamps:

T <sub>0</sub> :	Instant when a command to change set point is received at BESS boundary (be identified in advance);
Data Format:	dd/mm/yyyy hh:mm:ss.00
T <sub>1</sub> :	Instant when the BESS starts responding to the Command signal;
Format:	dd/mm/yyyy hh:mm:ss.00
T <sub>2</sub> :	Instant when the BESS attains 100% of full discharge rate when discharging full charge rate;
Format:	dd/mm/yyyy hh:mm:ss.00

# Annexure G

12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project(2.2MWp DC capacity) along with 4.5 MWh Battery Energy Storage System at Pavagada Solar Park, Karnataka, India

## 1. CONTRACTOR'S OBLIGATIONS

### 1.1. SERVICES

- 1.2. 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 Section –III: Special Technical Specifications (Volume II) of the Bid Document:
- 1.3. 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 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.
- 1.4. 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.
- 1.5. 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.
- 1.6. The Contractor shall, while rendering the Services, observe and comply with all the Applicable Laws, Good Solar& BESS Industry Practices, Ministry of New & Renewable Energy (MNRE), Ministry of Power (MoP), CEA, CERC, POSOCO, SLDC, SRLDC, Local ESCOM, KSPDCL& KPTCL guidelines and Performance Standards pursuant to the contract. The Employer shall have the right 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.
- 1.7. 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.).
- 1.8. 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 solar farms of a similar size, scope and complexity as the Plant. The

Contractor shall be responsible for all matters relating to labour 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.

- 1.9. 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.
- 1.10. 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
- 1.11. 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.
- 1.12. 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.
- 1.13. 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.
- 1.14. 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.
- 1.15. The EMS and SCADA system shall be connected with the Plant and the Contractor shall make arrangements to provide monthly reports from the SCADA system. The Contractor shall arrange to connect the Plant to the SCADA system operating at the Site enabling the remote operation of the Plant by the Contractor and to provide access to information pertaining to the Plant to the Employer's Representative at Site and SLDC. The Employer may collect the data generated by the SCADA system in respect of the Plant from the Contractor. And the Employer will facilitate such data transfer by installing an OPC server at site.
- 1.16. Upon the expiry or earlier termination of the contract, the Contractor shall arrange to provide and install an additionally extended terminal from the SCADA system at the Site to enable the Employer to continue to access data relating to the Plant, at no Additional Cost and upon such terms as may be mutually agreed between the Parties at such time of expiry or earlier termination of the contract as the case may be.
- 1.17. 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.

- 1.18. The Contractor shall notify and communicate to the Employer about any condition which may cause any malfunction or failure in the Project.
- 1.19. The Owner, at its discretion, may carry out periodic Fire Safety Audits of the project including Battery Energy Storage Systems by qualified agencies after duly notifying the EPC Contractor in accordance with the extant guidelines for grid connected storage systems, OEM installation recommendations and thermal runaway characterization of the Battery Storage systems. The EPC Contractor shall be obligated to ensure compliances as per the recommendations in the Audit Report at no extra cost to the Employer.

## **2. FUNCTIONAL GUARANTEES/WARRANTIES**

### **2.1. Technical and Functional Performance Guarantee**

- 2.1.1. The Contractor shall be responsible for meeting the performance guarantee of the Plant Facility (Applicable Individual guarantees for Solar PV Plant and BESS) as described in the contract.
- 2.1.2. 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 Annexure G.

### **2.2. General Repair Warranty**

- 2.2.1. 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.
- 2.2.2. 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.
- 2.2.3. 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.
- 2.2.4. During Defect Liability Period if any repair and replacement are done, then the warrantee of the equipment shall be extended from the date of such repair and replacement to the period of original equipment warrantee w.r.t. that replaced component.
- 2.2.5. 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.
- 2.2.6. The acceptance of the equipment by employer shall in no way relieve Contractor of his obligations under the contract.

### **2.3. 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, characterize 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).

#### 2.4. Grid Connection and balance of electricity commitments

The Contractor acknowledges that to allow the Employer to inject the energy generated by the Plant Facility to the Grid and be eligible for the full tariff under the PPA, the Plant and the Contractor must comply with the requirements prescribed by Applicable Law, Good Solar/BESS Industry Practices, Performance Standards and the Grid documents and that failure to comply with such requirements may cause the Employer to either: (i) not be able to collect the tariff energy injected; and/or (ii) be subject to penalties payable to the Grid operator and/or the Discom and/or the power purchaser and/or any Government body. The Contractor therefore undertakes to diligently comply the requirements referred to Grid Connection and balance of electricity commitments, as prescribed under the Grid documents as provided by or on behalf of the Employer from time to time (or of which the Contractor otherwise becomes aware), and/or with the reasonable requests of the Employer associated with the compliance therewith.

### 3. PERFORMANCE STANDARDS

#### 3.1. 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:

- 3.1.1. the Applicable Laws, and the requirements from the Grid Operator/SLDC;
- 3.1.2. the Permits and all the related documents;
- 3.1.3. the terms of the contract;
- 3.1.4. the functional Guarantee;
- 3.1.5. the Reference Documents including the manufacturers recommendations;
- 3.1.6. Employer's health and safety manuals and procedures and ESMP;
- 3.1.7. the Site Regulations;
- 3.1.8. the Equator Principles and the Equator Principles Requirements;
- 3.1.9. Good Solar/BESS Industry Practice;
- 3.1.10. 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.
- 3.1.11. The terms of insurances directly relating to the Project and
- 3.1.12. 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.

#### 3.2. 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 in which such conflict shall be resolved.

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

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 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 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.

- 3.4. 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).
- 3.5. 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. EXCLUSIONS**

- 4.1. General: Force Majeure events as per this RFP
- 4.2. 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.
- 4.3. 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.

## **5. ADDITIONAL SERVICES**

- 5.1. 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".

## **6. SERVICE PERSONNEL**

- 6.1. 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

- 6.2. 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 engages in material or persistent misconduct or lack of reasonable care; carries out duties incompetently or negligently; fails materially to conform with any provisions of the Contract; 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; engages in conduct which might reasonably result in a breach of any provision of the contract and threaten public health, safety or security.
- 6.3. 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.
- 6.4. 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.
- 6.5. 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.
- 6.6. 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.

