E -tender

Part-1
Section-1

Sr. No.	Particulars	**Remarks**
1.	Tender Notice No.	HIMURJA (F-7)/WB/Phase-II/SPP/500 KW/3/ 2024-25
2	NIT date	03-04-2025
3	Mode of tender	Online Tender.
4.	Estimated Cost of the work	Rs. 6,00,00,000
5.	Tender Document fee cost (Non-refundable)	Rs. 15000=00 (inclusive of GST)
6.	EMD (Refundable)	Rs 12,00,000/-
7.	Date & time of start of downloading tender document.	04-04-2025 at 11.00 AM
8.	Pre Bid Meeting (link will be generated online)	10-04-2025 at 3.00 PM
9.	Last Date & Time of downloading of tender document	25-04-2025 by 5.00PM
10.	Last date & time for online submission of technical and financial bid.	26-4-2025 by 5.00 PM.
11.	For online submission of Tender fee, detail of A/C is The Chief Executive Officer, HIMURJA, A/c No 55070883802 , IFSC Code- SBIN 0014639, in SBI, Kasumpti, Shimla-9	On or before last date of submission of Technical Bids & Financial Bids
12.	Date & time of opening of Technical Bids (Part-I)	28-4-2025 at 11.30 AM
13.	Date & time of opening of Financial Bids (Part-II)	Will be intimated later through online portal
14.	Validity of Rates	Fixed rate contract.
15.	Currency of Bids	Indian Rupees (INR)

H I M U R J A
(H.P Govt Energy Development Agency)
Shimla-171009

e- Tender document

No. HIMURJA (F-7) /WB/Phase-II/SPP/500KW/3/2024-25

Design, Engineering, Supply, Installation and Commissioning of 500 kW capacity each Ground Mounted Solar Power Projects to be installed at Kirti (Theog), Sharog(Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh.

Date of opening: ---- 21-4-2025

Time of opening: ---- 11:30 AM

H I M U R J A
(H.P Govt. Energy Development Agency)
Shimla-171009

e- TENDER DOCUMENT

No. HIMURJA (F-7) /WB/Phase-II/SPP/500 KW/3/2024-25

Address for Correspondence

The Chief Executive Officer,

HIMURJA

(H.P. Govt. Energy Development Agency)

8-A,SDA Complex, Kasumpti,

Shimla-171009, Himachal Pradesh, INDIA

Telephone No: 0177- 2620365/2628074

Tender sites:- https//hp tender.gov.in

H I M U R J A
(H.P Govt Energy Development Agency)
Shimla-171009

e- TENDER NOTICE

e-Tenders are hereby invited on behalf of HIMURJA for Design, Engineering, Supply, Installation and Commissioning of 500 kW capacity each Ground Mounted Solar Power Projects to be installed at Kirti (Theog), Sharog(Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh strictly as per the terms and conditions and specifications mentioned in the tender document. The tender document is available on websites https:/hp tender.gov.in under the department of Non-Conventional Energy Sources (NES). The tender cost can be paid through online mode in following account and receipt/ UTR No. shall be uploaded with the technical bid document.

Account Holders Name:-	The Chief Executive Officer, HIMURJA
Name of Bank;	SBI, Kasumpti, Shimla-171 009
Account No.	55070883802
IFSC code:-	SBIN 0014639

e- Tender Document No.	Name of work.	Completion time	Earnest Money
No. HIMURJA (F-7) /WB/Phase-II/SPP/ 500KW/3/ 2024-25	Design, Engineering, Supply, Installation and Commissioning of 500 kW capacity each Ground Mounted Solar Power Projects to be installed at Kirti (Theog), Sharog (Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh.	Eight months	Rs 12,00,000/- (to be depositesd in the shape of Bank Guarantee of equivalent amount). The original Bank Guarantee must reach this office before the opening date of the technical bids.

Terms and Conditions:

i) Tenders without earnest money will not be considered. The bidders who have earlier deposited the tender fees and EMD are exempted from paying the fees and EMD.

ii) HIMURJA reserves the right to reject any or all the tenders without assigning any reason.

iii) System Integrators of SPV systems or manufacturers of SPV Systems or EPC Contractors, or any combination of such entities are also eligible to bid in the form of a Joint Venture (JV) under an existing agreement. The bidder must have similar experience of installation and commissioning of Ground Mounted Solar Power Projects of at least 500 kW capacity. However, the cumulative capacity of such projects installed and commissioned by the bidder must be at least 1 MW to be eligible for the bid. Bidders will be required to submit the proof of their eligibility in the shape of work order, commissioning and satisfactory performance reports along with the bid.

iv) The minimum average annual turnover of the firm should be Rs 2 Cr for the last three consecutive years i.e (2021-22, 2022-23 & 2023-24)

Project Manager (Solar),
HIMURJA,
Kasumpti,Shimla-171009.

