

EPC Price:

Net EPC price is ₹3.3 Crore per MW + GST

EPC executor can raise bills for elevated/ raised Structures

The above rates are excluding taxes/ GST.

1. The government has approved to use Non DCR (Domestic Content requirement); means – we do not have to adhere to the Indian Made Solar Panels only, we can import from outside India as well.

Payment Terms:

1. Mobilization Advance: 20% of the total contract value shall be paid as mobilization advance on submission of Advance Payment Bank Guarantee (APBG). EPC Contractor will provide APBG (Advance Payment Bank Guarantee).
2. Material Supply: 50% of the total contract value shall be paid on material supply at site.
3. Completion: 25% of the total contract value shall be paid on completion of the project.
4. Retention: 5% of the total contract value shall be retained for 1 year as defect liability retention. This amount can be released on submission of Bank Guarantee.
5. Billing: On every 2 Mw (min capacity) Installed & handed over after Inspection.

EPC PROJECT PREAMBLE

INTRODUCTION:

In this context, we are inviting prospective EPC Partners & vendors for coming forward and take up the work in consultation with us.

SCOPE OF WORK: Site visit, land preparation, contour & Geotechnical survey, Fencing, Layout, design, supply, install and commissioning within 9~12 months' time from the date of work order with commencement letter. Transmission line and bay extension is excluded in this EPC work.

Note: The date is extendable and we can submit a Project execution Chart with milestones

System capacity between AC & DC is 1:1.2

Net Rate per MW AC is INR 3.30 Crores **EXCLUSIVE** of applicable taxes and duties. As the FPOs are the owners of the power plants, there will be every scope for tax exemptions from the government for women farmers and under those circumstances, the said taxes will be returned by the government.

PAYMENT TERMS: Mobilisation advance (against APBG) of 20% of the work order shall be given along with the work order and this will be adjusted against the RA bills.

- 50% of the work order value will be paid against supply of material to site
- 25% of the work order value will be paid after commissioning of plant
- 5% of the work order value will be paid after defect liability period from COD.

There is a flexibility to negotiate regarding payment terms and schedules as per the case and based on rational substantiation.

PROJECT TIMELINES: 9 months from the date of work order with commencement this may go up-to 12 months from the date of work order.

Annexure -1

Scope of work

(PPA Owner)	EPC contractor
Evacuation Line	EPC works Package with Design, Engineering, Manufacturing, Supply, Erection, Inspection, Installation, Testing, Commissioning and defect liability period,
Provisioning of Land banks (Agri & Non-Agricultural Land) for 1100 MW DC Solar PV project	Transportation of material unloading at site
	Fencing & Security At site
Road to site for material transportation	To be Discussed
Facilitate the permissions & the other relevant documents for executing the project smoothly, including the connect with the Govt and the farmers getting clearances etc	After the land is handed over the land will be secured and project team will be mobilized
Control room standards as per electricity board	Consortium will comply and execute
Codes and standards	Material will be ordered as per Codes and standards
Inspection	Will facilitate inspection
Solar Panels	Non DCR/ALMM
Structure	fifty percent and wherever needed we will study on case to case basis' of additional scope as we are not going 100 percent Agro PV The raised structure will be 12Feet height (and we will paid for the raised structure)

Technical terms:

- Termination at transformer – Yes
- Project is DC - AC & DC is 1:1.2 (as mentioned above)
- Fixed panels - Yes

ANNEXURE-A
EPC SCOPE OF WORKS AND CONTRACTOR'S OTHER

OBLIGATIONS SCOPE OF WORK FOR WORK ORDER No:

EPC CONTRACTOR:

1.1 The Contractor shall perform or cause to be performed all actions as may be required in connection with the design, engineering, manufacturing, inspection, shop testing, packing, fabricating, procuring and delivering the Equipment and Materials with respect to the Plant, at the Plant Site as set out in detail here in this Schedule. The Equipment and Materials shall be suitable and fit for its intended purpose as per the specifications in Annexure-B. All Equipment and Materials supplied shall be new and without defects.

1.2 INSPECTION AND EXPEDITING

1.2.1 Contractor shall conduct regular routine factory acceptance test (Procedure needs to be set out separately) as per relevant IS (Indian Standards)/IEC (International Standards) for the final Equipment. No additional or repeat test or inspection is envisaged. Routine test report shall be submitted along with Equipment, unless otherwise specified agreed in writing by Contractor. Contractor's scope is limited to submission of valid type test report in support of validity of the design.

1.2.2 OWNER INSPECTION RIGHTS

The Contractor will furnish a schedule of testing, so that Owner may associate his representative to witness the tests. The Contractor shall also furnish all test/inspection reports. In case Owner wishes to execute new type tests, the same shall be carried out with additional cost and time chargeable to Owner. All equipment shall be further tested at site, as recommended, before commissioning. The Inspection shall be carried out by the Owner or waived off within 7 days of written Notice from the Contractor.

2.2.3 ROYALTIES AND LICENSE FEES

The Contractor shall in supplying the Equipment and Materials also obtain from its Sub-Contractors the right of the Owner to use all the proprietary rights, intellectual property rights on a royalty free and non-exclusive basis. The Contractor shall pay all required royalties and license fees with respect to proprietary rights, intellectual property licenses and work orders and shall procure, as required, the appropriate proprietary rights, intellectual property licenses and work orders for materials, methods, processes and systems incorporated into the Equipment and Materials under the Scope of Supplies. In performing its obligations hereunder, the Contractor shall not incorporate into the Scope of Supplies, any materials, methods, processes or systems that involve the use of any confidential information, intellectual property or proprietary rights that the Contractor or the Owner does not have the right to use or that may result in claims or suits against the Owner or the Contractor arising out of claims of infringement of any patent rights, copyrights or other proprietary rights, or applications for any such rights, or use of confidential information. No separate consideration shall be payable by the Owner to the Contractor towards any royalties and license fees.

2.2.4 RELEASES AND WAIVERS

Upon payment of the sums due to the Contractor under this Work order it shall be deemed that the Contractor has released/waived all claims over the same.

2.2.5 OPERATING MANUAL

The Contractor shall at the time of shipment of the Equipment and Materials, provide along with such shipment, the equipment and system instructions for the operation and maintenance procedure of the Equipment and Materials (collectively, the “**Operating Manual**”). The copies/sets of the Operating Manual shall be in the English language. The Contractor shall obtain all instruction manuals and special directions required for preparation of the Operating Manual from the Sub-Contractors, equipment manufacturers or vendors.

2.2.6 COMMENCEMENT OF CONTRACTOR’S PERFORMANCE

The Contractor shall commence performance of the Contractor’s obligations hereunder on the date that the Owner specifies (the “**SupplyCommencement Date**”) in a written notice delivered to Contractor (the “**Notice to Proceed**”), the form of which is given in **Schedule for advance payment, whichever is later**. The Contractor acknowledges that time is of the essence for this Work order and shall provide the Equipment and Materials in accordance with the Supply Schedule.

2.2.7 COMPLIANCE WITH APPLICABLE LAWS

The Contractor shall comply with and shall cause all Equipment and Materials supplied hereunder, to comply and be capable of complying, with all Applicable Laws and Applicable Permits.

2.2.8 SUPPLY SCHEDULE

The Supply Schedule for supply of Equipment and Materials in accordance with the Scope of Supplies, as agreed between the Parties, is set-forth in **Schedule** thereof. The schedule should be such that the COD is completed in 3 (three) months from the Notice to Proceed (NTP) or advance payment, whichever is later. The EPC contractor shall be obligated to adhere to the Supply Schedule thereby, agreed and any variation therefrom shall require the prior written consent of the Owner. Provided that the Owner may vary the Supply Schedule on account of occurrence of a Force Majeure Event or failure or delay due to reasons attributable to Owner or with prior written notice of 30 (thirty) days to the Contractor. In the event of such variation of such Supply Schedule by the Owner, the Owner shall be liable for and shall compensate the Contractor for additional costs agreed in writing by the Owner on account of such change.

2.2.9 PACKING, TRANSPORTING, FORWARDING AND RELATED MATTERS

- (i) The Contractor shall be responsible for packing, loading, transporting and safe delivery of all the Equipment and Material at the Plant Site.
- (ii) The Contractor shall ensure transportation of the Equipment and Material such that the Equipment and Material shall be delivered to the Plant Site in accordance with the Supply Schedule.
- (iii) The Contractor shall provide such packing of the Equipment and Material as is required to

prevent their damage or deterioration during transit to the Plant Site. The Contractor, shall after proper painting, pack and crate all Equipment and Material in a manner suitable for transportation to and storage at the Plant Site per standard industry practice and in such a manner so as to protect them from damage and deterioration in transit by ship, road, rail or air and during storage at the Plant Site till the time of utilisation. The packing shall be sufficient to withstand rough handling during transit

by road, rail and / or air and exposure to rain, humidity, extreme temperatures, earthquakes, salt and precipitation. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the Plant Site and the availability of handling facilities at all points in transit. The packing, marking, and documentation within and outside the packages shall be in English and shall comply strictly with such special requirements as shall be expressly provided for in this Work order, including additional requirements, if any, in any subsequent instructions ordered by the Owner. The Contractor shall be held responsible for all damages or loss due to improper packing.

- (iv) All demurrage, wharfage and other expenses incurred due to delayed delivery or clearance of the Equipment at the delivery port/ railway side for reasons solely attributable to the Contractor shall be to the account of the Contractor.
- (v) At least 3 (three) days prior to the delivery of the Equipment and Materials at Plant Site, the Contractor shall send written communication to the Owner setting forth the information concerning each such consignments set forth in Part A of **Schedule H**
- (vi) Within 5 (five) days after each shipment, the Contractor shall send to the Owner by courier (or by certified airmail if the Owner so agrees) for information, the documents listed in Part B of **Schedule H**.
- (vii) The Contractor shall be solely responsible for any shortages or damage in transit or transportation or shipment of the Equipment and Materials till the Equipment and Materials have been safely delivered to the Plant Site. Further, the Contractor shall continue to be solely responsible for any shortages or damage or defect in the Equipment and Material till the expiry of a stabilization period of 2 (two) month beyond the Final Acceptance.
The Contractor shall be responsible for doing all necessary acts, acts and deeds to ensure safe delivery of the Equipment and Material at the Plant Site.

2.2.10 AS DELIVERED INSPECTION OF EQUIPMENT AND MATERIAL

After arrival of the Equipment and Material at the Plant Site, the Owner shall promptly schedule a joint inspection during which the Owner and the Contractor shall jointly inspect the packing, appearance and check the number of packages per bill of lading to check for any shortage or damage to the Equipment and Material or the packaging thereof. As a result of any such inspection, if any shortage or damage is discovered to exist, then the Contractor shall immediately take steps to make good such shortfall in the Equipment and Material or any damages therein by *inter alia* replacing the damaged Equipment and Material by replacing the same. Provided that such steps to remedy the shortage or damage shall be taken in consultation with the Owner. Provided further that any joint inspection carried out by the Owner pursuant to the terms of this Clause, shall not relieve the Contractor of its obligations hereunder. The Owner shall have no obligation to accept any Equipment and Material which is damaged in any manner or is not in accordance with the terms of this Work order and the Contractor shall replace at the Contractors cost any damaged Equipment and Material, provided that any inspection or acceptance of the Equipment and Material by the Owner shall

not relieve the Contractor from any of its obligations under this Work order. It is further clarified that any approval by the Owner to replace any defective Equipment and Material shall not be construed as a waiver of the obligations of the Contractor hereunder. Any Equipment and Material which needs to be replaced shall be removed from the Plant Site by the Contractor promptly so that it does not cost any hindrance to the work at the Plant Site. Further the Owner shall not be liable in any manner for any loss or damage to such Equipment and Material lying at the Plant Site, before removal of the same by the Contractor. If the Contractor fails to remove the Equipment and Material from the Site even after the Owner having given the Contractor a written notice of 15 (fifteen) days to remove such Equipment and Material, then the Owner shall be entitled to remove such Equipment and Material and the Contractor shall reimburse the Owner for any costs incurred in such removal.

2.2.11 INSPECTION NOT A RELEASE

Neither the inspection at the port of entry in India nor following delivery at the Plant Site, no matter whether the Owner's personnel have been present, shall release the Contractor from any of the obligations or warranties stipulated in this Work order.

3. SUB-CONTRACTORS

3.1 SUB-CONTRACTORS AND EQUIPMENT CONTRACTORS

- 3.1.1 All consultants and Sub-Contractors providing Equipment and Materials to the Contractor under a subcontract with the Contractor in connection with the Scope of Supplies are herein referred to as "**Sub-Contractors**" and such work orders entered into between Contractor and Sub-Contractors are herein referred to as "**Subcontracts**". In this regard, the Contractor shall, by way of written notice, provide the Owner's Representative (appointed pursuant to Clause 5.2 hereof) with a list of proposed Sub-Contractors ("**Notice of Proposed Sub-Contractors**") for the Owner's approval.
- 3.1.2 It is clarified that, in the event the Owner's Representative fails to respond to the Notice of Proposed Sub-Contractors issued under Clause 3.1.1., within a period of 5 (five) days of receipt of the list of "**Sub-Contractors**" submitted shall deemed to be considered as approved and the Contractor shall be entitled to proceed with the appointment of Sub-Contractors from the list so issued. For the avoidance of doubt, it is clarified that the procedure set-out in Clause 3.1.1. and Clause 3.1.2 shall be followed each time the Contractor proposes to appoint a Sub-Contractor in connection with providing Equipment and Materials.
- 3.1.3 Subcontracting shall not relieve the Contractor from any of its liabilities or obligations under this Work order and the Contractor shall continue to remain solely liable to the Owner for performance of its obligations under this Work order. The Contractor shall be liable to the Owner for the acts and omissions of Sub-Contractors and those of the employees and agents of the Sub-Contractors as if they were acts and omissions of the Contractor.
- 3.1.4 The Contractor shall ensure that each Subcontract includes provisions which shall enable the Contractor to discharge the Contractor's obligations and liabilities to the Owner under the terms of this Work order (including assignment of its rights in favor of the Owner as contemplated under Clause 3.2 below).

3.2 SUB-CONTRACTOR WARRANTIES

The Contractor shall, for the protection of the Owner, obtain from all Sub-Contractors guarantees and warranties on all Equipment and Materials procured/provided under any Subcontract and such guarantees and warranties shall not be amended, modified or otherwise discharged without the prior written consent of the Owner. A failure to obtain such warranties shall not excuse the Contractor from its warranty obligation under Clause 7 hereof. The Contractor shall enforce such guarantees and warranties still in effect to the fullest extent thereof until such time as they are transferred to the Owner. Upon the expiration or termination of any of the guarantees or warranties provided by the Contractor pursuant to Clause 7 hereof Contractor shall assign, and hereby assigns, effective as of such date, or otherwise make available, to the Owner all of Contractor's rights under all such Sub-Contractor guarantees and warranties still in effect. The Contractor shall ensure that each Subcontract shall allow the Contractor to freely assign its rights there under to the Owner.

3.3 REVIEW AND APPROVAL NOT RELEASE OF CONTRACTOR' LIABILITY.

The review, approval and consent by the Owner as to Contractor's entering into any Subcontract with any Sub-Contractor shall not relieve Contractor of any of its duties, liabilities or obligations under this Work order, and Contractor shall be liable hereunder to the same extent as if any such Subcontract had not been entered into. Any inspection, review or approval by the Owner permitted under this Work order of any portion of the Scope of Supplies or of any work in progress by Contractor or Sub-Contractors shall not relieve Contractor of any duties, liabilities or obligations under this Work order.