## **7. SAFETY PRECAUTION**

- 7.1. During performance of the Services, Contractor shall:
  - 7.1.1. comply with the safety standards and any safety procedures established by Contractor and same shall be approved by employer after the Commencement Date;
  - 7.1.2. 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.

## **8. CONSUMABLES, SPARE PARTS, TOOLS AND EQUIPMENT**

- 8.1. 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.

## 8.2. Consumables and Tools

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.

## 8.3. 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.

## 8.4. Inspection of Replaced Parts

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: must not include physical alteration or disassembly of such Replaced Part; and must not result in any material increased costs to Contractor or delay 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.

## 8.5. Tools and Equipment

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").

## 8.6. 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.

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

Contractor shall: 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; 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 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.

## 8.8. Title

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.

## **9. COMMUNICATION AND REPORTING**

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

### **9.1. 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.

### **9.2. 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.

### **9.3. 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:

- 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 (Solar and BESS) for the past quarter under Annexure 2: Functional Guarantees; and
- iii. to review the Services and Additional Services performed in the past quarter.

### **9.4. 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.

#### 9.5. Annual Calendaring of Maintenance Services.

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.

#### 9.6. 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.

## 10. CONTRACTOR'S PERMITS

10.1. 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 Solar/BESS 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.

## 11. 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

## **12.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.

## **13. RESERVED RIGHTS**

### **13.1. 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 noncompliance with the Type Certificate

13.2. 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.

## **14. CERTAIN NOTIFICATIONS BY CONTRACTOR**

14.1. 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: 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 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.

14.2. If the Contractor does not comply with its obligations under Certain Notifications by Contractor, 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.

## **15. ASSIGNMENT AND SUBCONTRACTING**

- 15.1. 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.
- 15.2. 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.
- 15.3. 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. INSPECTION AND TESTING**

- 16.1. 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.
- 16.2. The Project Parties and their respective nominees will have the right to examine and have access to documents relating to the Services.
- 16.3. 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 Solar/BESS Industry Practice. All these tests and inspections are to be carried out at the Contractor's expense, as part of Services.
- 16.4. The Project Parties and their respective nominees are entitled to attend any test and/or inspection.
- 16.5. 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.

16.6. 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.

16.7. 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.

16.8. 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.

16.9. 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.

16.10. 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:

#### 16.10.1. 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);

16.10.2. 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.

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

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

Contractor shall, promptly following receipt of the report, submit to the Employer

- i. 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
- ii. provide detailed measures to be put in place to prevent such defaults from recurring; 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.

#### 16.11. Employer Site Visit

16.11.1. 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.

16.11.2. 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.

16.11.3. 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

## **17. HAZARDOUS SUBSTANCES AND HAZARDOUS SITE CONDITIONS**

- 17.1. 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: does not violate any Applicable Laws, or Permits; and is consistent in quantity and with Good Solar/BESS Industry Practices for operating and maintaining solar energy conversion plants, such as motor fuels, solvents and lubricants (collectively, "Permissible Materials").
- 17.2. Contractor shall bear all responsibility and liability for: any Hazardous Substances that are not Permissible Materials belonging to the Contractor or present on site; or 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.
- 17.3. Contractor shall use Hazardous Substances in performance of the Services in accordance with the Performance Standards, Applicable Laws and Good Solar/BESS Industry Practices and shall not: 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 import or use at the Site such Hazardous Substances as are prohibited under Applicable Law.
- 17.4. 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.
- 17.5. 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,
- 17.6. 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.
- 17.7. 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 Solar Industry Practice and more specifically, with its obligations under Hazardous Substances and Hazardous Site Conditions.

## **18. EMPLOYER'S OBLIGATIONS**

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

- 18.1. Access

- 18.1.1. 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.
- 18.1.2. 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.
- 18.1.3. 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.
  - iii. 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.

#### 18.2. Employer's Permits

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.

### **19. 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.

### **20. CERTAIN NOTIFICATIONS BY EMPLOYER**

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

- 20.1.1. any events or facts or observations that the Employer believes has determined that would: 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 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;
- 20.1.2. 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.
- 20.2. Failure to furnish notice pursuant to Certain Notifications by Employer shall not affect the Contractor's obligations to perform its obligations. Contractor.

## 21. EMPLOYER 'S OWNERSHIP OF ENERGY, EQUIPMENT, SPARES AND PROJECT BENEFITS

- 21.1. 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.
- 21.2. 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:(i) such items becoming a permanent part of the Plant against the mutually agreed payment by both the parties
- 21.3. 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.
- 21.4. 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.
- 21.5. Sharing of Clean Development Mechanism (CDM) Benefits:
- 21.5.1. The Power Project shall be compatible to CDM claims and all such CDM claims shall be reported to KREDL periodically by the Solar Power Developer. The proceeds of carbon credit from approved CDM project shall be shared between the parties in the following manner:
- 21.5.1.1. 100% of the gross proceeds of CDM benefit accrued in the first year following the date of Commercial Operation Date shall be retained by the Solar Power Developer;
- 21.5.1.2. In the second year following the Commercial Operation Date, the Solar Power Developer shall give 10% share in the gross proceeds of the CDM benefit to KREDL and the share of benefit to KREDL shall be progressively increased by 10% every year thereafter till it reaches 50%, where after the proceeds shall be shared in equal proportion between the Parties.

## 22. PRICE AND PAYMENT

### 22.1. 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 installments at the end of every quarter for each year till 12 (Twelve) years in the amounts set forth in and payable in accordance with Schedule /SOR-2 (O&M) [Schedule of Rates] of the bidding documents for the plant facilities.