SECTION - I

INSTRUCTIONS TO BIDDERS

A. Introduction

1. Source of Funds

1.1 Funds will be provided under H.P. Power Sector Development Programme: World Bank Implementation Support Mission.

2. Bidders Eligibility and Qualification

2.1 System Integrators of SPV systems or manufacturers of SPV Systems or EPC Contractors, or any combination of such entities are also eligible to bid in the form of a Joint Venture (JV) under an existing agreement. In case of Joint Venture, all members shall be jointly and severally liable for the execution of the contract in accordance of the contract terms and conditions. The JV shall nominate a representative (also referred to as a Lead Partner) who shall have the authority to conduct all business for and on behalf of any or all the members/partners of the JV during the bidding process and, in the event the JV is awarded the contract, during the contract execution. In case of JV, the bidding JV (also referred to as the Bidder) shall submit a Joint Deed of Undertaking with the Bid. The bidder must have similar experience of installation and commissioning of Ground Mounted Solar Power Projects of at least 500 kW capacity. However, the cumulative capacity of such projects installed and commissioned by the bidder must be at least 1 MW to be eligible for the bid. Bidders will be required to submit the proof of their eligibility in the shape of work order, commissioning and satisfactory performance reports along with the bid. The minimum average annual turnover of the firm should be Rs 2 Cr for the last three consecutive years i.e (2021-22, 2022-23 & 2023-24).In absence of sufficient experience and turnover, the tender is liable to be rejected straight way.

2.2 The bidder will be required to submit declaration for Environmental, Social and Health and Safety Past performance and Forced Labour Performance Obligations as per table given below:

a) **For Environmental, Social and Health and Safety Past performance**

Criteria		Compliance Requirements			Submission Requirements
Requirement	Single entity	All partners combined	Each partner	One partner	
Declare any contracts that have been suspended or terminated and/or performance security called by an employer for reasons related to the non-compliance of any environmental,	Must make the declaration. If the bidder proposes specialist then also must make the declaration.	Not applicable	Each partner must make the declaration. If the bidder proposes specialist then also must make the declaration.	Not applicable	Undertaking by the bidder

health and safety relate contractual obligations, since last 5 years from the date of deadline for bid submission.					

b) **For Forced Labour Performance Obligations**

Criteria		Compliance Requirements			Submission Requirements
Requirement	Single entity	All partners combined	Each partner	One partner	
Declare any contracts that have been suspended or terminated and/or performance security called by an employer for reasons of breach of forced labour obligations since last 5 years from the date of deadline for bid submission.	Must make the declaration. If the bidder proposes specialist then also must make the declaration.	Not applicable	Each partner must make the declaration. If the bidder proposes specialist then also must make the declaration.	Not applicable	Undertaking by the bidder

3. Bid Form

3.1 The bidder shall complete the Bid Form and the appropriate Price Schedule furnished in the Bidding Documents, indicating the goods to be supplied, a brief description of the goods, quantity and prices. The rate should be quoted strictly as per scope of work and price bid.

4. Documents Establishing Bidder's Eligibility and Qualifications

4.1 The bidder shall furnish, as part of its bid, documents establishing the bidder's eligibility to bid and its qualifications to perform the Contract if its bid is accepted.

5. The documentary evidence of the Bidder's qualifications to perform the Contract, if its bid is accepted, shall have to be established to the HIMURJA's satisfaction.

(a) that, in the case of a Bidder offering to supply goods under the contract which the Bidder did not manufacture or otherwise produce, the Bidder has been duly authorized by the goods' manufacturer or

producer to supply the goods in the purchaser's country. In support party will provide the documentary proof of infrastructure support for the same.

(b) that the Bidder has the financial, technical, and production capability necessary to perform the Contract.

6. The documentary evidence of conformity of the goods and services to the bidding documents may be in the form of literature, drawings and data, and shall consist of:

(a) a detailed description of the essential technical and performance characteristics of the goods;

(b) a list giving full particulars, including available sources and current prices, of all spare parts, special tools, etc., necessary for the proper and continued functioning of the goods for a period to be specified in the Bid Data Sheet, following commencement of the goods by HIMURJA.

(c) a item-by-item commentary on the HIMURJA's Technical Specifications demonstrating the goods and services to those specification, or a statement of deviations and exceptions to the provisions of the Technical Specifications.

7. Earnest Money

7.1 Tender must be accompanied with earnest money, in the form of Bank Guarantee issued by any Nationalized/Scheduled Bank/Co-operative Banks of the State of Himachal Pradesh. Tenders received without tender fee/ EMD shall be rejected straightway. The format of B.G. is enclosed at **Annexure -3.**

7.2 The earnest money is required to protect the HIMURJA against risk of Bidder's conduct which would warrant the security's forfeiture.