3.4 DEED OF STEP-IN

The Contractor shall, if requested by the Owner, deliver to the Owner as soon as practicable, after it enters into a Subcontract a signed and enforceable deed of step-in in favour of the Owner in a form acceptable to the Owner.

4. CONSIDERATION

4.1 CONTRACT PRICE

As full consideration to the **EPC contractor** for the Equipment, Materials and services to be provided hereunder including and for performance of all its obligations under the work order in accordance with the terms of the Work order, the Owner shall pay, and the Contractor shall accept, the contract price as specified in **Schedule B** as such sum may be adjusted in accordance with the terms of this Work order (the "**Contract Price**").

- 4.1.1 The EPC contractor agrees that it shall provide the Owner with an irrevocable and unconditional performance Bank/Corporate guarantee in the form acceptable to the Lenders/Owner & the Bankers of the EPC contractor for the amount equal to the mobilization advance. The total sum for Equipment, Material and services for a sum of **Rs.3,50,00,000/- (Indian Rupees: Three Crores Fifty Lakhs Only)** for the period of 9 months from mobilization advance date to the commercial operation date (COD). All Guarantees being valid from the date of release of mobilization advance and shall have an additional claim period of 30 (thirty) days after the expiry period. The Owner shall be entitled to draw upon the Performance Bank/Corporate Guarantee to recover Performance Liquidated Damages payable to it in terms of this Work order for failure to meet any of its obligations, provided a due written notice at least 10 days prior to such event is given to the Contractor by the owner.

- 4.1.2 If it is a special Work Order agreed between the Parties, Performance Bank/Corporate Guarantee will not be taken for the mobilization advance in these circumstances and not under any other circumstances. In case any extension is granted to the Work order, it will be done on mutual consent of Owner & Contractor based on the realistic situation and shall be extended accordingly.

4.1.3 **CONTRACT PRICE FIRM AND FIXED**

The Contract Price is inclusive of all applicable taxes and duties shall be firm and fixed during the currency of the Contract and shall be subject to adjustment only in accordance with a Variation Order.

4.2 **TAXES & DUTIES**

- 4.2.1 As afore stated, the Contract Price is inclusive of all applicable Taxes and duties. if any payable on the Supplies to be made under this Work order and the payments to be made with respect to the same except income tax on the Contract value. The Owner shall furnish to the appropriate taxing authorities, all required information and reports in connection with such Taxes and, upon request by the Owner, EPC contractor shall assist in promptly furnishing copies of all such information and reports to the Owner. Any variation in the rates of existing taxes and duties/levies and/or introduction of new taxes/duties/levies shall be to the account of the Owner.
- 4.2.2 Both the Parties are aware that, the Equipment, Materials and Services being a part of a non-conventional energy project will be entitled to certain exemptions in Taxes subject to obtaining relevant certificates of exemptions from appropriate Governmental Authorities. The Contractor shall arrange the necessary exemption certificates for NIL Customs/Excise duty as may be applicable on various Equipment and Material from the concerned Government authorities. All necessary documents for getting Concessional Custom Duty Certificate (CCDC) & Excise Duty Exemption Certificate (EDEC) from MNRE will be provided by Owner/SSPL. Necessary coordination will be done by Contractor In absence of such certificates, differential Custom Duty and Excise Duty to be paid extra at actual. The taxes & duties amount exempted to be returned to the Owner as the EPC price is inclusive of all taxes & duties.
- 4.2.3 The Contractor & Owner shall at all times comply with Applicable Law with respect to Taxes and shall indemnify and hold the other party harmless with respect to any claim against or liability to the Owner due to the Contractor's failure to pay all Taxes required to be paid by the Contractor and vice versa.

4.3 **TERMS OF PAYMENT**

The Contract Price shall be payable to the EPC contractor after deducting mobilization advance, any taxes if required to be withheld in accordance with the Terms of Payment attached as **Schedule B** hereto.

The Owner shall release of mobilization advance equal to 10% of the work order value against advance bank guarantee of same amount valid for 12 months. 70% payment of major material/equipment (Solar Panel, Inverter, Transformers, Cables and mounting structure) shall be released upon receipt of material at site and inspection clearance of SPL representative at site. It is clarified that the Owner shall be entitled to withhold payment, if the Equipment and Materials are found to be defective or deficient, till such defective or deficient Equipment or

Material has been replaced to confirm with the terms of this Work order. Or on pro-rate basis or as per agreed terms.

In the event that the EPC contractor has completed all its obligations required to be completed till Final Acceptance under the terms of this Work order but the date of commercial operations of the Plant is not achieved within a period of 30 (thirty) days from the Scheduled Plant Commercial Operation Date (“**Wait Period**”), on account of failure on part of the Owner or TGSPDCL/TGNPDCL to provide Grid Connectivity except if such failure is solely attributable to a default on part of the Contractor to perform its obligations under terms of this Work order, the Owner shall on the expiry of the afore-mentioned Wait Period, be obliged to pay the EPC contractor such amounts of the Contract Price as were due and payable on the achievement of the SCOD in accordance with Schedule hereof.

Subsequently, after period of another 30 (thirty) days from the date of SCOD, the Owner shall be obliged to pay the EPC contractor such amounts of the Contract due to be paid on completion of successful closure of pending equipment/materials or services.

4.4 PAYMENT NOT ACCEPTANCE

Making of any progress payment or other payment to EPC contractor shall not constitute an acceptance of any of the Equipment and Materials provided hereunder and shall not relieve the EPC contractor of any of its contractual obligations or liabilities with respect thereto.

5. OWNER’S RESPONSIBILITIES

5.1. PAYMENT

The Owner shall make timely payments to the EPC contractor of all undisputed amounts due under this Work order in accordance with the terms and provisions of this Work order. Any delay in provision of LC or payment shall entitle the Contractor to an extension of time proportionately.

5.2. OWNER’S REPRESENTATIVE.

The Owner shall have authority and responsibility to act on behalf of the Owner and agree upon procedures for coordinating the Owner's obligations with those of the EPC contractor. The Owner’s Representative shall respond to the EPC contractor on any matters that require the approval of the Owner within 5 (five) Business Days of receipt from the EPC contractor, failing which the request deemed to be considered as approved and shall have the right to proceed on the matter. For the avoidance of doubt, it is clarified that the procedure prescribed in this Clause 5.2 shall be followed on each occasion that the EPC contractor requires the Owner’s approval.

5.3. PERMITS AND LICENSES

The Owner shall obtain and maintain in effect, in a timely manner so as to enable the EPC contractor to perform its obligations hereunder, applicable permits required in connection with the supply of the Equipment, Materials and services hereunder and asset-out in **Part A of Schedule M** to this Work order (the “**Owner Permits**”). The EPC contractor agrees to provide support to the Owner with respect to obtaining the Owner Permits, which support shall include attendance at meetings with the Owner and third parties designated by the Owner.

5.4. Access to Site

The Owner shall ensure full and complete access to the Plant Site and right of way for erection of transmission lines is made available to the EPC contractor, without any hindrances or obstacles to perform and complete its obligations under this Work order and to provide them with all assistance necessary in this regard.

- 5.5. The Owner shall promptly provide the EPC contractor with information and documents as may be requested by written notice of at least 5 (five) Business Days to perform its obligations hereunder in a timely manner.

6. EXTENSION OF TIME

6.1. GROUNDS FOR EXTENSIONS OF TIME

Except as may be otherwise agreed to in writing by the Owner no extension of time shall be granted to the Contractor for supply of the Equipment and Material except on account of an extension in the time for performance of obligations on account of a Force Majeure Event or in the event that the delay is caused due to a failure of the Owner to comply with its obligations as set-out under Clause 5.1, 5.3 or 5.4.

7. WARRANTIES AND INTELLECTUAL PROPERTY

7.1. WARRANTIES

The EPC contractor warrants with respect to the Equipment, Materials and Services that (i) all Equipment and Materials shall be free from defective workmanship and materials (ii) the design and engineering of the Equipment and Materials shall be free from deficiencies and (iii) shall be in accordance with the terms of this Work order. If the EPC contractor discovers or the Owner notifies the EPC contractor in writing (with adequate detail) of any defects with respect to item (i) above or deficiencies with respect to item (ii) above in any of the Equipment and Materials delivered hereunder and discovered, any time prior to Final Acceptance or during the Warranty Period, the Contractor shall promptly take all necessary action to, repair or replace any defective Equipment and Materials at the Contractor's cost. It being clarified that the decision of whether the Equipment and Material shall be repaired, rectified or replaced shall be determined by the Contractor in consultation with the owner and shall be in a manner which does not affect the operating efficiency of the Plant in any manner.

The warranty shall not be applicable under any of the following circumstances:

The Equipment and Material is not operated in accordance with the procedure of original equipment manufacturer (OEM) Operating Manual and the warranty conditions stipulated in the operating manual accompanying such Equipment and Material and provided by the Contractor to the Owner at the time of delivery of the Equipment and Materials.

7.2. WARRANTY PERIOD

For the purpose of this Work order, the “**Warranty Period**” for Equipment and Materials delivered hereunder performed hereunder shall be the period commencing on the date of Final Acceptance and ending at date/period specified by the manufacturer of the respective Equipment and Materials.

The Owner shall, within 30(thirty) days, give notice to the Contractor of the discovery of any defect or deficiency in the Equipment or Materials (a “**Defect**”). Following the receipt of notice of any Defect, the Owner and the Contractor shall conduct a joint survey of the alleged Defects and the Contractor shall promptly and at its cost and expense, repair, replace or otherwise make good any Defect at its discretion in the manner stated herein. In the event that the Contractor comes to the conclusion that such Defect(s) do not exist and the Owner does not agree with such decision of the Contractor, then the question of whether or not such Defect(s) exist shall be referred to the Complaints Redressal Committee which shall resolve such question in accordance with Clause 15.1 herein below.

- 7.3.** All costs incidental to the Contractor’s performance of its obligations under, this Clause 7, including the removal, redesign and/or replacement and **reinstallation** of Equipment and Materials necessary to gain access in order to correct the Defect shall be borne by the Contractor. The Contractor shall submit to the Owner details of the repairs and replacements which it proposes to make pursuant to this Clause, the estimated duration of the repairs or the duration required to affect the replacement, details of any shut down it considers necessary to be carried out in the Plant for the duration of the repairs contemplated to be made hereunder and the proposed schedule for such repairs or replacements. The Owner shall afford the Contractor such access to the Plant as may be necessary in the circumstances for such purposes. The Contractor shall coordinate with the Owner and the Other Contractors so as to minimize any loss to the Owner for the duration of the repair or replacement.

Where such defect can be remedied and the Contractor fails to remedy the Defect, within 15(fifteen) days after receipt of notice from the Owner, or, where such Defect affects the Plant’s safe operation, within 72 (seventy-two) hours after notice from the Owner, the Owner may carry out the work itself

at the Contractor’s risk and expense. The Contractor shall pay the costs mutually accepted by Owner & Contractor, that has been incurred by the Owner in remedying the Defect within 30 (thirty) days of claim thereof by the Owner.

7.4. TITLE, LIENS AND ENCUMBRANCES

Notwithstanding anything contained in this Work order, the Contractor warrants that title to the Equipment and Material provided hereunder shall pass to the Owner free and clear of all liens, security interests and other encumbrances on such items, subject to receipt by the Contractor from the Owner of all payments due and payable under this Work order to the Contractor, and that none of the Equipment and Material provided or acquired by the Contractor to the Owner are subject to any work order under which a security interest or other lien or encumbrance is retained by any person. In case of Sale in Transit, the title of the goods will be transferred on completion of the transit sale.

7.5. LATENT DEFECTS

7.5.1. CONTRACTOR’S LIABILITY FOR LATENT DEFECTS

Notwithstanding the expiration of the Warranty Period with respect to the Equipment and Materials, the Contractor shall be responsible for making good by repair, redesign and/or replacement, at its cost and expense and with all possible speed any Latent Defect in the Equipment and Materials that appears at any time before the expiration of 2 (TWO) years commencing on the COD or as that period as given by the Original Equipment manufacturers whichever is later.

7.5.2. APPLICABLE LATENT DEFECTS

This Clause 7.5 applies to *inter alia* defects in any design, engineering, Equipment and Materials and workmanship on the following components of the Plant, which a reasonable examination by the Contractor or the Owner at any time prior to the expiration of the Warranty Period would not have disclosed; provided that such defect significantly affects the operation, maintenance, safety, lifetime or performance of the Plant (the “**Latent Defects**”), more specifically in respect of, *inter alia*:

- (a) all static and rotary (if applicable) equipment;
- (b) all process control items;
- (c) all instruments and control system items; and
- (d) all electrical items.

7.5.3 The Contractor shall not be obliged pursuant to this Clause 7.5 to repair defects where at the time of discovery of the defect, the imminent repair or replacement is already contemplated for such parts under the recommendations contained in the Operating Manuals.

7.5.4 CONTRACTOR TO REPAIR AND REPLACE

The Owner shall promptly give notice to the Contractor of the discovery of any Latent Defect, the Contractor and Owner shall jointly survey the alleged Latent Defect, the Contractor shall promptly and at its cost and expense, repair, replace or otherwise make good (in the manner that the Contractor shall deem fit provided that it does not affect the operating efficiency of the Plant in any manner) any Latent Defect.

In the event that the Contractor comes to the conclusion that such Defect(s) do not exist and the Owner does not agree with such decision of the Contractor, then the question of whether or not such Latent Defect(s) exist shall be referred to the Complaints Redressal Committee which shall resolve such question in accordance with Clause 15.1 herein below.

All costs incidental to the Contractor’s performance of its obligations under this clause, including the removal, redesign and/or replacement and reinstallation of equipment and Materials necessary to gain access in order to correct Latent Defects shall be borne by the Contractor. The Contractor shall submit to the Owner details of the repairs and replacements which it proposes to make pursuant to this Clause, the estimated duration of the repairs or the duration required to affect the replacement, details of any shut down it considers necessary to be carried out in the Plant for the duration of the repairs contemplated to be made hereunder and the proposed schedule for such repairs or replacements. The Owner shall afford the Contractor such access to the Plant as may be necessary in the circumstances for such purposes.

7.5.5. The Contractor shall coordinate with the Owner and the Other Contractors so as to
minimiz
e any loss to the Owner for the duration of the repair.

7.5.6. FAILURE TO REMEDY LATENT DEFECTS

If the Contractor fails to remedy or commence remedying the Latent Defect, within a period of 15 (Fifteen) days after receipt of notice from the Owner, or, where such Latent Defect affects the Plant’s safe operation, within 72 (seventy-two) hours after notice from the Owner,

the Owner may carry out the work itself at the Contractor's risk and expense. The Contractor shall pay the costs mutually accepted by Owner & Contractor, that has been incurred by the Owner in remedying the Latent Defect to the Owner within 35 (thirty-five) days of claim thereof by the Owner.

7.6 INTELLECTUAL PROPERTY

- 7.6.1 All the intellectual property rights of any nature whatsoever in any intellectual property (including but not limited to patents, copyrights, trademarks, logos, brand names, corporate names, designs and artistic creations and similar rights of any type) in the Equipment and Material shall at all times vest in the Contractor or the respective Sub-Contractor/Manufacturer of the same.

The Owner further acknowledges that this Work order shall not be construed in a manner so as to assign, transfer or convey unto the Owner any rights in the intellectual property in the Equipment and Material, or any right to any use thereof, except to the extent that may be necessary for the purposes of this Work order. However, the Owner upon purchase of the Equipment and Materials will be entitled to a royalty-free license to use such intellectual property solely for the purpose of operation and maintenance of the Equipment & Material.