Following is the yearly breakup of the Total O&M price in line with the Price Schedule (SOR-2 (O&M)

SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]							
12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2MWp DC capacity) along with 4.5 MWh Battery Energy Storage System (excluding all variants of Lead Acid Batteries) at Pavagada Solar Park, Karnataka, India							
Sl. No	Description of Item	Year	PRICES (INR)				
			Yearly O&M Price (Excluding GST)	Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to	% (Percentage) of Goods & Service Tax (GST) considered	Yearly O&M Price including GST
·							

			Sola r PV - Part- A	BES S - Part- B		be calculated on absolute O&M Price					
1	2	3	4	5	6=4+5	7	8	9=6+7	10= 9* PVF		
<b>OPERATION &amp; MAINTENANCE</b>											
1	Operation and Maintenance of the Plant Facility for FIRST YEAR	1			0			0	0.921	0	
2	Operation and Maintenance of the Plant Facility for SECOND YEAR	2			0			0	0.848	0	
3	Operation and Maintenance of the Plant Facility for THIRD YEAR	3			0			0	0.781	0	
4	Operation and Maintenance of the Plant Facility for FOURTH YEAR	4			0			0	0.719	0	
5	Operation and Maintenance of the Plant Facility for FIFTH YEAR	5			0			0	0.662	0	
6	Operation and Maintenance of the Plant Facility for SIXTH YEAR	6			0			0	0.609	0	
7	Operation and Maintenance of the Plant Facility for SEVENTH YEAR	7			0			0	0.561	0	
8	Operation and Maintenance of the Plant Facility for EIGHTH YEAR	8			0			0	0.516	0	
9	Operation and Maintenance of the Plant Facility for NINTH YEAR	9			0			0	0.476	0	
10	Operation and Maintenance of the Plant Facility for TENTH YEAR	10			0			0	0.438	0	

SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]										
12Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2MWp DC capacity) along with 4.5 MWh Battery Energy Storage System (excluding all variants of Lead Acid Batteries) at Pavagada Solar Park, Karnataka, India										
Sl. No .	Description of Item	Year	PRICES (INR)							
			Yearly O&M Price (Excluding GST)	Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to be calculated on absolute O&M Price	% (Percentage ) of Goods & Service Tax (GST) considered	Yearly O&M Price includin g GST	Present Value Factor (PVF)	NPV of O& M Pric e	
1	2	3	4	5	6=4+5	7	8	9=6+7	10=9* PVF	
11	Operation and Maintenance of the Plant Facility for ELEVENTH YEAR	11			0			0	0.403	0
12	Operation and Maintenance of the Plant Facility for TWELVETH YEAR	12			0			0	0.371	0
	TOTAL NPV OF O&M FOR 12 YEARS (1+2+3+4+5+6+7+8+9+10+11+12)				0			0		0

Against the successful Operation and Maintenance of the entire Plant Facility (Solar & BESS) payment will be released on quarterly basis at the end of every quarter for each year till 12 (Twelve) years.

The O&M of the plant will commence from the date of Operational Acceptance of the plants.

- i. Year 1 : OM -1
- ii. Year 2 : OM -2
- iii. Year 3 : OM -3
- iv. Year 4 : OM -4
- v. Year 5 : OM -5
- vi. Year 6 : OM -6
- vii. Year 7 : OM -7
- viii. Year 8 : OM -8
- ix. Year 9 : OM -9
- x. Year 10 : OM -10
- xi. Year 11 : OM -11
- xii. Year 12 : OM -12

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:**

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.

## **23.INVOICES AND PAYMENT**

- 23.1. 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.
- 23.2. 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). 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.
- 23.3. 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).
- 23.4. In the event that the Employer fails to make any payment on its respective due date, the Employer shall pay to the Contractor interest on amount of such delayed payment at the rate as applicable for 46 days term deposit scheme as established by State Bank of India for Local currency payment and London Inter Bank Offered Rate (LIBOR) for Foreign currency payment, shall become payable as from the end of the 15 days period on certified amount due, but not paid, at the end of such period.

23.5. 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.

23.5.1. 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 Solar/BESS Industry Practices in: assessing all risks which it is assuming under the Contract; and 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.

23.5.2. 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.

23.5.3. 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.

23.5.4. 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.

## **24. SCADA, EMS & BMS**

Contractor shall be required from time to time to update the SCADA, EMS and BMS software, as required for the ongoing adequate operation of the Plant Facility. Such updates shall also be provided to the Employer at no additional costs.

## **25. INSURANCE**

### 25.1. Contractor's insurance

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 Equipment's, 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.

#### 25.2. 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:
- Notify without delay to the Employer
- 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.
- Collaborate with Employer and the insurer and provide them with all information and documents they may request.
- Arrange immediate reinstatement of the damage to the employer's satisfaction, without waiting for the settlement for the corresponding insurance claim.
- 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.

#### 25.3. General Insurance Requirements

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

25.3.2. 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.

25.3.3. 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.

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

25.3.5. 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.

25.3.6. The required coverages referred to and set forth under *Insurance* requirements shall in no way affect or limit the Contractor's liability with respect to its obligations under the Contract.