7.3 Unsuccessful Bidder's Bank Guarantee will be discharged as promptly as possible but not later than thirty (30) days after the expiry of the period of bid validity prescribed by the HIMURJA.

7.4 The earnest money may be forfeited:

a) If a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Bid Form.

b) In case successful Bidder fails to sign the Contract.

8. Period of Validity of Bids

Bids shall remain valid for the period of 180 days from the date of opening of price bids.

9. Format and Signing of Bid

9.1 The Bidder shall submit an original bid through online mode on https:/hp tender.gov.in

9.2 Any interlineations, erasures, shall be valid only if they are initialed by the person or persons signing the bid.

9.3 Bidder should log into portal well in advance for bid submission so that they can upload the bid in time.

9.4 The bidder's authorized representative has to digitally sign & upload the required documents.

9.5 The bidder (s) should submit/ upload, along with its bid, notarized power of attorney supported with necessary supporting documents in respect of its authorized representative, as written confirmation of authorization to digitally sign on behalf of bidder.

B Submission of Bids

The bids should be submitted online on the websites https:/hp tender.gov.in under the department of Non-Conventional Energy Sources (NES)**.**

C Bid Opening and Evaluation

10. Opening of Technical Bids by HIMURJA

10.1 The bids will be opened online by designated officers on scheduled date and time. The technical bids shall be evaluated by the HIMURJA for assessing responsiveness, bidder's qualification and technical confirmation.

10.2 The bidders whose technical bids are declared as technically responsive and qualified shall be informed accordingly through e-tender portal only and their Price Bids shall be opened.

10.3 The Price Bids of bidders, whose technical bids are found non-responsive, shall not be opened.

10.4 Price Bids opening date & time shall be intimated through e-tender portal only.

11. Clarification of Bids

11.1 During evaluation of the bids, the HIMURJA may, at its discretion, ask the Bidder for a clarification of its bid. The request for clarification and the response shall be in writing, and no change in the prices or substance of the bid shall be sought, offered, or permitted. If the firm does not respond to the clarification, the firm will be considered as non-responsive and their bid shall be rejected out rightly.

11.2 At any time prior to the submission of the tender or prior to the opening of the financial bid, HIMURJA may, for any reason, whether at its own initiative or in response to a clarification requested by the tenderers may modify the tender document by amendment. The amendment will be notified in writing to all prospective tenderers on web-portal who have received the tender documents and will be binding on them.

12. Evaluation and Comparison of Bids

12.1 The HIMURJA will evaluate and compare bids which have been determined to be substantially responsive.

12.2 The detailed techno-commercial analysis of the bid shall be carried out by the HIMURJA.

13. Contacting the HIMURJA

13.1 From the time of bid opening to the time of contract award, if any bidder wishes to contact the HIMURJA on any matter related to the bid, it should do so in writing.

13.2 Any effort by a Bidder to influence the HIMURJA in its decision on bid evaluation, bid comparison or contract award decisions may result in rejection of the Bidder's bid.

D Award of Contract

14. Award Criteria

The HIMURJA will award the Contract to the successful Bidder/Bidders whose bid has been determined to be substantially responsive and has been determined as the lowest evaluated bid, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

15. HIMURJA's Right to Accept Any Bid and to Reject Any or All Bids

15.1 The HIMURJA reserves the right to accept or reject any bid, and to cancel the bidding process and reject all bids at any time prior to award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders.

16. Signing of Contract

16.1 The successful Bidder will sign the contract within one month from the issue of award letter.

18. Performance Security:-

18.1 Performance security @ 10 % will be deducted from the bill of the firm and will be released each year on pro rata basis i.e. @ 2% each during the five years of the warranty/operation and maintenance period of the project. HIMURJA shall be entitled to forfeit the performance security deposit in whole, or in part, in the event of any fault, or failure of performance in any respect of any condition mentioned in the contract under reference.

18.2 The Performance Security shall be in INR.

SECTION - II

GENERAL CONDITIONS OF THE TENDER DOCUMENT

BRIEF HISTORY

The Ground Mounted Solar Power Projects of 500 kW each are to be installed at Kirti (Theog), Sharog(Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh for developing green initiatives at the panchayat level and also to make these Gram Panchayats self sustainable. Funds will be provided under the H.P. Power Sector Development Programme: World Bank Implementation Support Mission and Government of Himachal Pradesh. Accordingly, HIMURJA has prepared Tender Document No. HIMURJA (F-7)/WB/Phase-II/SPP/500KW/3/2024-25 for the Design, Engineering, Supply, Installation and Commissioning of 500 kW Ground Mounted Solar Power Projects to be installed at Kirti (Theog), Sharog(Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh. The components of systems such as PV modules, PCU (charge controller and inverter) transformer, etc to be supplied under the project should be tested as per the National & International Standards.