- 7.6.2 The Owner agrees and undertakes not to make any claim of any nature whatsoever with regard to the Ownership or any other right in the intellectual property of the Equipment and Material in violation of the terms stated hereunder.
- 7.6.3 The Contractor hereby warrants to the Owner, that the Owner has the right (without payment of any additional costs) to possess, own, use, operate and dispose-off the Equipment and Materials and agrees to defend and hold harmless the Owner from any claims or Losses arising out infringement or alleged infringement of intellectual property rights of any Person on account of possession or use of or disposal of the Equipment and Materials.
- 7.6.4 The Contractor's obligations under this Clause 7 shall be the sole responsibility of the Contractor and the Contractor shall not be relieved from its obligations to repair or replace the Equipment, And Materials in the event a Sub-Contractor or a Contractor to the Contractor fails to provide the necessary Equipment or materials to the Contractor.

8. FORCEMAJEURE

8.1 FORCE MAJEURE EVENT

As used in this Work order, a "**Force Majeure Event**" shall mean in respect of any Party, an unforeseeable act or event which is beyond the reasonable control of the Party and the Party has been unable to overcome such act or event by the exercise of prudent foresight and due diligence and which prevents the Party from performing its obligations under this Work order or complying with any conditions required by the Owner under this Work order, and is an event within one or more of the following categories: (a) war and other similar hostilities, rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot and any explosion or impact of any mine, bomb, shell, grenade or other projectile, missile, munitions or explosive, terrorist attack, riot or civil commotion (except where restricted to the employees of the Party and in case of the Contractor, the Contractor and/or its Sub-Contractors);

(b) flood, cyclone, typhoon, earthquake, fire, explosion, or any other act of God; (c) any

nationwide or state wide strike affecting transportation services required for performance of obligations by the Party.

The following events shall not be a Force Majeure Event (except to the extent that they are consequences of a Force Majeure Event):

- 8.2. unavailability, late delivery or change in cost of plants and materials, Equipment and Material or consumables for the Plant;
- 8.3. delay in performance of any Sub-Contractor or their agents;
- 8.4. breakdown/failure of plant, machinery or equipment;
- 8.5. strikes, collective bargaining work orders of the Party or its Sub-Contractors or any labor disputes at the facilities of the affected Party;
- 8.6. inefficiency of finances or funds or the Work order becoming onerous to perform;
- 8.7. weather conditions typical or usual for the Plant Site/sites where work pertaining to this Work order is to be performed; and
- 8.8. any event arising out of or caused due to (i) negligent and intentional acts, errors or commissions of the affected Party or any breach of obligations by the affected Party (ii) failure of the affected Party to comply with Applicable Law.

8.9 EFFECT OF FORCE MAJEURE EVENT

8.9.1. If either Party is rendered wholly or partially unable to perform its obligations under this Work order because of a Force Majeure Event, that Party shall be excused from performance of the Work order to the extent it is affected by the Force Majeure Event. Further,

8.9.2. the affected Party within 5 (five) Business Days (if not otherwise prevented from doing so by reason of such Force Majeure Event) after the occurrence of the prevention, delay or hindrance in the performance of its obligations due to a Force Majeure Event shall provide written notice to the other Party that such an event has occurred and, within 15 (fifteen) Business Days (if not otherwise prevented from doing so by reason of such Force Majeure Event) of the occurrence of such events provides further notice specifying the particulars of the occurrence, including estimation of its expected duration and probable impact on the performance of its obligations hereunder provided that where the affected Party has given notice after the expiry of the aforesaid period of 5 (five) Business Days, the affected Party shall be excused from performance of the Work order from the date of the occurrence of the Force Majeure Event;

8.9.3. The affected Party shall continue to furnish timely regular reports to the other Party with respect to the Force Majeure Event and actions being undertaken by it to overcome/remove the same, during the period of Force Majeure Event;

8.9.4. The affected Party shall use all reasonable efforts to continue to perform its obligations hereunder and to correct or cure or mitigate the event or condition excusing performance as soon as possible;

8.9.5. The affected Party shall provide the other Party with prompt notice of the cessation of the Force Majeure Event and shall promptly thereupon resume performance hereunder;

8.9.6. The non-performance of any obligation of either Party that was required to be completed prior to the occurrence of the Force Majeure Event shall not be excused as a result of such subsequent Force Majeure Event;

8.9.7. The occurrence of a Force Majeure Event shall not relieve a Party from its obligations to make any payment hereunder for performance rendered prior to the occurrence of the Force Majeure Event or for partial performance hereunder during periods of Force Majeure Event;

8.9.10. The Force Majeure Event shall not relieve either Party from its obligation to comply with Applicable Laws except for the duration of the Force Majeure Event;

8.9.11. Both Parties shall exercise all reasonable efforts to continue to perform their respective obligations hereunder and to mitigate or limit damages to each other;

8.9.12. The affected Party shall not be relieved from obligations under this Work order to the extent that the negligence or intentional acts of the affected Party (or in the case of Contractor, any of its Sub-Contractors, employees or agents) contributes to or aggravates the Force Majeure Event.

8.9.13. The occurrence of a Force Majeure Event affecting the Owner shall not excuse the Contractor from the fulfillment of its obligations unless the Contractor is itself affected by the Force Majeure Event.

9. VARIATIONS

9.1. FURTHER DETAILING NOT VARIATION

It is understood and agreed between the Parties that the Equipment and Materials shall be subject to further refinement, correction and detailing by the Parties from time to time and that Contractor shall receive no additional compensation for such refinement, correction and detailing as long as such refinement, correction and/or detailing does not change the scope of supply from what has been agreed between the Parties under this Work order. However, if the refinement, correction and/or detailing results in the supply of Equipment, and materials which are different from the Equipment and Materials stated under this Work order the same shall amount to a variation as stated below and accordingly the terms and conditions of the Work order shall be adjusted as necessary, in accordance with Clause 9.2 below. Any dispute as to whether such change results in change in the agreed scope of supply shall be determined by the Complaints Redressal Committee in the manner / set out in Clause 15.1.

9.2. VARIATIONS

Subject to the provisions of Clause 9.3 hereof, the Owner and the Contractor, shall be entitled to, without invalidating this Work order, order Variations to the Scope of Supplies and Equipment and Materials, in which event one or more of the Contract Price, the Scheduled Plant Completion Date, the Supply Schedule and any other terms and conditions of the Work order shall be adjusted as necessary by the mutual work order of the Parties.

9.3. VARIATIONS DUE TO CONTRACTOR DEFICIENCIES

No Variation Order shall be issued and no adjustment of the Contract Price, the Scheduled Plant Completion Date, the Supply Schedule or any other provision of this Work order shall be made in connection with any correction of omissions or defective work on the part of the Contractor or any Sub-Contractor.

9.4. PRICE CHANGE

An increase or decrease in Contract Price, if any, resulting from a Variation requested by the Owner or made pursuant to Clause 9.2 hereof shall be determined by the mutual work order of the Parties and shall be payable by the Owner in accordance with the Terms of Payment unless otherwise mutually agreed in writing. If the amount of increase or decrease in Contract Price is not agreed by the Parties, the amount shall be determined by the Complaints Redressal Committee which shall resolve such question in accordance with Clause 15.1 herein below. Such amount shall be a fair and reasonable adjustment to the Contract Price based (where appropriate) on the prices contained in this Work order in respect of compliance with such Variation and any additional reasonable expenses incurred in undertaking such Variation. The Parties shall be bound by the decision of the Complaints Redressal Committee.

10. INDEMNIFICATION

10.1. INDEMNIFICATION

The Contractor shall fully indemnify, defend and hold harmless, the Owner, each of its directors, officers, agents, employees (the “**Indemnified Parties**”), from and against any and all Losses, arising out of or resulting from or related to:

10.1.1. claims by third parties (including the Contractor’s or the Owner’s, agents, or consultants of any tier, personnel or their dependents or Sub-Contractors) on account of bodily injury, death, damages to property or Losses caused by or arising out of fault, act, omission, negligence attributable to the Contractor (or its Sub-Contractors, employees, agents or consultants) and vice versa; or

10.1.2. (a) the Contractor’s provision of the Equipment and Materials pursuant to this Work order; or (b) failure of the Contractor to comply with any of its obligations or covenants under this Work order; or (c) breach of any warranties by the Contractor or inaccuracy in any representations made by the Contractor hereunder; or (d) failure of the Contractor or any of its Sub-Contractors, employees or agents to comply with Applicable Laws or Approvals; or (e) any third party claims pertaining to the Equipment and Materials.

10.1.3 The Owner shall fully indemnify, defend and hold harmless, the Contractor, each of its directors, officers, agents, employees (the “**Indemnified Parties**”), from and against any and all Losses, arising out of or resulting from or related to (a) failure of the Owner to comply with any of its obligations or covenants under this Work order; or (b) breach of any warranties by the Owner or inaccuracy in any representations made by the Owner hereunder.

10.2. NOTICE AND LEGAL DEFENCE

In the event the Indemnified Parties receive any notice or communication from any third party in relation to any claim, the Indemnified Parties shall promptly notify the Contractor of such claim. The Indemnified Parties shall not admit, compromise or settle the claim, any action or proceeding without the prior written consent of the indemnifying person. The Contractor shall assume, on behalf of the Indemnified Party and conduct with due diligence and in good faith, the defense of such claims with counsel reasonably satisfactory to the Indemnified Party; provided that the Indemnified Party shall have the right to be represented therein by advisory counsel of its own selection and at its own expense; and provided further, that if the defendants in any such action include both the Indemnified Party and the indemnifying person and the Indemnified Party shall have reasonably concluded that there may be legal defenses available

to it which are different from or additional to, or inconsistent with, those available to the indemnifying person, the Indemnified Party shall have the right to select separate counsel to participate in the defense of such action on its own behalf at the indemnifying person's expense. All reasonable costs and expenses incurred by the Indemnified Party in connection with the defense or settlement of any such claim, action, proceeding or investigation shall be reimbursed by the indemnifying person promptly upon demand thereof. The indemnifying person's obligation to indemnify pursuant to this Clause 10 shall arise immediately upon the Indemnified Parties being required to make any payments or incur any liability or costs pursuant to a claim irrespective of any defence or right of appeal available to it.

10.3 FAILURE TO DEFEND ACTION

If any claim, action, proceeding or investigation arises as to which the indemnity provided for in Clause 10 hereof may apply, and the Contractor or Owner fails to assume the defense of such claim, action, proceeding or investigation, then the Indemnified Party may at the expense of the former, contest (or, with the prior written consent of the Contractor or Owner) settle such claim.

10.4. SURVIVAL, EXPIRATION OF INDEMNITY

The provisions of this Clause 10 shall survive Final Acceptance and the termination of this Work order.

10.5. REMEDIES

The indemnification rights of the Indemnified Parties under this Work order are without prejudice, independent of and in addition to, such other rights and remedies as the Indemnified Parties may have at Law or in equity or otherwise, to seek specific performance, rescission, restitution or other injunctive relief, none of which rights or remedies shall be affected or diminished thereby.

10.6. LIMITATION OF LIABILITY

Neither Party shall, under any circumstance whatsoever, be liable for any indirect or consequential losses of any nature whatsoever (including but not limited to loss of business, loss of profit, etc.) under this Work order. It is further agreed between the Parties that notwithstanding anything to the contrary the Contractors' cumulative liability under this Work order shall not under any circumstances whatsoever exceed 10% of the total Contract Price.

It is hereby, agreed and acknowledged by the Owner that, the Contractor shall not be liable for any other sums, monies or liabilities of any nature whatsoever in excess of the aforementioned capped amounts for any reasons whatsoever.

11. INSURANCE

11.1 INSURANCE OF EQUIPMENT AND MATERIALS

The Contractor shall arrange and pay for the transit for Equipment and Materials till the Plant Site and keep each part thereof insured for its full replacement value (as provided in the schedule for insurance at **Schedule G** hereto). Any insurance cover obtained by the Contractor shall be mutually agreed between the Contractor and the Owner. Such insurance

shall cover all risks of damage and loss of the Equipment and Materials during transit right from their ex-works dispatch till Final Acceptance. All insurance costs shall be deemed to be included in the Contract Price.

11.2. RISK OF LOSS OR DAMAGE

Notwithstanding anything to the contrary contained in this Work order, the Owner shall not bear the risk of physical loss or theft of the Equipment and Materials, regardless of whether the Owner has title thereto, till the material reached the final installation site, inspected, installed and commissioned. The Owner shall ensure the safety of equipment or materials are integrated in to system at site, thereafter from any theft or physical loss.

12. TERMINATION

12.1 TERMINATION OF CONTRACT BY THE OWNER FOR REASONS BEYOND THE CONTROL OF THE OWNER

In the event that any of the PPAs is terminated by TGSPDCL/TGNPDCL due to any reason whatsoever or if a Force Majeure Event affecting the performance of obligations hereunder subsists for a period of more than 60 (sixty) days, the Owner shall be entitled, to terminate any part of the Work order by giving at least 30 (thirty) days' prior written notice to the Contractor specifying the part of the Work order which shall stand terminated and the effective date of termination. Upon receipt of such notice, the Contractor shall promptly initiate steps to stop provision of further Equipment and Materials. In the event of a partial termination, the contractor shall continue to produce the part of the Equipment and Materials not terminated. Subject to the provisions contained in Clause 9 of the Work order, in case of a termination of part of the Contractor's Scope of Supplies, the Owner shall authorize a Variation Order making reasonable adjustments to one or more of the Scheduled Plant Completion Date, the Contract Price, the Supply Schedule and any other affected provisions of this Work order, as applicable. In the event of termination by the owner under this Clause (except where the termination of one or more PPAs is due to failure of the Owner to comply with its obligations under the respective PPA for reasons attributable to non-performance hereunder by the Contractor), the Owner shall be liable to pay the Contractor for all Equipment and Materials, delivered at the Plant Site till the date of the notice of termination, by the Contractor in accordance with the terms of this Work order.

12.2. TERMINATION UPON CONTRACTOR'S MATERIAL BREACH

In the event:

- 12.2.1. the Contractor is adjudged bankrupt or insolvent or if the Contractor makes a general assignment for the benefit of its creditors, or if a trustee or receiver is appointed for the Contractor or for any of its property, or if a proceeding is commenced to reorganize under the bankruptcy or similar laws; or
- 12.2.2 if the Contractor fails to supply Equipment and Materials in accordance with the terms of this Work order including Equipment and Materials which meet the standard for Equipment and Materials set forth in this Work order; or
- 12.2.3 if the Contractor fails to make payments to its Sub-Contractors, employees or agents as a result of which claims are brought by such third parties against the Owner; or

12.2.4 if the Contractor disregards any material provision of any Applicable Law; or

12.2.5 if the Contractor otherwise commits a breach of any of the terms of this Work order or fails to comply with its obligations under this Work order; (each of the events set forth in sub clauses 12.2.1 to 12.2.5 being referred to as a “**Default**”), the Owner shall be entitled to, without prejudice to any other right or remedy the owner may have hereunder or at law or in equity, upon the occurrence of a Default, terminate this Work order if such Default is not capable of being remedied or if capable of being remedied, the Contractor fails to remedy the Default within 7 (days) days of written notice to the Contractor notifying the occurrence of a Default and requiring the Contractor to remedy the same. Without prejudice to the aforementioned, the Owner shall be entitled, to terminate the Work order upon the occurrence of any event which the Contractor has agreed in writing will entitle the Owner to terminate this Work order.