25.4. 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 solar panel.
- b) Business Interruption: Cover for period of operational downtime i.e., covering the cash flow of the solar 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 solar system owners of the risk of either environmental damage done by their development or preexisting 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 Plant Facility and shall also indicate the proposed resources manpower, material & machinery) that would be deployed for O&M.
- ii. The Contractor shall be responsible for the smooth day-to-day operation of the Plant Facility.
- iii. The Contractor shall provide necessary routine and preventive maintenance schedules of the plant for the Employer's approval and shall carry out all routine and preventive maintenance accordingly.
- iv. The Contractor shall perform periodic overhauls and preventive maintenance required for the Plant in accordance with the recommendations of equipment manufacturers and as per the O&M manuals.
- v. Contractor shall perform all break down maintenance and other maintenance in the Plant Facility. The Contractor shall be responsible for achieving the performance guarantee of the plant as indicated in the contract.
- vi. The Contractor shall operate and maintain fire protection system and safety equipment for the plant.
- vii. The Contractor shall do maintenance of Electricity system including overhead lines in the Plant Facility area up to the Point of Common Coupling (PCC) to the grid at the site. Necessary co-ordination shall be made by the Contractor with PGCIL/PDD/SLDC and other agencies as may be required during the Operation and Maintenance term for smooth operation of the plant.
- viii. Contractor shall work in coordination with the Employer or any Employer's designated party to optimize the Plant production.
- ix. The Contractor shall provide required spare plant Equipment, Spare Parts, tools and tackles, consumables required for comprehensive operation and maintenance of the plant facility. The Contractor shall make arrangement to procure required spare parts, or equipment/s as required, overhauling of parts, tools and equipment, required to operate and maintain the Plant in accordance with the recommendations of individual original equipment manufacturer at his own cost. Cost of imported Equipment & spare parts, if any, shall be included in the O&M quoted cost. The List of Consumables, Spare Parts, tools and equipment shall be finalised in consultation with the Employer or Employer's representative. List of recommended spare parts shall be submitted by the Contractor at the beginning of services;however the complete recommended spares will be in the scope of Contractoronly. In case any equipment or spares is not listed in the mandatory spares list but is required vitally for the operation of the plant, then the same shall be procured and provided by the Contractorwithout any additional cost.
- x. It is the responsibility of the Service Provider to store the materials in appropriate stock yard or container at the site so as to ensure timely availability of the materials.
- xi. The Contractor shall employ only such personnel who are adequately qualified and experienced for operating and maintaining such power generating sets. The Contractor shall ensure that such personnel are on duty at the plant at all times, 24 (twenty-four) hours a day and 7 (seven) days a week commencing from the Date of Operational acceptance.
- xii. Contractor shall carry out all day-to-day operation and maintenance for the Plant Facility as set forth herein. Contractor shall perform the Work and supply all required spare parts in a prudent and efficient manner and in accordance with manufacturers and systems designers' specifications, the Annual Operating Plan for the Plant and all operation and maintenance manuals, all Indian applicable laws including environmental protection, pollution, sanitary, labour act, factory act, employment and safety laws, ("Government Rules") and Prudent Utility Practice.The Contractorshall adhere to all labour laws which are applicable and as specified in the EPC contract document.
- xiii. Contractor shall arrange necessary security staff for watch and ward of the Plant Facility round the clock at his own cost, the details of which shall be furnished along with the bid.
  - Contractor shall be responsible for:
  - Maximizing plant capacity utilization,
  - Reducing plant downtime,
  - Optimizing the useful life of the equipment of the power plant.

- xiv. The Contractor shall maintain all accounting records regarding the facility in accordance with the generally acceptable accounting principles under the Laws of India.
- xv. The Contractor shall maintain accurate and up-to-date operating logs, records and monthly reports regarding operation and maintenance of the Plant facility (Such records shall be distinctly recorded for Solar PV Plant and BESS Plant, in order to have clear data for assessment of any individual component of the Plant Facility) which shall include details of power output, other operating data, repairs performed and status of equipment. All such records to be maintained for a minimum of 60 (sixty) months after the creation of such record or data and for any additional length of time required by regulatory agencies with jurisdiction over the Parties. Upon expiry of term, the Contractor shall hand over all such records to EMPLOYER. However, EMPLOYER shall have access to all such records at any time. Generation and O&M reports should be made available to EMPLOYER on daily and monthly basis in required formats as well as the Quarterly and Annual Performance Reports shall be provided. Contractor shall provide communications as well as daily, weekly, monthly, quarterly and annual reports to the employer in the desired format as per the Contract with the Employer or Employer's Engineer.
- xvi. The Contractor shall develop and implement plans and procedures including those for fire fighting, maintenance planning, procuring and inventory control of stores and spares, plan to meet emergencies, plant safety and security; and such other facilities and systems as may be necessary to commence Contractor's ongoing responsibilities.
- xvii. The Contractor shall provide copies of all necessary documents including the following:
- Operation and maintenance manuals shall be prepared, and approval shall be accorded from Employer within three months from the date of Operational acceptance.
  - Failure Analysis/history/trouble shooting details of all the Equipment
  - Identification of Equipment needing preventive maintenance
  - List of Vendors indicating name and addresses during operation and maintenance with credentials
  - root cause analysis report for any major failure.
  - Record of consumables / spare parts
- xviii. The Contractor shall be responsible for conveying following details to the Employer on daily basis as well as on monthly basis (by the end of 5th day of each month) by fax/ e-mail giving the detail of plant performance during previous month.
- Power generated at all Solar PV Plant, Utilisation of BESS
  - Power fed to the grid
  - Internal power loss and internal consumption
  - Power consumption for captive use (if any)
  - Reactive power consumption
  - Downtime of Plant Facilities including Solar PV Plant, BESS and other infrastructure of the Plant facility.
- xix. The Contractor shall be responsible for liaisoning with statutory authorities and local authorities in order to ensure smooth operation of the Power Plant.
- xx. Contractor shall provide constant remote surveillance to the Plant Facility
- xxi. Contractor shall provide updates and revisions to Reference Documents, as and when applicable.
- xxii. Shall implement software updates to control and monitoring systems including EMS/SCADA/BESS in order to meet the plant facility operating requirement in consonance with the grid operations and in compliance with the grid codes as applicable during the operation.
- xxiii. Duly and timely provide the Employer (or parties designated by the Employer) with all notifications required under the Contract including in particular such notifications set forth in Certain Notifications by Contractor;
- xxiv. Contractor shall provide access to the Employer to all data for the Plant Facility from the EMS including the SCADA system.
- xxv. Contractor shall at all times allow and provide Employer all necessary information for the operation of EMS including the SCADA system (with no notification or approval of access being required unless specifically and otherwise agreed to by the Parties) full, free, unconditional, safe and complete access to the EMS including the SCADA system. Contractor shall monitor and operate the Plant in accordance with the contract and shall ensure smooth operation of the plant.