1 GENERAL SCOPE OF WORK:

The general scope under this contract includes verification of sites feasibility, development of sites, design, engineering, manufacture, shop testing, inspection, packing & forwarding, transportation up to project sitess, loading & unloading, storage, erection, preliminary testing at sitess, installation, commissioning, performance testing & handing over of the Solar Photovoltaic Power Projects of 500 kW capacity to the beneficiaries. The scope of the work will also include the following:-

a) Warranty period of five years which will commence from the date of successful commissioning of the project and acceptance by HIMURJA. During the warranty period, the contractor will have to ensure the required generation from the project, will carry out preventive, routine and breakdown maintenance of the project including replacement of any components including Modules, PCU etc. which goes bad free of cost.

b) The work includes the development of land if required for setting up of Ground Mounted Solar Power Project of 500 kW capacity at the sites. It includes making structure required for mounting of the modules, mounting of modules, inverter, transformer, control panels and other miscellaneous works required for successful installation and commissioning and synchronizing of the Ground Mounted Solar Power Projects of 500 kW capacity each at Kirti (Theog), Sharog(Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh.

c) The contractor will have to give an undertaking regarding the generation of 8 Lakh units of energy per annum from the Ground Mounted Solar Power Project of 500 kW capacity.

d) The bidders are advised to visit and examine the sites where the project is to be installed and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid, and entering into a contract for the provision of the project and services. The bidder shall bear the expenses incurred for visiting the sites.

2. Incidental Services

2.1 The firm may be required to provide any or all of the following compulsory services

(a) Performance or supervision of the on-sites assembly and/or start-up of the supplied Goods;

(b) Furnishing of sufficient T&P and tools required for assembly and/or maintenance of the supplied Goods;

(c) Detailed operations and maintenance manual will be supplied to different units as under:-

i) One set to HIMURJA H/Q

ii) Two set to each consignee

(d) Performance or supervision or maintenance and/or repair of the supplied Goods, for a period of ten years after the expiry of warranty period or for time as agreed by the parties, provided that this service shall not relieve the Firm of any warranty obligations under this Contract.

(e) Training of the personnel nominated by HIMURJA/the concerned agencies where the SPV Power Projects are to be installed, at the Firm's project and/or on sites, in assembly, start-up, operation, maintenance and/or repair of the supplied Goods.

3. Engineer/ Officer-in Charge

Project Officer, HIMURJA, Shimla/Kinnaur will be responsible for execution of the work at the sites as per contract agreement signed with the firm.

4. Payment

Payment shall be made in the currency specified in the contract in the following manner:

Payment for Goods and services

(i) First Installment i.e. 40% of the contract amount will be released on the supply of Module Mounting Structure and SPV Modules, and completion of civil work for the installation of modules **for each of the individual sites**. The payment will be released after receipt of bills duly verified by concerned Project Officer, HIMURJA, Shimla/Kinnaur, H.P. Performance security @ 10 % will be deducted from the bill of the firm.

(ii) Second Installment i.e. 30% of the contract amount will be released after the supply of Inverter, Power Conditioning Unit (PCU), DC & AC cables, transformer etc. required for the commissioning of the Solar Power Project of 500 kW capacity **for each of the individual sites**. The payment will be released after receipt of the bills duly verified by the concerned Project Officer, HIMURJA, Shimla/Kinnaur, H.P.

(iii) The balance 30% payment will be released after the installation and commissioning of the project and completion of all works at the **respective sites** as per the provisions of the Energy Policy, 2021 and receipt of all the documents duly verified by the concerned Agencies and concerned Project Officer, HIMURJA, Shimla/Kinnaur, H.P.

5. Completion Time Period

Time period for the delivery, installation and commissioning of the equipments shall commence immediately after the issue of Award letter. The supply should be completed within 6 (Six months), and the installation & commissioning should be completed in all respects within two months. Thus the Solar Power Projects must be commissioned within eight months from the date of issue of the award letter. Extension of time will be allowed for justified/ valid reasons only, which are not attributable to the contractor/bidder. A Tender Committee constituted at the HIMURJA headquarter shall be the competent authority for condemnation of the delay, if any, in supply of equipment and commissioning of the project, on justified / valid reasons only.