12.3. CONSEQUENCES OF DEFAULT

Upon the occurrence of any Default, without prejudice to its right to terminate the Work order, the Owner shall have all of the following rights:

12.3.1 To require the Contractor to remove all Equipment and Materials at the Plant Site within 7(seven) days from the date of the termination notice and refund (without any deduction whatsoever) any amounts paid by the Owner till the date of termination notice; and/or

12.3.2 Recover any Loss incurred on account of the Default by the Contractor; and/or purchase the Equipment and Material from any third party and recover any excess amounts paid to the third party over and above what would have been paid to the Contractor for the same purchase, from the Contractor; and/or

Require the Contractor to assist the Owner in preparing an inventory of all Equipment and Materials in use or in storage at Contractor’s premises and use all reasonable endeavors to assign to the Owner all Subcontracts as may be designated by the Owner, to the extent such Subcontracts are assignable; provided that the Owner shall assume and become responsible for all obligations arising under such Subcontracts after the date of such assignment (other than liabilities that have accrued prior to the date of assignment for which the Contractor shall continue to be liable).

12.4 TERMINATION BY THE CONTRACTOR

The Contractor shall have the right to terminate this Work order by issuing a written notice of 60 (sixty) Business Days if

a) On account of extended Force Majeure singly or cumulatively of 120days

b) Default of Owner

c) it does not receive amounts due and payable to it in terms of the Work order, from the bank issuing LC, within 15 (fifteen) days after the date of presentation of all the requisite documents required to be submitted to the bank for release of the payment in the form required by the bank and making a demand for such payment provided that there is no default on account of which the Owner is entitled to withhold payment; and (ii) the Contractor is not in breach of any of the terms of this Work order.

d) the Contractor is unable to carry out any of its obligations for any reason attributable to the Owner, including but not limited to the Owner's failure to provide possession of or access to the Site or other areas or failure to obtain any applicable permit necessary for the execution and/or completion of the facilities which the Owner is required to obtain.

Provided that if such notice of termination has been issued and in the meantime the default is rectified by the Owner, the notice of termination shall be deemed to be withdrawn.

The Contractor shall be entitled to all payments due from the Owner for supplies and such amounts shall be released by the Owner within 60 days of the Notice of Termination being issued.

12.5 WARRANTIES CONTINUING

The warranty obligations of Contractor under this Work order with respect to Equipment and Materials provided shall survive any termination of this Work order.

12.6 SURVIVING OBLIGATIONS

Termination of this Work order (a) shall not relieve either Party of its obligations with respect to the confidentiality of information as set forth in Clause 14 hereof, (b) shall not relieve either Party of any obligation hereunder that expressly survives termination hereof, and (c) shall not relieve either Party of any obligations or liabilities for loss or damage to the other Party arising out of or caused by acts or omissions of such Party prior to the date of such termination.

13. ASSIGNMENTS

13.1. CONSENT REQUIRED

The Contractor cannot assign, convey or transfer this contract, in whole or in part, except upon the prior written consent of the Owner, which consent shall not be unreasonably withheld. However, the Owner consents to the Contractor sourcing the equipment from the approved Sub-Contractors. The Contractor's right to sub-contract shall not in any way relieve the Contractor from its obligations under the contract. Except as may otherwise be provided herein, there shall be no privity between Sub-Contractors and Owner.

Nothing in the contract shall create any obligation on the part of Owner to pay any Sub-Contractor. The Contractor shall ensure each of its Sub-Contractors complies with law and terms of the Contractor.

However, the Owner may assign, convey or transfer this contract, in whole at its discretion any time without any prior consent of the Contractor.

13.2 SUCCESSORS AND ASSIGNS.

All of the rights, benefits, duties, liabilities and obligations of the Parties hereto shall inure to the benefit of and be binding upon their respective successors and permitted assigns.

14. CONFIDENTIAL INFORMATION

14.1 CONFIDENTIALITY

The Parties agree that they shall at all times keep confidential all Confidential Information which any of them may acquire in relation to the business of the other Party or the Plant or subject matter hereof, provided that a Party may deliver or disclose Confidential Information to: (i) such Party's employees, officers, agents and consultants and its group companies, provided that the Confidential Information is disclosed strictly on a "need to know" basis and subject to the Party taking steps to ensure that the terms of this clause are imposed in a legally binding manner on such representatives or group companies, (ii) the other Party, (iii) any Governmental Instrumentality to the extent required by Applicable Law as prevailing and in force from time to time, or (iv) any other Person to whom such delivery or disclosure may be necessary or appropriate to comply with any Applicable Law as prevailing and in force from time to time, or in response to any order of Court or pursuant to other legal process, provided that, in the cases of (iii) or (iv), the Party being required to disclose the information shall provide each other Party with prompt written notice thereof to enable the latter to take steps to protect its Confidential Information. Each of the Parties shall ensure that their respective officers, employees, agents and representatives observe the same degree of confidentiality. For the purposes of this Work order, "**Confidential Information**" shall include without limitation the terms of this Work order, all or any information being proprietary and confidential to the Party disclosing the same, whether written or oral, and whether or not marked as confidential, tender documents, plans, designs, elevations, sections, data, material, information, particulars, processes, drawings, sketches, charts, reports, procedures, notes, analyses, compilations, studies, documents and details or particulars whatsoever pertaining to the subject matter of this Work order, projects to be undertaken by the Company or to the business of the other Party but shall not include any information which is in public domain (except on account of a breach by a Party).

14.2 None of the Parties shall make or permit or authorise the making of any press releases or other public statement or disclaimer concerning this Work order without the previous consent in writing of the other Party.

14.3 PUBLICITY RELEASES

Each Party shall give prior notice to the other of any information contained in documents filed with public authorities or any other public disclosure required under Applicable Law, which would result in the dissemination of Confidential Information and shall make such disclosure only in the form acceptable to the other Party. Further, the Contractor shall not nor shall it permit any Sub-Contractor, employee, officer, agent, consultant, group company, affiliate or other person to issue any press or publicity release or any advertisement, or publish or otherwise disclosing the identity of the Owner in relation to the Project or in relation to this Work order being entered into by the Contractor. Further, the Parties shall comply and shall ensure that their affiliates, Sub-Contractors, group companies, agents, employees and consultants comply with the provisions of this Clause 14.

15. LIQUIDATED DAMAGES

15.1. The Contractor agrees that it shall be liable to pay liquidated damages to the Owner if the Contractor fails to achieve the SCOD Deadline or for any reason whatsoever other than a delay caused by the Owner as set forth in Clause 15.2 at the rate of one percent 1% per week(or part thereof) of the undelivered capacity of delay subject to a maximum of

10% of the total Contract Price beyond the COD Deadline
extension granted pursuant to Clause 3.5) till achievement (or beyond any time
of the SCOD Deadline.

15.2 The liquidated damages payable per Clause 15.1 hereof are not by way of a penalty but are a reasonable and genuine pre-estimate of the damages which will be suffered by the Owner on account of a delay by the Contractor in performance of its obligations. It being agreed and clarified that the Contractor shall not be liable to pay liquidated damages for delay in achieving the COD deadline if the delay in achieving the same is caused on account of non-availability of Grid Connectivity / approval from DISCOM as the same is not attributable to a default on part of the Contractor in performing its obligations under terms of this Work order.

15.3 Notwithstanding anything to the contrary contained herein, the Contractor represents, warrants and undertakes to the Owner that the Equipment & Materials will generate the energy output as set out in Schedule K (the "Guaranteed Energy Output") and in the event that the generation of Plant is less than the Guaranteed Energy Output for reasons attributable to any defect or deficiency in the Plant or any component thereof, the Contractor shall compensate the Owner for any shortfall in Guaranteed Energy Output by payment of liquidated damages as set forth in Schedule K ("Performance Liquidated Damages"). The Owner shall be entitled to draw upon the Performance Bank/Corporate Guarantee referred to in Clause 4.1.1 above, to recover the Performance Liquidated Damages payable to it in accordance with Schedule K. The Contractor agrees that the liquidated damages payable per this Clause is not by way of a penalty but is a reasonable and genuine pre-estimates of the damages which will be suffered by the Owner if the Plant does not deliver the Guaranteed Energy Output.

16. DISPUTERESOLUTION

16.1 AMICABLE RESOLUTION

In the event of any dispute, diswork order, complaint or difference between the Parties, in respect of or concerning or connected with the interpretation or implementation or arising out of this Work order or any Clause or provision hereof, or relating to the termination hereof (a "Dispute"), then such Dispute shall in the first instance be resolved amicably by the representatives of the Parties.

In the event that the Parties are unable to resolve any Dispute amicably as stated above within 15 (fifteen) Business Days of the same being raised by one of the Parties, then such Dispute shall be referred to the Complaints Redressal Committee. In the event that the Complaints Redressal Committee is unable to mutually resolve the Dispute within 21 (twenty-one) Business Days of the Dispute being referred to it, the same shall be referred to arbitration as stated below.

16.2 ARBITRATION

16.2.1 If any disputes or differences between the Parties are not resolved under Clause 15.1 above within the time period mentioned therein, the same shall be referred for arbitration in accordance with the Indian Arbitration & Conciliation Act, 1996, or any statutory modification or enactment thereof for the time being in force.

16.2.2 Each Party shall continue to perform its respective obligations under the Work order during the arbitration proceedings.

16.2.3 The arbitration shall be conducted by arbitral tribunal consisting of 3 (three) arbitrators, one arbitrator appointed by each Party and the third appointed by the two arbitrators so appointed. The arbitration shall be held in Hyderabad and the courts in Telangana shall have sole and exclusive jurisdiction on any matter connected with or arising under the Work order.

16.2.4 The arbitration shall be sole and exclusive remedy between the Parties regarding the dispute referred to arbitration and any claims, counterclaims issues or accountings presented to the arbitrators in connection with such dispute.

16.2.5 The award rendered in writing in any arbitration commenced hereunder, shall be final and conclusive.

16.2.6 The Parties hereby undertake to implement the directions contained in the award without delay. The costs and expenses of arbitration shall be paid as may be determined by the arbitrators.

17. INDEPENDENT CONTRACTOR

17.1 Deleted

18. REPRESENTATIONS AND WARRANTIES

18.1 CONTRACTOR'S REPRESENTATIONS AND WARRANTIES

The Contractor represents and warrants to the Owner that:

18.1.1 GOOD STANDING

The Contractor is a company duly organized, validly existing and in good standing under the laws of India and the execution, delivery and performance of this Work order have been duly authorized by all requisite corporate action and will not violate any provision of any Governmental Instrumentality rule, regulation, permit, statute or ordinance, or violate any provision of its charter or bylaws or any indenture, work order or instrument to which it is a party or by which it or its property may be bound or affected.

18.1.2 NO VIOLATION OF LAW

The Contractor is not in violation of any Applicable Law, statute, order, rule or regulation promulgated, or judgment entered, by any national, state or local Governmental Instrumentality that, for either an individual violation or for a number of violations in the aggregate, would adversely affect its ability to perform its obligations under this Work order.

18.1.3 LICENSES

The Contractor is, or will be, the holder of all national, state, local or other permits required to conduct its business and has all the necessary approvals to perform its obligations under this Work order. The Contractor has obtained, or has no reason to expect that it will not in due course and without undue delay (subject to Force Majeure Events) obtain, all of the approvals,

certificates, permits, and licenses with respect to any applicable authority or instrumentality of government, or any department or agency thereof, necessary, required or appropriate in connection with the Contractor's performance hereunder.

18.1.4 LITIGATION

The Contractor is not a party to any legal, administrative, arbitral, investigation (to the best of its knowledge), or other proceeding or controversy pending or, to the best of its knowledge, threatened, which would adversely affect its ability to perform under this Work order.

18.1.5 QUALIFICATIONS

The Contractor has (a) examined this Work order thoroughly (and has had the opportunity, if so desired, to review it with legal counsel) and become familiar with its terms and, (b) by itself and through its Sub-Contractors, the Contractor possesses the full experience and proper qualifications to provide the Equipment and Materials for facilities similar to the Plant and that it realizes that completion and detailing will occur during performance of this Work order.

18.1.6 APPROVALS, CERTIFICATIONS, PERMITS AND LICENSES

Owner SSFWPL will provide all the statutory approvals like project registration with competent authority, provides right of way etc. The Contractor has obtained, or has no reason to expect that it will not in due course and without undue delay obtain, all of the approvals, certificates, permits, and licenses with respect to any applicable authority or instrumentality of government, or any department or agency thereof, necessary, required or appropriate in connection with the Contractor's performance hereunder.

18.2 THE OWNER'S REPRESENTATIONS AND WARRANTIES

The Owner represents and warrants to Contractor that:

18.2.1 GOOD STANDING

The Owners a company organized, validly existing and in good standing under the laws of India and that the execution, delivery and performance of this Work order have been duly authorized by all requisite action and will not violate any provision of any Governmental Instrumentality, rule, regulation, statute or ordinance, or violate any provision of its charter or bylaws or any indenture, work order or instrument to which it is a party or by which it or its property may be bound or affected.

18.2.2 No VIOLATION OF LAW

The Owner is not in violation of any Applicable Law, or any other law, statute, order, rule or regulation promulgated, or judgment entered, by any national, state or local Governmental Instrumentality that, for either an individual violation or for a number of violations, in the aggregate, would adversely affect its ability to perform its obligations under this Work order.

18.2.3 LITIGATION

The owner is not a party to any legal, administrative, arbitral, investigation (to the best of its knowledge), or other proceeding or controversy pending or, to the best of its knowledge,

threatened, which would adversely affect its ability to perform under this Work order.

18.2.4 LICENSES

The owner is, or will be, the holder of all national, state, local or other permits required to conduct its business and shall obtain all applicable Permits necessary for the Work order other than such approvals for which the Contractor is responsible for.

18.2.5 APPROVALS, CERTIFICATES, PERMITS AND LICENSES

The Owner has obtained, or has no reason to expect that it will not in due course and without undue delay (subject to Force Majeure Events) obtain, all of the approvals, certificates, permits, and licenses with respect to any applicable authority or instrumentality of government, or any department or agency thereof, necessary, required or appropriate in connection with the Owner's performance hereunder.

18.2.6 UPDATES

Each Party further warrants to the other that it will notify the other Party if prior to Final Acceptance any of the foregoing representations and warranties ceases to be accurate and complete in any material respect.

19. CO-OPERATION OF THE CONTRACTOR

The Contractor agrees to provide any assistance, as may be required by the Owner to apply for and obtain any clean development mechanism ("CDM") benefits for the Project. In this regards the Contractor agrees to provide any information or assistance that the Owner may require in applying for such CDM benefits;

20. MISCELLANEOUS

20.1 DELAY NOT WAIVER

It is understood and agreed that any delay, waiver or omission by either party to exercise any right or power arising from any breach or default by the other in any of the terms, provisions or covenants of this Work order shall not be construed to be a waiver by such party of any subsequent breach or default of the same or other terms, provisions or covenants on the part of the other Party.

20.2 Governing Law and Jurisdiction

This Work order shall in all respects be governed by and construed in accordance with the laws of India, including with respect to all matters of construction, validity and performance, without giving effect to any choice of law rules thereof that may direct the application of the laws of other jurisdiction and the courts in Andhra Pradesh & Telangana shall have sole and exclusive jurisdiction on any matter connected with or arising under this Work order.

20.3. SEVERABILITY

In the event that any of the provisions, or portions or applications thereof, of this Work order are held to be unenforceable or invalid by any court of competent jurisdiction, the Owner and Contractor shall mutually agree upon a reasonable adjustment in such provisions of this Work

order with a view toward effecting the purpose of such provisions of this Work order, and the validity and enforceability of the remaining provisions, or portions or applications thereof, shall not be affected thereby.