- xxvi. Provide the training to the Employer's personnel in relation to the operation of the complete plant facility. Training shall be provided to the employer within 190 days before end the contract.
- xxvii. Contractor shall provide the insurances prescribed in insurance. The Contractor shall, with [prior intimation of 5 Business Days] at regular business hours, allow persons duly authorized by the Employer including but not limited to the officials of the insurance company of the Employer, to inspect the Project and provide to such personnel, access to all information which is necessary for their inspection, and is reasonably requested by the Employer.
- xxviii. All representatives of the Employer shall strictly adhere to the Applicable Laws and the Health, Safety and Environmental (HSE) practices of the Contractor as provided in the Reference Documents;
- xxix. Contractor shall provide for the watch and ward of the Plant at all times during the Term. The watch and ward deployment plan shall take care of comprehensive Project level security and the Contractor shall take necessary steps to prevent sabotage, theft, vandalism and malicious damage of the assets comprising the Plant, and shall also coordinate and liaison with law enforcement authorities. The Contractor shall take all possible measures to keep the plant operational and secure.
- xxx. Contractor shall Coordinate with PGCIL/KSPDCL, SLDC and other related entities/departments/local Panchayats as required for proper operation of the Plant Facilities. Also coordinate with relevant agencies for monthly Joint Meter Readings, meter testing, and any other requirements such as any audit or inspection by the government agencies or authorities, financiers, any designated third-party agency etc. for the Project operations.
- xxxi. Contractor shall be responsible for appointing a Qualified Coordinating Agency at the 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, as applicable). 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.
- xxxii. The operation and maintenance of BESS shall be done in coordination with the use cases as defined in the Technical Specifications under Section II (Volume II) of the Bid Document. In case any modification or any other requirement from the grid operator, then the same shall be discussed with Employer or Employer representative, and any such modification shall be done by the Contractor only on after Employer's approval.
- xxxiii. Contractor will be required to maintain the BESS rating (In MW as well as MWh) as specified in the Technical Specifications (Section II (Volume II), requirement of Bid Document) during the entire O&M period by means of replacement or augmentation of the Battery.
- xxxiv. Water requirement for module cleaning arrangement and the cost for the same shall be borne by Contractor. The Contractor shall arrange for water on its own, by ensuring ESIA norms.
- xxxv. Contractor shall be responsible to comply with all applicable National and International Standards as well as local statutory provisions related to Environmental Protection Regulations, Health and Safety requirement.
- xxxvi. Contractor will be responsible for coordinating with the OEMs for securing warrantee conditions and services from OEMs as per the warrantee of each equipment, as well also for the Project insurance claims.
- xxxvii. Contractor shall carry out the performance monitoring for the Plant Facility (Solar and BESS) 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 analyse 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.
- xxxviii. Contractor shall be responsible for maintenance of all each and every civil infrastructures parts like Building, cable trench, fencing, drain, plumbing system fire-fighting system, CCTV system, security arrangement, road, earthing, any foundations, anti-weeding, clearing bushes in the solar field etc.,as per the direction of employer's Engineering In-charge.

# ANNEXURE 2

## Functional Guarantees

### 1. Annual CUF 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 CUF Guarantee on the terms and conditions set forth in the contract.
- B. The Contractor guarantees the annual CUF committed herein over the O&M Period ("Annual CUF Guarantee") from the date of Operational Acceptance. In the event the CUF is less than the Guaranteed CUF, the Contractor shall immediately, upon demand, indemnify the Employer, as liquidated damages and not as penalty, amounts equivalent to remuneration of the equivalent Energy, subject to a maximum of hundred (100) percent of the Total Annual O&M Price.
- C. The Procedure for measurement and verification of the CUF Guarantee is as per Annexure-C: Performance Guarantee Test procedure.
- D. The Procedure for measurement and verification of the BESS Availability shall be as per relevant section (Battery energy Storage System: System Rating Verification) of Annexure-F: Plant Documentation, Commissioning and Test Procedure, Section II: Technical Specifications (Volume II) of the bid document
- E. Liquidated Damages for Shortfall in Annual Generation for Solar PV Plant
  - i. If the Contractor fails to achieve guaranteed annual generation as per the stipulated AC CUF of 21%, then the Contractor shall pay compensation to the Employer as detailed in clause No. 3.6.1.1.2.
  - ii. Void
- F. 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 KSPDCL/ CTU, it shall be considered as "an event of default". In the case of default the entire Contract Performance Security will be forfeited.
- G. Penalty during O&M period against breakdown of other Infrastructure of Plant Facilities that don'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 Section-I : Scope of Works (Volume II) & Section II: Technical Specifications (Volume II) shall be penalized at Rs.25000/day/MW subject to maximum of 1 month beyond which, the contractor is liable of penalty payment of Rs.1,25,000/- per MW Per day.. for non-compliance with PM Schedule (Initiation/Completion of Scheduled maintenance Activity as agreed under this Contract) beyond 48 hours. Cumulative value of such penalty shall be limited to 50% of yearly O&M cost. Cumulative value of such penalty shall be limited to 50% of yearly O&M cost.

For the purpose of this Clause, the PM shall be inclusive of, but not limited to, the following PM activities:

Item	Scope of Maintenance Activity	Periodicity
Environmental/Corrosive Protective Coatings	White washing/Application/Re- application of Distemper, Epoxy coatings	Once in every 2 years under the O&M Contract period, in consultation with the Owner

Item	Scope of Maintenance Activity	Periodicity
Roads and Access paths	Repair and maintenance of all roads – Access, Internal and Periphery roads, walkways as well as fences, gates, cable- trenches and outdoor equipment platforms.	Once every year prior to Monsoon season, in Consultation with the Owner
Water Supply Network	Repair and Maintenance of Water Supply Network Including piping network, valves, pumps etc.	Once Every Year in Consultation with the Owner.
Periphery Lighting	Repair and maintenance of Peripheral Lighting including replacement of non-functional lighting fixtures, Junction Boxes, Conduits etc.	Once every Six Months
Rodent Entry Points	Application/re-application of Anti-rat protection measures like PUF filling, sealant etc. at Checker/Gland Plates, Cable Entry Points (in PCU/SMU, Switchgear Panels, Buildings, Enclosures)	Once every Six Months
All bolted/tightened structures	Tightening/fastening of bolts that are exposed to winds/vibrations like MMS members/foundation bolts	Once every Year before onset of Windy season, in consultation with the Owner.
Enclosures of Equipment requiring Temperature and Dust Controlled environment for Normal Operation	Application/re-application of insulation/ Dust-Filters/ Temperature-control equipment at Enclosures/Buildings housing BESS, PCU, Switchgear	Once every Year, consultation with the Owner.
Entire Plant Facility	Oversight management of the hazardous/toxic materials including its handling and disposal as per Government of India Rules and environmental and safety assessments by a qualified Specialist	Once every Year, in consultation with the Owner.

**Note:** The Contractor shall ensure intimation and submission of requisite Reports to the owner at least 15 days prior to initiation of maintenance action for the activity.