6. Liquidated Damages

a) If the firm fails to achieve the completion of works within the time period specified in the award letter/agreement, then the firm shall have to pay to HIMURJA, the liquidated damages for such default (except for the reasons not attributable to the firm) and not as a penalty, a sum equivalent to 0.5 % of the contract price for every week or part of a week which shall elapse between the time period prescribed in the award letter/agreement and the date of completion of the work. HIMURJA may, without prejudice to any method of recovery, deduct the amount from any payment of the firm lying with HIMURJA, due or which may become due to the firm. The payment of deductions of such damages shall not relive the firm from his obligations to complete the work or from any other of his obligations and liabilities under the contract.

b) The total amount of LD payable to HIMURJA under this clause shall be subject to a maximum of 10% of the contract price after which the work will be rescinded without giving any further notice.

c) The LD as aforesaid shall be paid by the firm without cavil or argument and without linking with the actual losses or damages to HIMURJA due to delay in completion of the works. However, in case, the firm fails to complete the work even after levying of maximum LD then HIMURJA will serve a Show Cause Notice to explain reasons within two week time of notice, for not executing the awarded work. If the reply submitted by the firm to the Show Cause Notice is not found to satisfactory the

award will be rescinded without any further notice and the EMD/performance security deposited will be forfeited and HIMURJA will be at liberty to get the work done at its own or from any other agency at the risk and cost of the firm. Further the firm will be blacklisted and will not be allowed to participate further in any of the tenders floated by HIMURJA.

All disputes relating to this contract shall be subject to the jurisdiction of courts in Shimla.

7. Inspection and Tests

A team of Officers authorized by HIMURJA shall have access to the firm's work place at any time during working hours for the purpose of inspecting the material to be supplied by the manufacturer, and the firm shall provide all necessary facilities for such inspection. No supply shall be dispatched without prior inspection and approval by the HIMURJA and the charges on account of inspection shall be borne by the firm.

Inspection and tests prior to shipment of Goods and at final acceptance are as follows:

7.1 The inspection of the Goods shall be carried out to check whether the goods are in conformity with the technical specifications attached to the purchase order form and shall be in line with the inspection/test procedures laid down in the schedule of specifications and the contract conditions.

7.2 Manufacturer must have suitable facilities at their works for carrying out various routine and performance tests on the equipment.

7.3 All tests specified in the technical specifications approved by MNRE and other standards.

7.4 The HIMURJA shall have the right to inspect the firm's premises and any part of the work at any time.

7.5 The firm shall submit, within the time stated in the contract or in the program, drawings showing how the projects are to be designed and any other information required for approval to HIMURJA.

7.6 Before the goods and equipment are taken over by the HIMURJA, the firm shall supply operation and maintenance manuals together with drawings of the goods and equipment. These shall contain such details which will enable the HIMURJA to operate, maintain, adjust and repair all parts of the works as stated in the specifications. The manuals and drawings shall be in English and in such form and numbers as stated in the contract. Unless and otherwise agreed, the goods and equipment shall not be considered to be completed for the purposes of taking over until such manuals and drawings have been supplied to the HIMURJA.

7.7 In case, at any later stage, it is found that the material supplied at the sites, and the material installed is not as per the specifications, then the complete material will be got tested from any of the approved MNRE/or other test centre at the risk & cost of the firm.

7.8 If the HIMURJA and the firm disagree on the interpretation of the test results each shall give a statement of his views to the other within 14 days after such disagreement arises. The statement shall be accompanied by all relevant evidence. The HIMURJA will review both the statements and render a final decision which shall be binding on the firm.

For the System & Other Software, the following will apply:

The firm shall provide complete and legal documentation of hardware, all subsystems, operating systems, compiler, system software and the other software. The firm shall also provide licensed software for all software products, along with the software manuals whether developed by it or acquired from others. The firm shall also indemnify the HIMURJA against any levies/penalties on account of any default in this regard.

8. Acceptance Certificate:

8.1 On successful completion of acceptability test, receipt of deliverables etc, and after the HIMURJA is satisfied with the working on the project, the acceptance certificate signed by the firm and the representative of the HIMURJA will be issued. The date on which such certificate is signed shall be deemed to be the date of successful commissioning of the systems which will normally be the date, on which the COD is declared by Directorate of Energy. If required HIMURJA desires, then third party inspection can be carried out at the expense of the firm before acceptance.

8.2 The training shall be imparted for seven days after successful commissioning of project to the concerned beneficiaries & HIMURJA for operation and routine maintenance of the Solar Power Project.