20.4. NOTICE

20.4.1 Any notice or other communication required to be sent under this Work order shall be sent or delivered to the receiving Party at the address set forth below, or at such other address of the concerned Party as such Party may from time to time designate in writing as a notice as required hereunder by giving to all the other Parties not less than 10 (ten) Business Days prior written notice.

20.4.2 Any notice or other communication shall be sent by registered post acknowledgement due, email, or by a recognized courier.

20.4.3 Any notice required or permitted to be given by the Parties hereunder shall be in writing and unless otherwise specified in this Work order all notices referred in this Work order or other communications shall be deemed to have been duly given or made:

20.4.4 on the expiry of 7 (seven) Business Days after posting, if sent by registered post;

20.4.5 if delivered by email, the day immediately after the date of confirmation of transmission recorded on the sender's computer in case of email transmission;

20.4.6 Unless otherwise notified in accordance with this Clause 20.4, all notices referred to in this Work order shall be addressed to:

FOR THE OWNER: (Responsible person & full

address) Kind Attention:

Designation:

.....

Address: XXXXXXXXXXXX

Telephone:

..... Email:

FOR THE CONTRACTOR: (Responsible person & full address) Kind Attention:

Designation:

..... Address:

.....

Telephone No:

E-mail:.....

Any change in the above shall be notified immediately to the other Party in accordance with this Clause 20.4.

20.5 DELIVERY

All notices under Clause 20.4 hereof shall be delivered in person to the Party above mentioned or shall be sent *via* registered mail with a return receipt requested in a securely sealed

envelope and shall be effective when received at the address specified first above. The Parties hereto, by like notice in writing, may designate, from time to time, other address or office to which notices may be given pursuant to this Work order.

20.6 CLAUSE HEADINGS

The Clause headings herein have been inserted for convenience of reference only and shall not in any manner affect the construction; meaning or effect of anything herein contained nor govern the rights and liabilities of the Parties hereto.

20.7 PRIOR WORK ORDER

No oral work order exists between the Parties. This Work order supersedes any and all written or oral work orders, proposals, negotiations, understandings and representations pertaining to the subject matter hereof, prior to the date of this Work order.

20.8 AMENDMENTS

No amendments, supplements or modifications of this Work order shall be valid unless evidenced in writing and signed by duly authorized representatives of both Parties.

20.9. CONFLICTING PROVISIONS

In the event of any conflict, variation or inconsistency between any provision of this Work order pursuant to being amended, modified or supplemented from time to time, and any other provision of this Work order, the amended provision of this Work order shall control. It is expressly agreed between the Parties that any changes in this Work order, as may be required can be made with mutual consent in writing.

20.10. NO THIRD-PARTY RIGHTS

This Work order and all rights hereunder are intended for the sole benefit of the Parties hereto and to the extent expressly provided in Clause 10 hereof, for the benefit of the Indemnified Parties, and shall not imply or create any rights on the part of, or obligations to, any other person.

20.11 DUTY TO MITIGATE

In the event of a termination of this Work order pursuant to Clause 12, each Party shall endeavor to exercise all reasonable efforts to mitigate or limit any damage, cost or expense to the other Party.

20.12 COSTS

Each Party shall be responsible for and shall bear all the expenses incurred by it in preparing, negotiating and executing this Work order.

20.13 EXPIRY OF WORK ORDER

Unless otherwise earlier terminated pursuant to the express provisions of this Work order, this Work order shall be deemed to have been completed upon the expiration of the Warranty Period; provided that all provisions of this Work order that expressly continue in force and effect after the expiration of the Warranty Period or termination of this Work order shall

remain in effect and be enforceable following such expiration or termination.

20.14 TITLE TO THE EQUIPMENT AND MATERIAL

(i) **TITLE**

The title of property in the Equipment and Material shall get transferred to Owner in accordance with Clause 7.4 hereof upon the Contractor receiving all payments due and payable to the Contractor under this Work order. Irrespective of the time of transfer of title to the Owner, the risk in the Equipment and Material shall continue to be borne by Contractor until the date of Final Acceptance.

(ii) **CUSTODY AND CONTROL**

Transfer of title pursuant to Clause 20.14(a) above shall in no way affect the Owner's rights as set forth in any other provision of this Work order. For the purpose of protecting the Owner's interest in all Equipment and Material with respect to which title has passed to the Owner pursuant to Clause 20.14 (a) above, but which remain in possession of the Contractor or any Sub-Contractor, the Contractor shall take or cause to be taken all steps necessary under the laws of the appropriate jurisdiction(s) to protect the Owner's title and to protect the Owner against claims by other parties with respect thereto in accordance with the terms of this Work order. Upon termination of any or all of the Scope of Supplies, risk in Equipment and Material completed and in transit, and which shall be delivered to the Owner pursuant to Clause 11 hereof, shall pass to the Owner.

20.15 SET-OFF

The Owner shall be entitled to deduct and set-off against any part of the balance due or to become due to the Contractor under this Work order, any amounts, costs or expenses that are due and outstanding as payable from the Contractor or for which the Contractor is liable to the Owner pursuant to the terms hereof. The Owner shall be entitled to make any such deduction or set-off, and shall give notice thereof to the Contractor together with brief details of the deduction or set-off and the reasons therefor.

20.16 LANGUAGE PROTOCOL

Except as otherwise specifically indicated in this Work order, all notices, manuals, design documents and other writings and communication required pursuant to this Work order shall be in the English language.

20.17 WORK ORDER NOT A PARTNERSHIP

Nothing in this Work order is intended to create, nor shall it be construed as creating, a partnership, joint venture, agency or association of persons between or among Contractor or Sub-Contractors.

20.18 LIABILITY OF CONTRACTOR

Notwithstanding anything contained herein, the Contractor shall be liable for, *inter alia*, in respect of any guarantees, liquidated damages etc., with respect to the Plant and responsible to the Owner for the Equipment and Materials supplied under this Work order.

IN WITNESS WHEREOF, the Parties, intending to be legally bound, have caused this Work order to be executed by their duly authorized officers as of the date first above written.

XXXXXXXXXX

NAME:
DESIGNAT
ION:

Witness 1:

Witness 2:

ACOR

EPC SCOPE OF WORKS

GENERAL

1. The broad scope of Supplies covered under this Work order is described herein below and detailed in the technical specification. The scope of work shall include design, engineer, manufacture, inspection, shop testing, packing and shipment of Equipment and Materials.
2. In respect of equipment and systems listed below, all items required to make the equipment and/or system complete in all respects are deemed to be included whether or not these items are specifically mentioned in the Work order.
3. The Contractor shall provide the manuals for the equipment being supplied within 45 (forty-five) days of signing of this Work order.

MAJOR EQUIPMENT AND MATERIALS LIST

The list of equipment and material to be supplied under the terms of the Work order shall include but not limited to the following:

1. Solar Panels
2. Inverters with mounting arrangement and shed
3. Fixed type of Solar panel mounting structure with SS314 hardware
4. DC Cables (cable from module up to string monitoring units to Inverters)
5. AC cables from Inverters to Transformers to Control Panels to VCB to ACB till take off point
6. Step up Inverter duty power transformers (IDT) 600-800VAC /11000V AC)
7. Auxiliary power transformer (11000VAC to 415VAC) for plant usage
8. HT Panel with HT & LT Switchgears, AC&DC power and control cables
9. Illumination system for main control room & plant area
10. Earthing system (maintenance free)
11. Lightning Protection through ESE (LA).
12. Remote monitoring system (RMS) for complete plant.
13. Weather monitoring system (WMS) with irradiance sensor
14. Firefighting equipment as required
15. Solar panel cleaning system
16. All civil works (Control room, Fencing, Gate, Solar panel mounting structure, IDT, HT Panel etc.)
17. Main Control Room

11KV TERMINAL POINT:

18. Plant substation with end take off with terminations.

SCHEDULE- B**CONTRACT PRICE AND TERMS OF PAYMENT****1. CONTRACT PRICE**

Item No.	Description	Qty.	UOM	Unit Price (INR in Cr)	Total Price (INR in Crores)
1.	Site survey, Layout, Fencing, design, engineering, procurement, supply of equipment and materials, testing at manufacturers works, multi-level inspections, packing and forwarding, receipt, unloading and storage at site, services, permits, licenses, installation and incidentals, insurance at all stages, erection, testing and commissioning of a of 100 MW Grid Interactive Solar PV Power generating Plant with 19% CUF	100	MW	2.45	245
2.	Installation and other services as per the scope of work	100	MW	1.05	105
GRAND TOTAL					350

TOTAL RUPEES IN WORDS: THREE HUNDRED FIFTY CRORES ONLY

2. TERMS OF PAYMENT

An initial advance of 10% of the Contract Value shall be released within 7 working days against bank guaranty from a nationalized bank.

1. 70% of the contract value shall be released on supply of material after inspection clearance by XXXXXXXXXX (SSPL) against running account (RA) bill equal to the inspected and cleared bills related to the work completed. Advance payment shall be adjusted during these RA bill payments
2. 20% of the contract value shall be released on commissioning & acceptance test of the system
3. 5% of the contract value shall be paid after defect liability period of 1 year from the commercial operation day (COD)
4. Balance 5% shall be released in the first month of completion of 5 years warranty period. However, this can be claimed against a bank guarantee after COD

SCHEDULE-C

SUPPLY SCHEDULE

The Parties shall mutually agree upon a Supply Schedule before release of advance which shall be considered as an integral part of this Work order. EPC contractors can submit the schedule considering the mobilisation advance date as zero day which is a mandatory requirement.

SCHEDULE-D

PERFORMANCE TESTING PROCEDURE

a. The purpose of this test is to demonstrate the continuous operation of plant with respect to different operational parameters & highlighting major faults faced like any abnormal/nuisance tripping & special cause of failure. (Both manual & auto clearing faults like Grid failure).

b. Testing should be performed as per IEC 61724 -1998 (amended till
date)

c. During the performance testing period of 7 days, the following data shall be recorded:

- C1 DC current and voltage for each Fuse box
- C2 Inverter input and output data, including:
- C3 DC current and voltage at each inverter input
- C4 Phase voltage at each inverter output
- C5 Energy output
- C6 Phase current at each inverter output (PV box Contractor Scope)
- C7 Module temperatures
- C8 Parameters measured at the meteorological stations
- C9 Fault log
- C10 Plant electrical generation at every voltage level.

Data Format: -All the daily report during test to be given in Excel sheet.

d. The Contractor will provide a daily report to the Owner which will include the daily energy technical availability & Performance Ratio (PR).

FORM OF NOTICE TO PROCEED

Sub:: Work order dated, entered into between XXXXXXXXXX and ,
for the supply of Equipment, Materials and Services

Dear Sir,

This is the “Notice to Proceed” referred to in Clause 2.2 of the Work order. Capitalized terms used herein have the meanings given to them in the above Work order. The Owner hereby, confirms as under:

The mobilization advance payment shall be released as per the terms and mode of payment under the Work order in Schedule B.

.

Yours

Sincerely,

XXXXXXXXXX

XXXXXXXXXX

Managing Director

Accepted and

agreed: By:

.....

.....

EPC Contractor

SCHEDULE OF INSURANCE

The EPC contractor shall, against their liability under the contract, at their own expense, obtain the following insurances with reputable insurance companies:

A. All risk Marine insurance for Equipment and Materials

The Contractor shall insure all equipment, tools and materials with a reputable insurance company. The insurance shall cover all risks including sea and land transport from place of origin to site. The EPC contractor shall be liable for paying the insurance premium under the insurance covers so obtained by the EPC contractor.

SCHEDULE

**E - G LIST OF DOCUMENTS AND INFORMATION TO BE PROVIDED BY EPC
CONTRACTOR IN CONSIGNMENTS**

PART A

1. A reference to the date, parties and subject matter of the Work order;
2. A description of the Equipment and Materials contained in such consignment;
3. The date of transportation/ departure;
4. The place of origin;
5. The means of transportation (road, rail or air);
6. The estimated date of arrival at the Plant Site;
7. The value of the consignment;
8. The approximate weight and volume (gross and net);
9. The name and Owner of the carrier if transportation by road or the designation of the wagon or aircraft if transportation is by rail or air and
10. The number and value of the airfreight bill or railway receipt or carrier receipt.

ANNEXURE - H

1. Delivery note, railway receipt or carrier receipt or shipping documents consisting of full set clean “onboard” airway bill, freight prepaid FOR site for Equipment and Materials despatched by air
2. Declaration made by the Contractor by fax in such form as shall be specified by the Owner to the insurer providing the transit insurance stating that such Equipment and Materials are covered by such insurance;
3. Commercial invoice with itemized prices duly signed by the Contractor;
4. Packing lists for each separate package;
5. Statement of the Contractor that the Equipment and Materials are in accordance with the Specifications and having attached all previously issued certificates and test certificates concerning the Equipment and Materials being transported;
6. Certificate of Insurance; and
7. Inspection certificate, issued by the nominated inspection authority and the Contractor’s factory inspection report.

SCHEDULE - I

COMPLETION CERTIFICATE

PROJECT : 2MW solar PV utility plant

OWNER : XXXXXXXXXXX. EPC Contractor

:

This is to certify that the all the Equipment and Materials have been supplied by the Contractor as per the agreed specification. All the equipment installed as per specifications and commissioned to our satisfaction. This completion certificate is issued hereto in completion of all the supplies as per terms of the above-referred Contract.

Encl.: Approved & Accepted BOQ.

SCHEDULE- J

SPECIFICATIONS

The complete specification manual of the relevant Equipment & Materials being supplied shall be submitted by the Contractor to the Owner in line with the specifications mentioned in the EOI/NIQ. such specification manual as accepted by **XXXXXXXXXX** shall form an integral part of this Work order.

However, the basic specification of major equipment shall be submitted on the date of this work order

SCHEDULE – K

GUARANTEED ENERGY OUTPUT

A. PERFORMANCE GUARANTEES FOR THE PLANT

The performance of the Plant will be guaranteed by the Operator for an annual average energy output of minimum 1.9M KWh/units per Mega Watt or more for the first year of operation. This guarantee is based on the reference annual average global solar radiation at horizontal surface of 5.4 kWh/m².

OR

annual average performance Ratio shall be 80%. However, the energy output shall be adjusted as per actual annual solar irradiation at Site and grid availability. The irradiation and weather parameters shall be measured using devices located at Site. The Energy output will be measured at the metering point of TGSPDCL/TGNPDCL. The Energy Output shall meet all the technical parameters and limits of supply as specified by the utility company.

The Contractor shall independently carry out performance estimation based on the solar resource data and proposed project components.

The performance test shall be carried out to compare the guaranteed PR and measured PR. Performance Ratio during the acceptance test shall be calculated using following formula

$$100 \text{ PR (\%)} = \frac{\text{Energy Generated (kWh)} \times}{\text{Installed Capacity (kWp)} \times \text{Solar Insolation (kWh/m}^2\text{)}}$$

- The Party shall be required to meet minimum guaranteed generation with performance ratio (PR) at the time of Commissioning as per GHI level.
- PR should be shown minimum of 80% at the time of inspection for initial commissioning acceptance.
- The performance Guarantee Test (PG Test) shall be carried out by measuring PR and comparing to the Guaranteed PR. Same mathematical formula as given above shall be used for calculating PR.

METHOD FOR CALCULATING PR & APPLICABLE LD

- Contractor shall be responsible for arranging measuring instrument to record on site data.
- The PR will be measured at Inverter Output level during peak radiation conditions.