#### H. Void

- I. 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. Above mentioned Penalties specified under this clause are independent of each other.

#### 2. BESS Availability

- A. The Contractor shall maintain all BESS equipment to ensure guaranteed Annual Equipment Availability. 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 interface with the solar PV arrays.

- 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.

Equipment Availability =

$$\left[ 1 - \left( \frac{\sum \text{Accountable BESS Outage duration in hours} \times W_e}{8760} \right) \right] * 100$$

Where:

$W_e$ , Weightage is  $\frac{\text{Outage Capacity}}{\text{Rated Capacity}}$ , where Outage Capacity and Rated Capacity shall be in Energy terms i.e. MWh. Rated Capacity in a given year shall correspond to the daily throughput capacity guarantee for the beginning of the year.

- C. Accountable BESS outages are outages caused or necessitated by the BESS equipment that result in reduced capacity or loss of essential function of the BESS. These outages may be initiated by failure of components, loss of battery capacity, operation of protective devices, alarms, or manual action. Such outages include both forced outages due to equipment problems and scheduled outages for BESS maintenance.
- D. 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.
- E. The Procurement specific nameplate ratings shall be as defined in Section II: Technical Specifications (Volume II). The BESS shall be considered to be under an accountable outage if any of those ratings cannot be met. The BESS shall also be considered to be under an accountable outage if a scheduled (or required) charge cycle cannot be completed.
- F. The data required for assessment of the availability of the BESS shall be collected through the Plant's integrated SCADA system.
- G. Grid outage hours shall be subtracted from total no. of hours in the year.
- H. If the Plane of Array Radiation is less than  $2\text{kWh/m}^2$  on a day, the day (i.e. 24 hours) shall be excluded.
- I. Liquidated Damages for Shortfall in Equipment Availability If the annual equipment availability for BESS is less than 100 during any year, then Contractor shall compensate the Employer an amount calculated as per the following formula.

$$\text{COM} = (100 - EA) / EA \times C \times E$$

where,

COM is Compensation payable to the Employer in Indian rupees

EA is Annual BESS Equipment Availability

C is INR 22/kWh

E is the intended energy output from BESS in kWh during the respective year in guaranteed availability condition.

### 3. BESS Round-trip-Efficiency

- a. Round-trip energy efficiency ( $\text{RtE}$ ,  $\eta$ ) shall be determined as a function of the charge and discharge power and calculated using the following formula:

$$\eta_p = \frac{\sum E_o}{\sum E_i}$$

where,

$\sum E_i$  is the sum of Energy input to the BESS over n cycles

$\sum E_o$  is the sum of Energy output from the BESS over n cycles

$\eta_p$  is the RoundTrip Efficiency at charge/discharge Power, P (expressed as a percentage of rated power)

Criterion:  $\eta_p$ , as determined through the process described above shall be equal and/or greater than 80% at the time of commissioning.

- b. Liquidated Damages for Shortfall in Round-trip-Efficiency, if the annual Round-trip-Efficiency for BESS is less than committed value during any year, then Contractor shall compensate the Employer an amount calculated as per the following formula.

$$\text{COM}_{(\text{RTE})} = (85\% - \text{RTE}_{\text{actual}}) \times \text{Energy input to the BESS} \times C$$

where,

COM is Compensation payable to the Employer in Indian rupees

$\text{RTE}_{\text{actual}}$  is Annual BESS Round-trip-Efficiency achieved(%)

Energy input to the BESS is sum of Energy input to the BESS over n cycles in a year (kWh)

E is the intended energy output from BESS in kWh during the respective year in guaranteed availability condition.

C is INR 22/kWh

#### Recovery of Compensation

The above compensations shall be deducted from Contract Performance Security (CPS) submitted by the developer

#### Scheduling and Forecasting:

The Contractor shall be responsible for appointing a Qualified Coordinating Agency if required by concerned authorities at the Pooling Substation Level for scheduling and forecasting activity. Also the Contractor 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, as applicable). Scheduling given by the Contractors 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 recovered from the CPS given by the Contractor.

# Volume III

# Schedule of Rates

1. Bidders are required to quote for the Total Contract Price on Lumpsum basis in cognizance with the Tender Terms & Conditions.
2. Bidder's quoted prices shall be strictly as per various Formats included under this Section [i.e. VolumeIII, Schedule of Rates (SOR)]. Bidder shall quote Lumpsum (LS) Price for the entire scope of work including Design, Engineering, Manufacture, Supply, Storage, Civil Work, Erection, Testing & Commissioning as per the Section-II: Technical Specifications (Volume II) as defined under.
3. All the Columns of quoted items in the Schedule of Rates including currency must be filled with required information, as applicable.
4. Bidder must quote the price in enclosed SOR formats only. The formats shall not be changed and/ or retyped.
5. Bidder to note that breakup of Lumpsum price is to be provided for assessment of Total Evaluated Bid Value (TEBV), however total price payable under the Contract shall be restricted to the Lumpsum Price/ Contract Price only.
6. The Lumpsum Price shall be considered as Total Contract Price which Owner agrees to pay and the Contractor agrees to accept as full compensation for the Contractor's full performance of the Work in accordance with the provisions of the Contract Documents. Contract Price shall not be subjected to any adjustment except in case of Change Order or Statutory Variations in accordance with the provisions of the Contract.
7. The price quoted shall be Lumpsum price on Turnkey basis. Unless the basic parameter changes or additional/ extra requirements are made, total payments to be made to the Contractor shall be limited to Lumpsum price indicated, irrespective of the progressive payments made during execution based on the split up of price.
8. Obligation of the Contractor is not limited to the quantities that the Contractor may either indicate in the Schedule of Breakup of Lumpsum Prices along with his bid or in further detailed break of Lumpsum prices furnished along with the bid or after award of work. Contractor shall carry entire scope of work/ supplies as detailed in various sections/ volumes of the Tender Document within the quoted Lumpsum Price (Contract Price).
9. Lumpsum Prices quoted by the Bidder shall include cost of any other supplies/ work(s) not specifically mentioned in the Bidding Document but necessary for the efficient, trouble free commissioning & operation of the Plant and to make this package job complete. Quoted price is FIRM and fixed till complete execution of the entire order. Also, variation on account of Foreign Exchange rate is not to be payable extra.
10. Spares for start-up/ commissioning and mandatory spares required are in Contractor's Scope and deemed included in the quoted Lumpsum Prices.
11. Bidder shall furnish following Forms of Schedule of Rates: -
  - a) SOR -1(Price) is the Schedule and Breakup of Lump sum Price (Supply, Service and NPV of O&M) of the Tender. SOR -2 (O&M) comprises of the yearly Breakup of the O&M including NPV of O&M price for 12 years period.
  - b) Details of Goods & Service Tax (GST) as included in SOR-1(Price) & SOR-2 (O&M)
  - c) Prices shall be considered for evaluation on NPV basis as per Evaluation Methodology Specified in Section II: Instructions to Bidders (Volume I) of the Tender Document.
  - d) Bidder to mention the NPV of O&M amount for total 12 years in CELL NO I 47 of SOR-1 (Price) which should match with the NPV of O&M amount for total 12 years in CELL NO L 25 of SOR 2.(O&M)
  - e) In case of any variation of the total NPV of O&M price, the NPV of O&M amount for total 12 years mentioned at CELL NO I 25 of SOR 2 (O&M) will be considered for evaluation purpose.
12. INR = Indian Rupees
13. Bidder confirms that he has noted the contents of the Preamble to the Schedule of Rates, Schedule of Rate, Bid Document and quoted his Prices accordingly without any deviation.
14. O & M Charges on YoY basis must be equal or in ascending order only.