9. Spare Parts

Firm shall carry sufficient inventories to assure ex-stock supply of consumable spares such as modules, connectors, HT Switchgear, LT switchgear, DC cable, AC cable etc as per list specified at **Annexure "A".**

10. Maintenance Service

A During warranty period

Free maintenance services shall be provided by the firm during the warranty period of five years. No payment will be made on this account as it is included in the cost of main equipment. This Maintenance service will include:-

a) Preventive & Routine Maintenance:-

It shall include activities such as cleaning of modules, checking of connections of panels, electric connections of arrays , control panels, inverter , charge controllers, and any other activity that may be required for the proper functioning of the project as a whole. Proper record will be maintained by the firm on this account in the concerned location with a copy to the concerned Project Officer, with all the details. A log register will be maintained by the firm at the sites. Any

spare and consumables required during the period of five years will be supplied free of cost by the firm including replacement of any components which goes bad.

12 Packing

The Firm shall provide such packing of the Goods as is required to prevent damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall be taken into consideration, where appropriate, considering the remoteness of the Goods' final destination and the absence of heavy handling facilities at all points in transit.

13. PRICE LOW CLAUSE

If at any time during the supply period, the firm offers similar SPV Projects to some other customers on similar terms and conditions and technical specifications at reduced rates in respect of items contained in this order, then such reduced rates will also be applicable to this organization and the benefit shall be passed on to HIMURJA.

14. FRAUD AND CORRUPTION

14.1 HIMURJA and its personnel, as well as firms and individuals participating in procurement activities, including but not limited to, Bidders, Firms, and Contractors, agents, service providers, manufacturers (including their respective officers, directors, employees and personnel) under the contracts where HIMURJA is a party, are obliged to and shall observe the highest standard of ethics during the procurement and execution of such contracts in accordance with the Anti-Corruption Guidelines/ Laws/ Policy in force of HIMURJA/ State Government (as amended from time to time). In pursuance of this policy, HIMURJA

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) **"**corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

(v) "abuse" means theft, waste, or improper use of assets related to the Financer-related activity, either committed intentionally or through reckless disregard;

(vi) "conflict of interest" means any situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations; and "integrity violation" is any violation of integrity principles and guidelines (as amended from time to time), under the Employer's Anticorruption Policy including failure to adhere to the highest ethical standard.

(b) will reject a proposal for award if it determines that the Bidder recommended for award or any of its officers, directors, employees, personnel, sub consultants, subcontractors, service providers, firms or manufacturers has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the Contract;

(c) will impose remedial actions on a firm or an individual, at any time, in accordance with the State Government's Anticorruption Policy, including sanctions, ban, debarment or declaring ineligible, either indefinitely or for a stated period of time, to participate[1] in the Employer, -administered, or -supported procurement activities or to benefit from a Employer -administered, or -supported contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations. in connection with the procurement process, selection and/or execution of a contract.

14.2 All Bidders, consultants, contractors, firms, manufacturers, service providers, and other third parties engaged or involved in the procurement-related activities and their respective officers, directors, employees and personnel, are obliged to cooperate fully in any investigation by Authorities legally authorized to do so.

14.3 All Bidders, consultants, contractors and firms shall require their officers, directors, employees, personnel, agents to ensure that, in its contract with its sub-consultants, subcontractors, and other third parties engaged or involved in the Employer -related activities, such sub-consultants, subcontractors, and other third parties similarly are obliged to cooperate fully in any investigation by Authorities when required to do so.

14.4 The Contractor undertakes that no fees, gratuities, rebates, gifts, commissions or other payments have been given or received in connection with the procurement process or in the contract execution.

15. LABOUR

15.1 Engagement of Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labor, local or otherwise, and for their payment, housing, feeding, and transport.

(b) The Contractor shall provide and employ on the sites in the installation of the Facilities such skilled, semi-skilled, and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills.

(c) The Contractor shall be responsible for obtaining all necessary labor licenses, registration, permit(s) and/or visa(s) from the appropriate authorities for the entry of all labor and personnel to be employed at the sites. HIMURJA will, if requested by the Contractor, use his best endeavors in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.

(d) The Contractor shall at its own expense provide the means of repatriation to all of its personnel employed on the Contract at the sites to the place where they were recruited or to their domicile. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure. In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, HIMURJA may provide the same to such personnel and recover the cost of doing so from the Contractor.

(e) The Contractor shall, if required by HIMURJA, deliver to him a return in detail, in such form and at such reasonable intervals as HIMURJA may prescribe, showing the staff and the numbers of the several classes of labor from time to time employed by the Contractor on the Sites and such other information as may be required by HIMURJA.

15.2 **LABOUR LAWS**

(a) The Contractor shall comply with all the relevant labor Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration, and emigration, and shall allow them all their legal rights.

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

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

(d) During continuance of the Contract, the Contractor and his sub-contractors shall abide at all times by all applicable existing labour enactments and rules made there under, regulations notifications and byelaws of the State or Central Government or local authority and any other labour law (including rules), regulations bye laws that may be passed or notification that may

be issued under any labour law in future either by the State or the Central Government or the local authority. The employees of the Contractor and the Sub-contractor in no case shall be treated as the employees of HIMURJA at any point of time.