If Contractor fails to achieve the guaranteed performance level, the Contractor shall its own cost rectify all the defect identified during the test and take necessary steps/effort to pass the PR test within one-month period. subsequent to rectification & intimation to Owner, The PR test will have to be done.

B. PERFORMANCE TESTING:

Performance test shall be conducted as per procedure given hereunder.

Initial testing shall be carried out on stabilization after COD for provisional acceptance and then also repeat after 1 year from COD after adjusting the degradation, if any based on guaranteed by Contractor. This is subject to O&M under Contractor scope.

C. PERFORMANCE GUARANTEE TEST PROCEDURE:

The testing should be performed as per IEC 61724 -1998 (amended till date)

1. PERFORMANCE TEST FOR PROVISIONAL ACCEPTANCE:

The Performance Test at Provisional Acceptance will commence once the physical completion certificate is issued.

The data for the Performance Test will be collected during a Thirty (30) days period between sunrise and sunset. In the event the Plant is not fully available for some time during the test period the respective daily dataset will be skipped and the test period will be extended in order to obtain a full set of data for an equivalent 30day period with 100% availability.

The energy generation and performance ratio (PR) is a measure of the quality of the design and the components of the PV Plant ie the conversion efficiency of a PV System and a ratio of the actual energy measured at the Plant's energy meter and energy theoretically produced by the PV modules. For PR calculation, the plant auxiliary consumption shall be deducted from the energy measured.

The PR test shall be conducted as specified below:

- The PR measured on-site shall be compared with the guaranteed performance levels provided for the specified time period.
- The PR values shall be computed based on actual energy measured at the inverter level.
- If the Contractor fails to achieve the guaranteed performance levels, contractor at its own cost rectify all the defects identified during the test and take necessary steps/efforts to pass the PR test within the stipulated time span. Subsequent to rectification the PR shall be re-tested.

2. ANNUAL PERFORMANCE TEST

The duration of the PR measurement shall be the 12-month period after the plant
COD

The procedure for establishing PR will match the procedure described above but will be extended to cover a full 12-month period. However, there will be no limitation to the irradiation and the irradiance levels.

ACOR

The Performance Test Procedure shall determine:

- The Actual Annual Performance Ratio of the Plant over the full 12 months period following the date of Provisional Acceptance, to be compared to the Guaranteed Annual Performance Ratio.

D. PERFORMANCE LIQUIDATED DAMAGES AFTER ANNUAL PERFORMANCE TEST:

In case the energy generation after one year of operation is lower than Guaranteed, EPC contractor shall pay predetermined liquidated Damages.

Liquidity Damages shall be 1% of the Turnkey/Contract Price for every 1% drop in PR on prorate basis, with a cap of 10.0% of Turnkey/Contract Price or in case EPC contractor wish to refurbish the project component by compensating for the loss of generation for the first five years as per sales tariff of Rs.3.13 per kWh for first year with 5% escalation every two years and also refurbish the system to achieve the guaranteed Generation

/ PR and retest the same. Owner shall require the Contractor to remedy the PR ratio within a period of 30 days failing which the Owner shall be entitled to encash the Performance Bank/Corporate Guarantee to the extent of losses caused to the Owner.

Guaranteed PR (corrected for the efficiency of the module) to be maintained during various stages is as follows:

PG test at the time of COD	After completion of 1st Year	After completion of 2nd Year	After completion of 3rd Year	After completion of 4th Year	After completion of 5th Year
80%					

The formula for calculating Y-Y

drop in PR Base Year PR = A

Y-Y Linear degradation of SPV modules over the year = 0.7% Present year PR Value= A x {1- (0.7%/2)}

In case the Energy Output and other parameters for the Plant as per Clause A of Schedule K falls below 10 % of the guaranteed energy output for 1st year, for reasons attributable to the Contractor, the Contractor shall, within thirty days or as may be mutually agreed, 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 the Owner upon completion of the necessary changes, modifications and/or additions, and shall seek the Owner's consent to repeat the Guarantee Test(s). If the guaranteed level is still not met but the parameters are achieved within the acceptable shortfall limit, then the Owner will accept the equipment/ system/ plant after levy of additional liquidated damages over and above the cap specified under this Schedule K Guaranteed energy output of this Contract.

However, if during repeat of the Guarantee Test(s) Guaranteed Energy Output /PR is below 10 % the Owner may at its option, either

- (i) Accept the equipment / system / plant after levy of additional liquidated damages in accordance with the provisions specified under Schedule K Guaranteed energy output of this Contract, or

In case the Owner exercises its option to accept the equipment after levy of liquidated damages, the payment of additional liquidated damages under above Clause, over and above the cap specified

under this Schedule K and the Contractor shall have no further liability whatsoever to the Owner in respect thereof. Upon the payment of such additional liquidated damages by the Contractor, the Owner shall issue the Operational Acceptance Certificate for the Works or any part thereof in respect of which the liquidated damages have been so paid, or

(ii) Owner may rectify the plant on its own at reasonable cost mutually acceptable to both parties and the cost to be recovered from Contractor or

(iii) Terminate the Contract pursuant to Clause 12 above

SCHEDULE - L

MANUFACTURERS WARRANTY PERIOD (As per Clause 7.2)

The Contractor shall submit the details of the Warranty Period for all Equipment, Materials and Spare Parts to be supplied by it, to the Owner, within a period of 45 (forty-Five) days from the date of NTP or release of Advance whichever is later and shall be considered as an integral part of this Work order.

However, the Contractor shall submit the details of primarily warranty period for all Equipment, Materials and Spare Parts to be supplied by it, to the Owner, within a period of 15 (fifteen) days from the date of NTP release of Advance whichever is later.

SCHEDULE - M

LIST OF APPLICABLE PERMITS

The parties having the primary responsibility to obtain permits / approvals from appropriate authorities are listed below.

PART A: OWNER PERMITS

1. Project Registration with MNRE/TGREDCO
2. Approval for power evacuation as applicable
3. Sales Tax Registration
4. GST Registration
5. Land Conversion by DC&NOC, State Pollution Control Board, Forest, Gram Panchayat Clearance.
6. Road Permit for material transport
7. Other Necessary Statutory approvals
8. ROW (Right of way approvals and issues to be sorted by owner and to be cleared before starting evacuation work)

PART B: CONTRACTOR PERMITS

1. Local transportation approvals
2. Local labour approvals (incl. insurance and PF for employees by respective sub-Contractors)
3. Professional Tax Registration
4. Interstate migrant work man Registration
5. Contract Labour License
6. Registration under PF Act
7. Registration under Employee state insurance Act
8. Registration under Workmen Compensation Act
9. Permission for movement of capital goods
10. Clearances for Lift & crane use
11. License for construction labours pursuant to Section 7 of the Contract Labour
(Regulation & Abolition) Act, 1970.
12. Registration of workers required pursuant to Section 2A of the Employees State Insurance Act, 1984, or exemption to be claimed if other group insurance is taken (for the Contractor's personnel)
13. Registration under building and other construction work
14. Approval of Construction activity and building Plan/Layout, Architectural, machinery drawings and building drawings
15. Approval of Electrical Inspectorate for commissioning of transmission line and solar powered grid interactive power converters
16. MNRE/statutory approvals for Customs/Excise duty exemptions. (All necessary supportive documents will be provided by Owner)

All the contents of this document are read in full, understood and agreed to implement and demonstrate as and when demanded by Owner.

Name of authorised person of EPC Contractor:

Designation:

Signature:

EPC Company Seal with address:

ANNEXURE-B

TECHNICAL SPECIFICATIONS FOR PM-KUSUM COMPONENT-A

SCOPE OF WORK FOR WORK ORDER No:

EPC CONTRACTOR:

1 PHOTOVOLTAIC MODULES

1.1 GENERAL

- 1.1.1 PV Modules shall be registered with Bureau of India Standards (BIS) and bear the Standard Mark as per Solar Photovoltaics, Systems, Devices and Components Goods (Requirements for Compulsory Registration) Order, 2017 and subsequent amendments.
- 1.1.2 The PV Module shall be enlisted in ALMM – List in accordance with extant provisions of Approved Models and Manufacturers of Solar Photovoltaic Modules (Requirements for Compulsory Registration, Order, 2019) and subsequent amendments.
- 1.1.3 PV Modules shall conform to MNRE Order on Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of RE Sector dated 9th February, 2021 and subsequent amendments.

1.2 STANDARDS AND CODES

Photovoltaic Modules shall comply with the specified edition of the following standards and codes or equivalent IEC Standards, wherever applicable. Higher revision of standards specified are acceptable.

STANDARD	DESCRIPTION
IS 14286: Part 1: 2019	Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval, Part 1: Test Requirements (Second Revision)
IS 14286: Part 1: Sec 1:2019	Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval, Part 1: Test Requirements, Section 1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules (Second Revision)
IS 14286 (Part 1/Sec 2): 2019	Terrestrial photovoltaic (PV) modules - Design qualification and type approval: Part 1 test requirements: Sec 2 special requirements for testing of thin - Film cadmium telluride (CdTe) based photovoltaic (PV) modules (Second Revision)
IS/IEC 61730- 1: 2016	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
IS/IEC 61730-2: 2016	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing

IS 17210: Part 1: 2019	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon
------------------------	---

Note: PV Module shall have been tested for design loads applicable at site (Refer TS- Civil, relevant clause on Design Load combinations) with minimum safety factor of 1.5 (as per IEC 61215-2)

1.3 TECHNICAL REQUIREMENTS

PARAMETER	SPECIFICATION
Cell type	(i) Mono-crystalline Si - PERC / TOPCon
Module Efficiency	(i) Mono-crystalline Si $\geq 20.9\%$
Rated power at STC	No negative tolerance is allowed
Temperature co-efficient of power	(i) Mono-crystalline Si: Not less than - 0.4%/°C
Maximum System Voltage	1500 VDC
Application Class as per IS/IEC 61730	Class II

1.4 COMPONENT SPECIFICATIONS

1.4.1 Glass Panel: □ Glass/Back-sheet Modules: The PV Modules glass panel shall have transmittance of above 90%. The minimum thickness of glass shall be 3.2 mm. □ Glass/Glass Modules: Glass shall have minimum 2 mm thickness on each side. Glass shall have transmittance above 90%.

1.4.2 The back sheet used in the PV modules (applicable in case of Glass/Back-sheet) shall be of three-layered structure with properties of moisture barrier, elongation retention and UV resistance. The back sheet shall have the following properties: Parameter Value Material Thickness ≥ 300 microns Water Vapor Transmission Rate ≤ 2 g/m²/day Partial Discharge Test Voltage ≥ 1500 V Elongation at break $\geq 100\%$ Adhesion strength with encapsulant ≥ 40 N/cm Interlayer adhesion strength ≥ 4 N/cm

1.4.3 The encapsulant used for the PV modules (applicable for Crystalline Si Modules) should be 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	$\geq 75\%$ for EVA (applicable for glass/polymer modules) $\geq 70\%$ for POE or EPE i.e. EVA co- extruded with POE (applicable for glass/glass modules and glass/polymer modules)
Volume resistivity	$\geq 1 \times 10^{14} \Omega \cdot \text{cm}$
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 Aluminium, which shall be electrically

& chemically compatible with the structural material used for mounting the modules. It shall have provision for earthing to connect it to the earthing grid. The anodization thickness shall be 15 micron (12 micron in case of 6005 Grade Aluminium).

- 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 IP 67.
- 1.4.7 Minimum three number of bypass diodes and two number of IS 16781 / IEC 62852 certified MC4 compatible connectors with IS 17293 / IEC 62930 certified 4 sq.mm. copper cable shall be provided.
- 1.4.8 The following information must be mentioned in the RFID used on each module (This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions).
- i. Name of the manufacturer of PV Module
 - ii. Name of the Manufacturer of Solar cells
 - iii. Month and year of the manufacture (separately for solar cells and module)
 - iv. Country of origin (separately for solar cells and module)
 - v. I-V curve for the module at Standard Test Condition (1000 W/m², AM 1.5, 250 C)
 - vi. Wattage, Im, Vm and FF for the module
 - vii. Unique Serial No. and Model No. of the module
 - viii. Date and year of obtaining IEC PV module qualification certificate
 - ix. Name of the test lab issuing IEC certificate
 - x. Other relevant information on traceability of solar cells and module as per ISO 9000

NOTE: RFID scanner and database of all the modules supplied, containing the above information shall also be provided.

1.5 WARRANTY

- Performance Warranty: PV modules must be warranted with linear degradation rate of power output except for first year (up to 3% including LID) and shall guarantee minimum 80% of the initial rated power output at the end of 25 years from the date of supply.
- Product Warranty: The modules shall be warranted for minimum of 10 years from the date of supply against all material/ manufacturing defects and workmanship.

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 IEC 61215/61730 Constructional Data Form (CDF)s, subject to suitability of the proposed BOM for other type tests applicable as per Clause 1.2. The BOM extensions for PV Module BOM components shall be in accordance with IEC 62915 retest guidelines.
- 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 during manufacturing of Modules or during pre-dispatch Inspection. 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 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.
- 1.7.4 The modules shall be uniformly laminated without any lamination defects.
- 1.7.5 Current binning of modules shall be employed (max. 3 no. of bins) so that current mismatch of modules in a bin does not exceed 150 mA. Different colour codes shall be provided on the modules as well as pallet for identification of different bins.
- 1.7.6 Pre-dispatch inspection of modules shall be performed as per the Standard Inspection Protocol.
- 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 for approval.
- 1.8.2 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:
- 1.8.4 Modules shall be covered with tarpaulin sheet. Alternatively, the Modules, properly stacked as per OEM recommendations.
- 2 STRING COMBINER BOX
- 2.1 STANDARDS AND CODES

STANDARD/CODE	DESCRIPTION
IS/IEC 60529	Enclosure Ingress Protection

IEC 62262	Enclosure Impact Protection
IEC 60269-6	Fuse
IEC61643-31 / EN 50539-11	Surge Protection Device
IS 17293 / IEC 62852	Solar cable connector
EC 60947-3	Switch disconnecter
IEC 60695-2-11	Fire hazard testing

2.2 CONSTRUCTION

- 2.2.1 SCB enclosure shall be made of UV resistant, fire retardant, thermoplastic material. Enclosure degree of protection shall be at least IP 65 and mechanical impact resistance shall be at least IK 08.
- 2.2.2 Not more than two strings can be connected in parallel to a single input of SCB. One spare input terminal along with connector shall be provided for each SCB.
- 2.2.3 Every SCB 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 disconnecter of suitable rating shall be provided at SCB output / SIB to disconnect both positive and negative side simultaneously.
- 2.2.5 Type-II surge protective device (SPD) conforming to IEC 61643-31 / EN 50539- 11 shall be connected between positive/negative bus and earth.
- 2.2.6 Connector conforming to IS 17293 / IEC 62852 shall be provided at each SCB input. Cable gland (double compression metallic) of suitable size for DC cables shall be provided at the SCB output.
- 2.2.7 UV resistant printed cable ferrules for solar cables & communication cables and punched/ embossed aluminium tags for DC cables shall be provided at cable termination points for identification.