SCHEDULE OF RATES [SOR-1]							
---------------------------	--	--	--	--	--	--	--

**12 years Plant Operation & Maintenance of 2MW (AC) Solar PV Project (2.2 MWp DC capacity) along with 4.5 MWh despatchable Battery Energy Storage System (excluding all variants of lead acid batteries) at Pavagada Solar Park, Karnataka, India**

		PRICES (INR)					
Sl. No.	Description of Item	Quantity (Ls)	Unit Ex works Price	Total Ex works Price	Total value of Applicable	% of GST applied	Total Price including GST
			(Excluding GST)	(Excluding GST)	GST (in figures)	(Ex 5%, 18% etc)	
1	2	3	4	5 = 3 * 4	6	7	8= 5 + 6
<b>PART A : SCHEDE OF RATES [SOR-1] - SOLAR PART (2 MWAC) with 2.2MW DC</b>							
1	Supply of PV Modules as specified in the Tender Documents	1					
2	Supply of Inverters as specified in the Tender Documents	1					
3	Supply of Inverter Transformer as specified in the Tender Documents	1					
4	Supply of Panels & Switchgears as specified in the Tender Documents (Common for Solar + BESS)	1					
5	Supply of Module Mounting Structure as specified in the Tender Documents	1					
6	Spare Modules (As Mandatory Spares, 0.50% of total supply of solar modules)	1					
7	Mandatory Spares excluding Modules	1					
8	Cables (All DC, LT & HT)	1					
9	Weather Monitoring Station & SCADA	1					

10	Manufacture & Supply of Balance of System including all Equipments, Materials, Spares, Accessories, Safety & Fire Fighting System, Common control room etc. excluding in above Solar Part supply and any other Supplies specified in the Tender Documents	1					
	Sub Total - A						
<b>PART B : SCHEDULE OF RATES [SOR-1] - BESS PART (4.5MWh despatchable) 5MWh (Equiped) excluding all variants of Lead acid batteries</b>							
11	Supply of Battery excluding all variants of lead acid batteries along with the Battery Management System (BMS) as specified in the Tender Documents	1					
12	Supply of Bidirectional Inverter (PCS) as specified in the Tender Documents	1					
13	Supply of Step-up Transformer as specified in the Tender Documents	1					
14	Manufacture & Supply of Balance of System including all Equipment's, Materials, Spares, Accessories, Grounding, Lighting, Lightning, Safety & Fire Fighting System etc. excluding BESS part supply above and any other Supplies specified in the Tender Documents	1					
	Sub Total - B						
<b>PART C : SCHEDULE OF RATES [SOR-1] - Interfacing with existing 33kV Terminal Bay in 220/33kV KSPDCL Substation No 4</b>							
15	Supply of components with respect to termination of UG cable at 220/33kV substation along with laying of 33kv UG cable for 1.5KMs from plant to existing 33kv Terminal Bay by adding 33 KV bay materials with metering at 220/33kV Sub- station No. 04, KSPDCL, Pavagada Solar Park with upfront bay charges	1					
	Sub Total - C						
<b>PART D : SERVICES FOR PART A , SOLAR PART (2 MWAC)</b>							

16	Freight & Insurance including Loading, Unloading, Storage, Handling at Site	1					
17	Design, Engineering, Installation, Erection, Testing and Commissioning including Performance Testing in respect of all the Equipments Supplied and any other Services Specified in the Tender Documents	1					
18	Civil and allied works including construction of Trenches, Module Mounting Structure, foundations, Common control room, etc of all the Equipments Supplied.	1					
Sub Total - D							
PART E : SERVICES FOR PART B , BESS PART (4.5 MWh/5 MWh) excluding all variants of Lead acid batteries							
19	Freight & Insurance including Loading, Unloading, Storage, Handling at Site	1					
20	Design, Engineering, Installation, Erection, Testing and Commissioning including Performance Testing in respect of all the Equipments Supplied and any other Services Specified in the Tender Documents	1					
21	Civil and allied works including construction of foundations, etc of the Equipments Supplied	1					
Sub Total - E							
PART F : SERVICES FOR PART C -220/33kV Sub-Station							
22	Civil portion of Part C	1.00					
	Sub Total - F						
	Total EPC Price - G						
PART G: OPERATION AND MAINTENANCE PART							
23	NPV of total amount for 12 years						
	Sub Total - H						
	TOTAL EVALUATED BID VALUE (TEBV) (G+H)						

**SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]**

12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2 MWp DC capacity) along with 4.5 MWh Battery Energy Storage System at Pavagada Solar Park, Karnataka, India