Salient features of some major laws applicable to establishments engaged in building and other construction works are summarized below, however, notwithstanding the same, the Contractor shall comply with laws in force, and as might have been amended from time to time or as shall be amended till Completion of the Facilities.

i) Employee's Compensation Act 1923: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

ii) Payment of Gratuity Act 1972: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

iii) Employee P.F. and Miscellaneous Provision Act 1952: The Act provides for monthly contribution by the employer plus workers @10% or 8.33%. The benefits under the Act are:

   a. Pension or family pension on retirement or death, as the case may be.
   b. Deposit linked insurance on death in harness of the worker.
   c. Payment of P.F. accumulation on retirement/death etc.

iv) Maternity Benefit Act 1951: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

v) Contract Labour (Regulation & Abolition) Act 1970: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certification of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more labour/ contract labour.

vi) Minimum Wages Act 1948: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provision of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.

vii) Payment of Wages Act 1936: It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

viii) Equal Remuneration Act 1979: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

ix) Payment of Bonus Act 1965: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of

8.33% of wages and maximum of 20% of wages to employees drawing Rs. 3500/- per month or less. The bonus is to be paid to employees getting Rs. 2500/- per month or above up to Rs. 3500/- per month shall be worked out by taking wages as Rs. 2500/- per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

x) Industrial Dispute Act 1947: the Act lays down the machinery the procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

xi) Industrial Employment (Standing Orders) Act 1946: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

xii) Trade Unions Act 1926: The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

xiii) Child Labour (Prohibition & Regulation) Act 1986: The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.

xiv) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service Act 1979: The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home upto the establishment and back, etc.

xv) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996 : All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act

applies has to obtain a registration certificate from the Registering Officer appointed by the government.

xvi) Factories Act 1948: The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

e) The Contractor shall keep HIMURJA indemnified in case any action is taken against HIMURJA by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments.

(f) If HIMURJA is caused to pay under any law as principal employer such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/ byelaws/Acts/ Rules/regulations including amendments, if any, on the part of the Contractor, HIMURJA shall have the right to deduct any money due to the Contractor under this contract or any other contract with HIMURJA including his amount of performance security for adjusting the aforesaid payment. HIMURJA shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by HIMURJA.

15.3 **Rates of Wages and Labour**

(a) The Contractor shall pay rates of wages, and observe conditions of labor, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

(b) The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, and allowances as are chargeable under the Laws for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

(c) The Contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements. The Contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspects of employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline.

(d) The Contractor shall provide equal wages and benefits to men and women for work of equal value or type.

15.4 Working Hours

(a) No work shall be carried out on the sites on locally recognized days of rest, or outside the normal working hours, unless

(i) otherwise stated in the Contract;

(ii) the sites incharge gives consent; or

(iii the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the sites incharge.

(b) If and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the sites incharge consent thereto, the site incharge shall not unreasonably withhold such consent.

(c) This sub clause shall not apply to any work which is customarily carried out by rotary or double shifts.

15.5 **Facilities for Staff and Labour**

(a) Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel/ staff. The Contractor shall also provide facilities for HIMURJA personnel as stated in the Specification.

(b) The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Facilities.

15.6 **Health and Safety**

(a) The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay, and ambulance service are available at all times at the sites and at any accommodation for Contractor's and HIMURJA personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

(b) The Contractor shall appoint an accident prevention officer at the sites, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the performance of the Contract, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

(c) The Contractor shall send to the site incharge, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety, and welfare of persons, and damage to property, as the site incharge may reasonably require.

(d) The Contractor shall conduct health and safety programs for workers employed under the project, and shall include information on the trafficking of women and the risk of sexually transmitted diseases, including HIV/AIDS in such programs.

(e) The Contract shall ensure compliance to and observe the safety regulations and provisions, if any, specified in conditions of the contract.

15.7 **Funeral Arrangements**

In the event of the death of any of the Contractor's Personnel or accompanying members of their families, the Contractor shall be responsible for making the appropriate arrangements for their return or burial.

15.8 **Records of Contractor's Personnel**

The Contractor shall keep accurate records of the Contractor's Personnel, including the number of each class of Contractor's Personnel at the sites and the names, ages, gender, hours worked, and wages paid to all workers. These records shall be summarized on a monthly basis in a form approved by the site incharge and shall be available for inspection by the site incharge until the Contractor has completed all work.

15.9 **Supply of Foodstuff**

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

15.10 **Supply of Water**

The Contractor shall, having regard to local conditions, provide at the sites an adequate supply of drinking and other water for the use of the Contractor's Personnel.