2.3 WARRANTY

The SCB 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/ Insulation	Voltage Rating	Applicable Standard
Solar Cable	Module	Module	Copper/XLPO	1.8kV DC	IS17293/IEC62930
Solar Cable	Module	SCB	Copper/XLPO	1.8kV DC	IS17293/IEC62930
DC Cable	CB	Inverter	Copper or Aluminium/XLPE	1.8kV DC	IS7098 Part II

- 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-II. DC cable with positive polarity and negative polarity shall have red and black outer sheath respectively.
- 3.4 In addition to manufacturer's identification on cables as per relevant standard, following marking shall also be provided over outer sheath.
- Cable size and voltage grade
 - Word 'HALOGEN FREE LOW SMOKE'
 - Sequential marking of length of the cable
- 3.5 Cables shall be sized based on the following considerations:
- Rated current of module
 - In case of central inverters, average voltage drop in the cables (from PV Modules to Inverter) 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.
 - Short circuit withstand capability
 - 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 IS 17293 / IEC 62930 for solar cables and IS 7098-II 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 aluminium 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 Solar cables or group of solar cables combined through branch connector may be laid over ground on GI or FRP cable trays / underground through Double Wall Corrugated (DWC) HDPE conduits from PV String (Series connection of PV Modules) to SCB/String Inverter. The size of the conduit or pipe shall be selected on the basis of 40% fill criteria. Solar cable terminations shall be made with connectors complying IS 16781 / IEC 62852. The connectors shall have degree of protection of IP 68.
- 3.8.5 Solar cables shall be aesthetically tied to Module Mounting Structure using GI/SS cableties.
- 3.8.6 DC cables from SCB to PCU shall be laid directly buried underground as per IS 1255. DC 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.

4 POWER CONDITIONING UNIT (INVERTER)

- 4.1 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.3	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
IEC 61000-6-4 Ed.3	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 Ed.6	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2 Ed.5	Environmental testing - Part 2-2: Tests - Test B: Dry heat
IEC 60068-2-14 Ed.6	Environmental testing - Part 2-14: Tests - Test N: Change of temperature
IEC 60068-2-30 Ed.3	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

The Inverter Supplier shall be Class-I local supplier as per MNRE Order on Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Renewable Energy (RE) Sector dated 9th February, 2021 and subsequent amendments.

4.3 Technical Requirements

PARAMETER	SPECIFICATION
Type	Central/String
Rated AC power	As per design
Maximum input voltage	1500VDC
Rated AC output voltage	600-800VAC
Tolerance on rated AC output voltage	+/-10%
Rated frequency	50 Hz
Operating frequency range	47.5 Hz to 52 Hz
Power factor control range	0.8 lag to 0.8 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	Central Inverter – IP 20 (Indoor) / IP 54 (Outdoor), String Inverter – IP 65

4.3.1 The rated/ name plate AC capacity of the PCU shall be AC power output of the PCU to 25C. Note: The equipment shall be suitably derated for the Altitude.

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 the 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 / MCB / MCCB 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. String inverters without DC fuse may be acceptable in case not more than two strings are connected to the same MPPT.

4.4.3 DC input current monitoring shall be provided at each input of the PCU.

- 4.4.4 Type-I+II surge protective device (SPD) conforming to IEC 61643-31 shall be connected between positive/ negative bus and earth on the DC side. Type-II SPD conforming to IEC 61643-11 shall be provided on the AC side.
- 4.4.5 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.
- 4.4.6 Circuit Breaker or Relay of appropriate voltage and current rating shall be provided at the output to isolate the PCU from grid in case of faults.
- 4.4.7 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.
- 4.4.8 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. Grounding on DC side of the PCU shall be as per the requirements of PV Module Manufacturer. 4.4.9 Dedicated communication interface shall be provided to monitor the PCU from SCADA.
- 4.4.10 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
- NOTE: In case of outdoor PCU, PCU without LCD display with provision for Data access over Bluetooth / WiFi shall be acceptable.
- 4.4.11 String inverter, if installed in open, shall be placed inside a canopy shed with at least 15 cm in all directions.
- 4.4.12 AC combiner box for string inverter configuration shall comply with Clause 9 of the Technical Specifications with exception of the following. i. Rated System Voltage – Inverter Output Voltage ii. IP Rating – IP 5X (Indoor) iii. Metering System – Not required iv. CBCT – Not applicable
- 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. The Contractor shall also provide the short-circuit characteristics of the PCU (Voltage and Time dependent) as per the CTU requirements for Connectivity.
- 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 the 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 from the date of supply.

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 centers. 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. 317 & CEA regulations and other statutory regulations apply	

5.2 TECHNICAL REQUIREMENTS

PARAMETERS	INVERTER TRANSFORMER	AUXILIARY TRANSFORMER
VA Rating	As per system design requirement	
Voltage Ratio	11 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	50Hz	50Hz
Nos. of Phase	3	3
Vector Group & Neutral earthing	Dyn11	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	
Permissible Temperature rise over an ambient of 50°C (irrespective of tap)		
Top Oil	50 Deg C	
Winding	55 DegC	
Short Circuit withstand time	2 seconds	
Termination	As per system requirement	

Top Oil	50 Deg C	
Bushing rating, Insulation class (Winding & bushing)	12 Kv- porcelain bushings 1.1 kV – epoxy bushings	
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. Bidder shall furnish over fluxing characteristic up to 150%	
Air clearance	As per IS/IEC	

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 earthing of inverter transformer shall be as per the recommendations of inverter manufacturer. Even if neutral earthing is not required, neutral bushing 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 Deleted

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 within last five years from the last date of bid submission.

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
- iii. Tank vacuum test & pressure test as per CBIP manual

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 tests mentioned in Clause 5.6.1.1(ii) & (iii) shall be performed for auxiliary transformers. Special tests are not required.

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 11 KV HT SWITCHGEAR PANEL

6.1 STANDARDS AND CODES

6.1.1 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.

STANDARDS/CODES	DESCRIPTION
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 62271-206	High-voltage Switchgear and Control gear - Part 206: Voltage presence indicating systems 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 15086-4	Surge Arresters, Part 4: Metal-Oxide Surge Arresters Without Gaps for A.C. systems
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
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6.2 TECHNICAL PARAMETERS

PARAMETER	SPECIFICATION
Highest system voltage	13 kV
Rated system voltage	11 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	25 kA / 1s
Internal Arc Classification	IAC-A, FLR, 25 kA for 1s
Circuit Breaker Type	Vacuum type
Circuit Breaker Operating duty cycle	O – 3min – CO – 3min – CO
Circuit Breaker Short circuit breaking current	As per system requirement
Circuit Breaker Short circuit making current	2.5 times S.C. breaking current
Circuit Breaker Re-strike performance class	C1
Circuit Breaker Mechanical endurance class	M1
Current Transformer Accuracy class	0.2 for metering (0.2S for metering at outgoing feeder), 5P20 for protection
Current Transformer Rated VA burden	As per requirement
Current Transformer Insulation class	Class E or better
Voltage Transformer Accuracy	class 0.2 for metering, 3P for protection
Voltage Transformer Rated VA burden	As per requirement
Voltage Transformer Insulation class	Class E or better

SYSTEM PARAMETERS

Note: Electrical ratings of switchgear shall be in accordance with altitude correction factors above their standard designs, applicable as per IS/IEC 62271-1

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 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.
- 6.3.11 240 V, 5 A, SPN industrial socket-outlet with ON/OFF switch shall be provided in each panel.
- 6.3.12 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.
- 6.3.13 Gapless, metal-oxide surge arrestors shall be provided between line and earth in cable compartment of the switchgear panel.
- 6.3.14 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 shall be 110 VDC/220 VDC. The closing coil and spring charging motor shall operate at all values of control voltage between 85% and 110% of rated voltage. The shunt trip coil shall operate correctly under all operating conditions of the circuit breaker up to the rated short-circuit breaking capacity and at all values of control voltage between 70% and 110% of rated voltage.
- 6.4.4 Each circuit breaker shall be provided with two tripping coils. Each trip coil shall have its own actuating contacts.
- 6.4.5 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.
- 6.4.6 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.
- 6.4.7 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 / 220 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 enough 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 feature for time synchronization through the SCADA System / networking.

6.5.14 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.

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 BUSBAR

6.8.1 Bus bar shall be made of copper or aluminium 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 aluminium to copper connections is 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, 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. Validity period of type tests conducted on the equipment shall be as per 'CEA Guidelines for the Validity Period of Type Test(s) conducted on Major Electrical Equipment in Power Transmission'.

TEST	STANDARD	RELEVANT IEC CLAUSE
Switchgear Panel		
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
Circuit Breaker		
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
Relays		
Vibration tests	IEC 60255-21-1	
Shock and bump tests	IEC 60255-21-2	
Seismic tests	IEC 60255-21-3	
Electromagnetic compatibility requirements	IEC 60255-26	
Product safety requirements	IEC 60255-27	
Common requirements	IEC 60255-1	
Functional Requirements	Relevant standards of IEC 60255-1xx series	

Communication requirements	IEC 61850	
Current Transformers		

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
Voltage Transformer		
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

ACOR

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 Beneficiary/SHGs authorized representative.

7 AC CABLES

7.1 STANDARDS AND CODES

All AC Cables shall conform to IS7098-I for Crosslinked Polyethylene Insulated Thermoplastic Sheathed Cables, Part 1: For Working Voltages up to and including 1100V. IS7098-II for 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

- 7.5 Sequential marking of length of the cable in meters at every meter Cables shall be sized based on the following considerations:

- Rated current the equipment
- In case of Central inverters, average voltage drops in LT cable (from PCU to inverter transformer) shall be limited to 0.5% of the rated voltage. In case of String inverters, average voltage drops (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), average voltage drop shall be limited to 1% of the rated voltage. The Contactor shall provide voltage drop calculations in excel sheet.
- Short circuit withstand capability as per design
- 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 from the date of supply.

- 7.7 Testing Type, routine and acceptance tests requirements shall be as per relevant standards for all cable sizes.

7.8 INSTALLATIONS

- 7.8.1 Cable installation shall be as per IS 1255.
- 7.8.2 In case of central inverter configuration, AC cables from inverter-to-inverter transformer shall be laid above ground on horizontal GI cable trays of required width. The cable trays shall be supported on concrete foundations. Minimum clear height of the cable tray shall be 350 mm above FGL.
- 7.8.3 Cables within transformer yard/ switchyard shall be laid through RCC cable trench with supports. 11 kV Switchgear Panel in Local Control Room may be laid over ground on GI cable trays / directly buried underground. AC cables from 11 kV Switchgear Panel in Local Control Room to 11 kV Switchgear Panel in Plant Main Control Room may be laid over ground on GI cable trays / directly buried underground / on over ground transmission lines.
- 7.8.4 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.
- 7.8.5 AC cables shall be provided with punched/embossed aluminium 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 incorporate redundant source of power supply for increased reliability.
- 8.4 Following consideration shall be taken into account while sizing the auxiliary transformer:
 - (i) 20% future load margin
 - (ii) Total connected load at 0.8 power factor

9 LT SWITCHGEAR

The LT switchgear specifications mentioned in this section are applicable for auxiliary supply distribution panel, AC combiner box and LT switchgear panel in case of string inverter configuration.

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.

STANDARD/CODE	DESCRIPTION
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
IS3043	Code of practice for earthing
IEC 60255	Measuring relays and protection equipment - Part 1: Common requirements

9.2 TECHNICAL PARAMETERS

System Details	
Rated system voltage	415 V $\pm$ 10%, 3 Phase, 50Hz, 4 wire, Neutral Solidly Earthed
Rated frequency	50 Hz $\pm$ 5%
System fault current	As per system requirement
Moulded case circuit breaker (MCCB)	
Rated voltage	415 V
Rated current	As per system requirement
Rated insulation level	690 V
Rated ultimate short-circuit breaking capacity and Rated service short-circuit breaking capacity	As per system fault current
Rated short-circuit making capacity	2.1 $\times$ Rated ultimate short-circuit breaking capacity
Rated short-time withstand current duration	1 s
Utilization category	A
Current transformer (CT)	

Type	Cast Resin Bar Primary
Voltage class and frequency	650 V, 50 Hz
CT Secondary Current	1:00 AMP
Class of insulation	Class E or better
Accuracy class & burden	
a) For Protection	5P20, 5VA
b) For Metering	Class 0.5, 5VA (min)
Instrument Security Factor for metering CT	5
Voltage transformer (VT) Type	Cast Resin Accuracy class 0.5
Rated Voltage factor	1.1 continuous, 1.5 for 30 seconds
Class of insulation	E or better
Digital Multifunctional Meter (MFM)	
Accuracy class	0.5
Communication with SCADA	RS485 communication with Modbus RTU

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 5X (Indoor) and IP 55 (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

LT switchgear shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 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 LT SWITCHGEAR

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 UPS system shall comprise of two nos. of UPS of 100% capacity, i.e., two inverters, batteries and UPSDB connected by bus coupler.

10.2.3 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.

10.2.4 The battery sizing shall account for suitable temperature correction factors, ageing factors of 1.25, design margin of 1.1 & depth of discharge of 80%.

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

a) Insulated Gate Bipolar Transistor (IGBT) Converter

b) Insulated Gate Bipolar Transistor (IGBT) Inverter

c) Digital Signal Processor (DSP) using Pulse Width Modulation (PWM) for Direct Digital Control (DDC) of all UPS control and monitoring functions d) 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	SPECIFICATIONS
Topology	Online double conversion UPS
Overall efficiency	> 90%
Input	
Voltage	230 V $\pm$ 10% AC for UPS rating of less than 5 kVA 415 V $\pm$ 10% AC for UPS rating of 5 kVA and above
Frequency	50 $\pm$ 5%
Power factor	0.95
Output	
Voltage	230V $\pm$ 1% AC
Frequency	50 Hz
Power factor	0.8
Battery	
Type	Sealed maintenance-free (AGM)
Capacity	100% 100% UPS load for 2 hours
Monitoring and communication	
LED Indication	Yes
Local Display	LCD / LED
SCADA communication	RS-485 Interface Port

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 The Contractor shall provide the Operation & Maintenance Manual and mandatory spare parts list along with the equipment.

10.4 WARRANTY

10.4.1 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

- Routine tests and acceptance tests on final product shall be done as per QAP approved by the Employer.
- 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

11.1 STANDARDS AND CODES

STANDARD/CODE	DESCRIPTION
IEC 60896- 21:2004	Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test
IEC 60896- 22:2004	Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements
IS 15549	Stationary Regulated Lead Acid Batteries

11.2 GENERAL

- 11.2.1 110 V / 220 V DC system (Battery, Battery Charger & DCDB) in accordance with this specification and standards stated herein, shall comprise of the following.
- Sealed Maintenance Free VRLA battery complete with racks & accessories.
 - Float cum Boost Charger (FCBC)
 - DC Distribution Board (DCDB)
- 11.2.2 DC system shall comprise of two nos. of battery, battery charger and DCDB connected by bus coupler.
- 11.2.3 Battery shall be used to supply the following loads with back up of two hours in case of complete power failure:
- Trip and closing coil of HT circuit breaker
 - Spring charging motors for HT circuit breaker
 - Annunciator and Indication circuit of HT switchgear panel
 - Auxiliary supply to protection relays
- 11.2.4 The battery sizing shall account for suitable temperature correction factors, ageing factors of 1.25, design margin of 1.1 & depth of discharge of 80%.
- 11.2.5 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 BATTERY

The battery shall be VRLA type complying with IEC 60896-21 & IEC 60896-22 / IS 15549. The Contractor shall submit type test reports as per IEC 60896-21 & IEC

11.4 BATTERY CHARGER

- 11.4.1 The Battery Charger as well as its automatic regulator shall be of static type and shall be compatible with offered batteries. The Battery Charger shall be capable of continuous operation at the respective rated load in float charging mode. The charger shall also be capable of boost charging the associated battery at the desired rate.
- 11.4.2 The battery charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and shall be wired up to the respective charger for feedback control.
- 11.4.3 The battery charger shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during float charging, the charger output voltage shall remain within $\pm 1\%$ of the set value for AC input voltage variation of $\pm 10\%$, frequency variation of $\pm 5\%$, combined voltage and frequency variation of $\pm 10\%$, and DC load variation from zero to full load.
- 11.4.4 The battery charger shall have a constant voltage characteristic throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.
- 11.4.5 The battery charger shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the charger. The load-limiter characteristics shall be such that any sustained overload or short circuit in DC system shall not damage the charger, nor shall it cause blowing of any of the charger fuses. The charger shall not trip on overload or external short circuit.
- 11.4.6 Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the charger panel covering the entire float charging output range specified. Step less adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for float charging mode.
- 11.4.7 During boost charging, the battery charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the boost charging current continuously over a range of 50 to 100% of the rated output current for boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode.
- 11.4.8 Suitable filter circuits shall be provided in all the chargers to limit the ripple content (peak to peak) in the output voltage to 1%, irrespective of DC load level, even when they are not connected to battery.