S.No	Description of item	Year	PRICES (INR)							
			Yearly O&M price (Excluding GST)		Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to be calculated on absolute O&M Price	% (Percentage) of Goods & Service Tax (GST) considered	Yearly O&M Price including GST	Present Value Factor (PVF - 10.71%)	NPV
			Solar PV + Park charges - PART-A	BESS - PART-B						
1	2	3	4	5	6=4+5	7	8	9=6+7	10	

**OPERATION & MAINTENANCE**

1	Operation and Maintenance of the Plant Facility for FIRST YEAR	1								
2	Operation and Maintenance of the Plant Facility for SECOND YEAR	2								
3	Operation and Maintenance of the Plant Facility for THIRD YEAR	3								
4	Operation and Maintenance of the Plant Facility for FOURTH YEAR	4								
5	Operation and Maintenance of the Plant Facility for FIFTH YEAR	5								
6	Operation and Maintenance of the Plant Facility for SIXTH YEAR	6								
7	Operation and Maintenance of the Plant Facility for SEVENTH YEAR	7								
8	Operation and Maintenance of the Plant Facility for EIGHTH YEAR	8								
9	Operation and Maintenance of the Plant Facility for NINTH YEAR	9								

10	Operation and Maintenance of the Plant Facility for TENTH YEAR	10									
11	Operation and Maintenance of the Plant Facility for Eleventh YEAR	11									
12	Operation and Maintenance of the Plant Facility for Twelfth YEAR	12									
<b>TOTAL</b>											22

## NOTES

1. O & M Charges on YoY basis must be in equal or in ascending order only.

**SOR 2: Operation and Maintenance**

SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]										
12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2MWp DC capacity) along with 4.5 MWh despatchable Battery Energy Storage System at Pavagada Solar Park, Karnataka, India										
Sl. No.	Description of Item	Year	PRICES (INR)							
			Yearly O&M Price (Excluding GST)	Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to be calculated on absolute O&M Price	% (Percentage) of Goods & Service Tax (GST) considered	Yearly O&M Price including GST	Present Value Factor (PVF)	NPV of O&M Price	
1	2	3	4	5	6=4+5	7	8	9=6+7	8.61%	10= 9* PVF
OPERATION & MAINTENANCE										
1	Operation and Maintenance of the Plant Facility for FIRST YEAR	1			0			0	0.921	0
2	Operation and Maintenance of the Plant Facility for SECOND YEAR	2			0			0	0.848	0
3	Operation and Maintenance of the Plant Facility for THIRD YEAR	3			0			0	0.781	0

SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]									
12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2MWp DC capacity) along with 4.5 MWh despatchable Battery Energy Storage System at Pavagada Solar Park, Karnataka, India									
Sl. No.	Description of Item	Year	PRICES (INR)						
			Yearly O&M Price (Excluding GST)	Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to be calculated on absolute O&M Price	% (Percentage) of Goods & Service Tax (GST) considered	Yearly O&M Price including GST	Present Value Factor (PVF)	NPV of O&M Price
1	2	3	4	5	6=4+5	7	8	9=6+7	8.61% 10= 9* PVF
4	Operation and Maintenance of the Plant Facility for FOURTH YEAR	4			0			0	0.719 0
5	Operation and Maintenance of the Plant Facility for FIFTH YEAR	5			0			0	0.662 0
6	Operation and Maintenance of the Plant Facility for SIXTH YEAR	6			0			0	0.609 0

SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]									
12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2MWp DC capacity) along with 4.5 MWh despatchable Battery Energy Storage System at Pavagada Solar Park, Karnataka, India									
Sl. No.	Description of Item	Year	PRICES (INR)						
			Yearly O&M Price (Excluding GST)	Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to be calculated on absolute O&M Price	% (Percentage) of Goods & Service Tax (GST) considered	Yearly O&M Price including GST	Present Value Factor (PVF)	NPV of O&M Price
1	2	3	4	5	6=4+5	7	8	9=6+7	8.61% 10= 9* PVF
7	Operation and Maintenance of the Plant Facility for SEVENTH YEAR	7			0			0	0.561 0
8	Operation and Maintenance of the Plant Facility for EIGHTH YEAR	8			0			0	0.516 0
9	Operation and Maintenance of the Plant Facility for NINTH YEAR	9			0			0	0.476 0

**SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]**

12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2MWp DC capacity) along with 4.5 MWh despatchable Battery Energy Storage System at Pavagada Solar Park, Karnataka, India

Sl. No.	Description of Item	Year	PRICES (INR)							
			Yearly O&M Price (Excluding GST)		Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to be calculated on absolute O&M Price	% (Percentage) of Goods & Service Tax (GST) considered	Yearly O&M Price including GST	Present Value Factor (PVF)	NPV of O&M Price
			Solar PV - Part-A	BESS - Part-B						
1	2	3	4	5	6=4+5	7	8	9=6+7	8.61%	10= 9* PVF
10	Operation and Maintenance of the Plant Facility for TENTH YEAR	10			0			0	0.438	0
11	Operation and Maintenance of the Plant Facility for ELEVENTH YEAR	11			0			0	0.403	0
12	Operation and Maintenance of the Plant Facility for TWELTH YEAR	12			0			0	0.371	0

SCHEDULE OF RATES [SOR-2] [OPERATION AND MAINTENANCE]										
12 Years Plant Operation & Maintenance of 2 MW (AC) Solar PV Project (2.2MWp DC capacity) along with 4.5 MWh despatchable Battery Energy Storage System at Pavagada Solar Park, Karnataka, India										
Sl. No.	Description of Item	Year	PRICES (INR)							
			Yearly O&M Price (Excluding GST)	Total O&M Price (INR) (Excluding GST) in figures	Total value of Applicable GST in absolute figures [GST to be calculated on absolute O&M Price	% (Percentage) of Goods & Service Tax (GST) considered	Yearly O&M Price including GST	Present Value Factor (PVF)	NPV of O&M Price	
1	2	3	4	5	6=4+5	7	8	9=6+7	8.61%	10= 9* PVF
	TOTAL NPV OF O&M FOR 10 YEARS (1+2+3+4+5+6+7+8+9+10+11+12)			0			0		0	

## NOTES

1. Bidders are required to mention the GST amount (Column 7) on the actual O&M cost of the yearly basis & not on the NPV of O&M cost.
2. O & M Charges on YoY basis must be in equal or in ascending order only.