11.4.9 Digital Outputs shall be configured for connection to the SCADA to monitor the

outputs like charger output current, output voltage, float/boost mode, etc.

11.4.10 The battery charger shall have an AC contactor on the input side. It shall be of air brake type and suitable for continuous duty. A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.

11.4.11 The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective charger. 11.4.12 Digital or analog indicating instruments to indicate DC current, DC voltage & AC voltage shall be provided.

11.4.13 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.

11.4.14 The panel shall be of CRCA sheet steel construction having thickness of at least

11.4.15 2.0 mm. Degree of protection provided by the enclosure to the internals of charger shall be IP 42 (Indoor) / IP 55 (Outdoor).

11.4.16 The instruments, switches and indicating lamps shall be flush mounted on the front panel.

11.4.17 DCDB shall have adequate number of outgoing feeders with double pole, DC MCBs. At least 20% feeders shall be provided as spare.

11.5 WARRANTY

Batteries and battery charger shall be warranted for minimum of 2 (two) years against all material/ manufacturing defects and workmanship from the date of supply.

11.6 Tests Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Beneficiary/SHGs or its authorized representative.

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. Standard/Code Description 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 CEA Regulations and other statutory regulations

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 microns 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. For Transformer- yard/Switchyard earthing, mild steel rod may be used as earth electrode.

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 Combiner Box (SCB) structures in the PV array field shall be bonded to the earthing system by two distinct connections.

12.3.2 Earthing of PV Modules shall be as per the requirements of the PV Module Manufacturer.

12.3.3 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 galvanising and anti-corrosion paint afterwards.

12.3.4 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.

12.3.5 SCB 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/INVERTER EARTHING

12.4.1 Grounding on DC side of the PCU shall be as per the requirements of PV Module Manufacturer. PCU earth bus shall be connected to earth electrodes through flexible copper cable of sufficient cross section as mentioned by PCU 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 earthing shall be as per the recommendation of inverter manufacturer.
- 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

- 12.7.1 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.
- 12.7.2 Switchyard shall be shielded against direct lightning strike by provision of over-head shield wire or earth wire or spikes(masts) or a combination thereof as per CEA regulations 2010 (Technical standards)- 42(2)(C).

12.8 TESTS

- 12.8.1 Type test reports for earthing electrode, earth enhancing compound and its associated accessories shall be submitted during detailed engineering for approval.
- 12.8.2 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.
- 12.8.3 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 the entire plant except buildings and transformeryard/switchyard against direct lightning strokes shall be provided as per IS/IEC 62305:2010 or NF C 17-102. Lightning Protection System for buildings shall be provided as per IS/IEC 62305:2010.
- 13.2 Protection level for the entire plant shall be Level-III.
- 13.3 Air terminals, down conductors and earth termination system shall be designed as per relevant parts of IS/IEC 62305:2010 or NF C 17-102.

13.4 Necessary foundation/anchoring for holding the air terminal in position to be made after giving due consideration to shadow on PV array, maximum wind speed and maintenance requirement at site in future.

13.5 Type test reports as per IS/IEC 62305:2010 or NF C 17-102 shall be submitted during detailed engineering for approval.

13.6 Lightning Protection System for Transformer Yard/Switchyard

13.6.1 Direct Stroke Lightning Protection (DSLPL) for Transformer Yard/Switchyard shall be provided by Lightning Mast and Shield Wires.

13.6.2 The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.

13.6.3 Down conductors shall not be connected to other conductors above ground level. Down conductors shall be cleated on the structures at 2000 mm interval.

13.6.4 Every down conductor shall be provided with a test joint at about 1000 mm above ground level. The test joint shall be directly connected to the earthing system.

14 COMMUNICATION CABLES

14.1 OPTICAL FIBRE CABLES

14.1.1 Optic Fibre cable shall be 8/12 core, galvanized corrugated steel taped armoured, fully water blocked, for outdoor/ indoor application so as to prevent any physical damage.

14.1.2 The cable shall have multiple single-mode or multimode fibres 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 50% cores (not less than 4) 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 RS-485 CABLE

RS-485 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.

15 REMOTE MONITORING SYSTEM

15.1 GENERAL REQUIREMENTS

15.1.1 Management platform for Remote monitoring of solar plants installed. Remote Monitoring System (RMS) should have followed minimum features or modules

a) Solar System Performance: DC Voltage, DC current, AC output Current, Power, Energy, Status of Inverter & String Combiner Box etc.

b) Net Metering:

i. As per CEA guidelines, grid connected solar plant will require minimum Two energy meters mainly:

- Bi-Directional Grid Interface Meter
- Solar Generation Audit Meter.

ii. Remote Monitoring System should have provision to integrate both energy meters on DLMS communication protocol on RS232 ports

iii. Important electrical parameters of Bi-Directional Grid Interface Meter such as Imported Energy, Exported Energy, Net Energy, Solar Generation Energy, Voltage, Power (Import or Export).

iv. Important electrical parameters of Solar Generation such as Voltage, Current, PF, Power, Energy etc.

c) Billing Data Management: Remote Monitoring System should provide Billing parameters from Bi-Directional Grid Interface meter required by DISCOMS

d) RMS Performance: %Device Connectivity, %Data Availability etc.

e) Events and Notifications: Faults related to solar generation, inverter fault/alarms, Breaker status change such as on/off/trip etc.

f) Asset Management: Ratings, Serial Number, Make, Model Number of Inverter, String combiner Box, IMEI number (of communication module) and ICCID (of SIM) etc.

g) Complaint and Ticket Management

15.1.2 Remote Monitoring System (RMS) provided by all bidders should connect to State Level Solar Energy Data Management platform.

15.1.3 Communication Architecture between SWPS and RMS should be as per following:

A. Communication Connectivity:

i. Field Device Connectivity: Communication between RMS and Inverter /String Combiner Box should be on RS485 MODBUS RTU protocol to ensure interoperability irrespective of make and manufacturer

ii. Remote Connectivity: RMS of SWPS should be using GSM/GPRS/2G/3G/4G cellular connectivity

iii. Local Connectivity: Ethernet/Bluetooth/Wi-Fi connectivity to configure parameters, notifications, communication interval, set points etc. or to retrieve locally stored data

iv. Sensor Connectivity: RMS should have provision for at least four Analog inputs with 0.1% accuracy for applications such as breaker & transformer health etc. and four digital inputs for breaker status

B. COMMUNICATION MODES

i. Push Data on Event/Notification: Faults related to solar generation, inverter fault/alarms, Breaker status change

ii. Push Data Periodically: important parameters of inverter, string combiner box and energy meter should be pushed to central server on configurable interval. Interval should be configurable in multiple of 1 minute.

iii. Command On Demand: It should be possible to send commands via GSM or GPRS to RMS either to update configuration

C. COMMUNICATION PROTOCOL:

i. RMS should provide data on MQTT Protocol to establish communication with thousands of systems.

D. SECURITY:

i. Communication between RMS and Server should be secured and encrypted using TLS/SSL/X.509 certificate etc.

ii. As a part of IoT protocol, Authentication and Authorization should be implemented using token/password mechanism

E. MESSAGE FORMAT:

i. RMS should provide data in a JSON message format as required by respective DISCOM

F. DATA STORAGE: i. In case of unavailability of cellular network, RMS should store data locally and on availability of network it should push data to central server. Local data storage should be possible for at least one year in case of unavailability of cellular network.

G. CONFIGURATION UPDATE OVER-THE-AIR: Configuration update over the air of multiple parameters such as IP, APN, Data Logging Interval, Set Points etc. is essential.

15.1.4 EMI/EMC Certifications:

Electrical Fast Transient (IEC 61000-4-4)	A
Electrostatic Discharge (IEC 61000-4-2)	A
Radiated Electromagnetic Field Test (IEC 61000-4-3)	A
Power Frequency Magnetic Field (IEC 61000-4-8)	

A Conducted Disturbances induced by radio frequency (IEC 61000-4-6) A Voltage Dips, short interruptions (IEC 61000-4-11)

A Dry Heat test (IEC 60068-2-2), continuous operations @ 55 deg. C

O Damped Heat Test (IEC 60068-2-78), @ 95% RH and 40 deg. C

O

Note: Passing Criteria

A: Temporary degradation or loss of function or performance which is self-recoverable O: Normal performance within the specified limits O

15.2 HARDWARE AT MAIN CONTROL ROOM:

15.2.1 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.

15.2.2 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:

Operator Workstation (OWS) – 1 Nos.	
Hardware	i7 CPU running at 3.0 GHz or faster with 8GB RAM, 2TB SSD hard disk, 28" LED monitor, keyboard and mouse, 4 USB ports, LAN port
Operating System	Windows operating system with necessary tools, anti-virus software.
Accessories	1. UPS of required capacity with 2-hour battery backup. 2. Common for the Operator Workstations: 3. Screen Display Unit: Min 50" LED Flat Monitor with wall mounted arrangement for the display of SCADA screen 4. A4 size monochrome laser printer.

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

15.3 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 ILLUMINATIONS

16.1 Standards and Codes

LED luminaries 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 Colour Maintenance of LED Packages, Arrays and Modules

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16.2 GENERAL SPECIFICATION

- 16.2.1 This specification covers design, supply and installation of uniformly Illumination system along the peripheral corridor, access & internal roads, main control room & inverter rooms, switchyard and other facilities including entry points/gate(s) inside the plant area.
- 16.2.2 The Contractor shall furnish Guaranteed Technical Particulars of the LED luminaries, from renowned brands available in the market for approval of Employer.
- 16.2.3 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.

16.3 LIGHTING LEVELS

- 16.3.1 The lighting system 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 / Access Roads	4
Transformer yard/Switchyard	20
H – pole and metering point	10

- 16.3.2 The lighting level shall take into account appropriate light output ratio of luminaries', coefficient of utilization maintenance factor (of 0.7 or less) to take into account deterioration with time and dust deposition and luminance uniformity [Uo] shall be min 0.3.

16.4 LED LUMINARIES FOR OUTDOOR APPLICATIONS

- 16.4.1 LED luminaries' 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)
Luminaire Casing	Powder coated metal / Aluminum
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)

- 16.4.2 LED luminaries of minimum 50 W mounted at a pole height of 4 m shall be provided at every 100 m interval for plant boundary.
- 16.4.3 The LED luminaries (outdoor) housing, heat sink, pole mounting bracket, individual LED reflectors and front heat-resistant tempered glass should be provided.
- 16.4.4 The LED luminaries (outdoor) housing should be made of non-corrosive, high-pressure, die-cast aluminium 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.
- 16.4.5 The luminaire should be provided with in-built power unit and electronic driver.
- 16.4.6 The luminaire should be suitable for standard street light poles and should be suitable for side entry and bottom entry (post top).
- 16.4.7 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.
- 16.4.8 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.
- 16.4.9 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.
- 16.4.10 Junction box for lighting shall be made of fire-retardant material. The degree of protection shall be IP 55 for outdoor JB.
- 16.4.11 Lighting cables, wherever exposed to direct sunlight, shall be laid through Double Wall Corrugated (DWC) HDPE conduits.
- 16.5 LED Luminaire/Lamps for Indoor Applications All indoor LED luminaire/lamps shall be supplied with proper diffuser to avoid direct visibility of LED and suitable heat sink for longer life.
- 16.6 Warranty All luminaires shall be warranted against all material/manufacturing defects and workmanship for minimum of 2 (two) years from the date of supply.

17 CCTV CAMERA

- 17.1 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) Each entry/exit gate.

(ii) Any strategic location in the Plant Area required to be monitored.

- (iii) Main Control Room: Covering Entry/Exit and Equipment Rooms
- (iv) Inverter Station & Inverter Transformer Yard

- 17.2 Monitoring stations of the CCTV Network shall be installed in Main Control Room.
- 17.3 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.
- 17.4 Camera shall be colour, suitable for day and night surveillance (even under complete darkness) and network compatible.
- 17.5 It shall be possible to control all cameras i.e., PTZ auto/ manual focus, selection of presets, video tour selection etc. The software shall support flexible 1/2/4 windows split screen display mode or scroll mode on the display monitor (minimum 32") for live video.
- 17.6 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.

18 FIRE ALARM SYSTEM

18.1 Standards and Codes

STANDARD/CO DE	DESCRIPTION
IS 2189	Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System - Code of Practice
IS 15683	Portable Fire Extinguishers - Performance and Construction – Specification
IS 2546	Specification for galvanized mild steel fire bucket
National Building code 2016	

- 18.2 The 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.
- 18.3 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.

18.4 Minimum two numbers of fire extinguishers (CO2 and Foam type each, of capacity 9 kg having BIS certification marking as per IS 15683) 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.

18.5 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.

18.6 Digital output from the fire detection system shall be integrated with SCADA.

18.7 The Contractor shall submit the plan for fire and smoke detection system for the Employer's approval.

19 TESTING INSTRUMENTS

19.1 The Contractor shall provide the following set of instruments for on-site testing.

19.2 All testing equipment shall possess valid calibration certificate issued from approved NABL labs.

19.3 Instruments of superior rating are allowed after seeking consent of the Employer.

19.4 Maintenance, calibration, up keeping, repair & replacement of these tools will be in the scope of the Contractor during O&M.

19.5 It is Contractor's responsibility to arrange for tools, tackles, logistics, test kits, manpower, experts etc. required for trouble free operation of Plant.

20 WARRANTY AND MAINTENANCE

1. The PV modules will be warranted for a minimum period of 25 years from the date of supply. (Output wattage should not be less than 90% at the end of 12 years and 80% at the end of 25 years).
2. The mechanical structures, electrical components including evacuation infrastructure and overall workmanship of the Solar PV Rooftop power plant system must be warranted for a minimum of 5 years from the date of commissioning and handing over of the system.
3. The contractor/ bidder shall be responsible to replace free of cost (including transportation and insurance expenses) to the purchaser whole or any part of supply which under normal and proper use become dysfunctional within 72 hours of issue of any such complaint by the purchaser.
4. The service personnel of the Successful Bidder will make routine quarterly maintenance visits. The maintenance shall include thorough testing & replacement of

any damaged parts Apart from this any complaint registered/ service calls received / faults notified in the report generated by the IVRS should be attended to and the system should be repaired/ restored/ replaced within 4 days.

5. During operation and maintenance period of the SPV Power Plant, if there is any loss or damage of any component due to miss management/miss handling or due to any other reasons pertaining to the deputed personnel, what-so- ever, the contractor shall be responsible for immediate replacement/rectification. The damaged component may be repaired or replaced by new component

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