15.11 **Measures against Insect and Pest Nuisance**

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed at the sites from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

15.12 **Alcoholic Liquor or Drugs**

The Contractor shall not, otherwise than in accordance with the Laws of India, import, sell, give barter, or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter, or disposal by Contractor's Personnel.

15.13 **Arms and Ammunition**

The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

15.14 **Prohibition of All Forms of Forced or Compulsory Labor**

The contractor shall not employ "forced or compulsory labor" in any form. "Forced or compulsory labor" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

15.15 **Prohibition of Harmful Child Labor**

The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. “Child” means a child below the statutory minimum age specified under applicable National, State or local law in India.”

15.16 In addition to the above, the stipulations, if any, specified in contract shall also apply.

SECTION-III

SCOPE OF WORK

1. Project Particulars:

Particulars	Description
Design & Engineering	
Capacity of the solar PV power project	500 kW (AC)
Minimum DC Capacity	600 kW
Technology	(Mono crystalline SPV Modules)
O&M Period	5 Years
Design life of PV Power project	25 years
Location/Sites Details	
Location	Kirti (Theog), Sharog(Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh.
Annual Temperature Range	**-2°C to 30°C**
Type of Land	Government/Forest
District	Shimla and Kinnaur
State	Himachal Pradesh
Electrical Interconnection Details	
Interconnection Voltage	11/22 kV
Interconnection Point	The power to be generated from the Solar Power Projects will be interconnected to the existing 11/22 KV line which is located at around 0.1 to 1 KM approx from the project sites.

2. Brief Scope of Work

Scope of Supply & Work includes all design & engineering, procurement & supply of equipment and materials, testing at manufacturers works, multi–level inspections, packing and forwarding, supply, receipt, unloading and storage at sites, associated civil works, services, permits, licenses, installation and incidentals, insurance at all stages, erection, testing and commissioning of Ground Mounted SPP of 500 kW capacity at Kirti (Theog), Sharog(Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh, on turnkey basis in the State of Himachal Pradesh and 05 (Five) years comprehensive Operation and Maintenance from the Commercial Operation Date of the Project.

3. Design and Engineering

Contractor shall prepare the detailed Design Basis Report (DBR) along with relevant standards (with respective clause description), Chart and Master Document List (MDL). Contractor shall submit a copy to HIMURJA for evaluation.

Submission of basic design data, design documents, drawings, and engineering information including General Technical Parameters and test reports to HIMURJA or its authorized representative for review and approval in hard copy and soft copy from time to time as per project schedule. The documents typically include, but not limited to, the following:

- General arrangement and assembly drawings of all major equipment
- Schematic diagram for entire electrical system
- GTP & General Agreement drawings for all types of structures/ components, protectionswitchgears & other interfacing panels
- Test reports (for type, routine and acceptance tests)
- Relay setting charts
- Design calculations and sheets (licensed software as well as design templates)
- Geo technical investigation data
- Overall project layout
- GA drawings of the entire project including equipment rooms/ inverter control rooms, roads, storm water drainage, sewage networks,security gate, fire protection system, fencing/ boundary wall etc.
- Transmission line drawings and erection plans as per DISCOM/STU guidelines
- Quality assurance plans for Manufacturing Quality Plan (MQP) and Field Quality Plan(FQP)
- Detailed sites EHS plan, fire safety & evacuation plan and disaster managementplan.
- Detailed risk assessment and mitigation plan.
- O&M Instruction's manuals for major equipment
- As-built drawings / documents and deviation list from good for construction (GFC)

Estimation of the project generation based on Solar Radiation and other climatic conditions prevailing at sites based on P75 values from Energy Yield Simulations.

Design of associated civil, structural, electrical & mechanical auxiliary systems includes preparation of single line diagrams and installation drawings, manuals, electrical layouts, erection key diagrams, electrical and physical clearance diagrams, design calculations for Earth- mat, Bus Bar & Spacers indoor and outdoor lighting/ illumination etc., GTP and GA drawings for the major equipment including transmission line, design basis & calculation sheets, and other relevant drawings and documents required for engineering of all facilities within the periphery to be provided under this contract.

All drawings shall be fully corrected to match with the actual "as built" sites conditions and submitted to HIMURJA after commissioning of the project for record purpose. All as-built drawings must include the Good for Construction deviation list.

4. Procurement & Supply

The equipment and materials for Ground Mounted Solar Power Project of 500 kW capacity with associated system (Typical) shall include but not limited to the receipt, unloading, storage, erection, testing and commissioning of all supplied material for the following:

- Adequate capacity of Solar PV modules of suitable rating including module mounting structures, fasteners, MMS foundation and module interconnection.
- Array Junction boxes, distribution boxes and Fuse boxes: MCBs/ isolators, Surge Arrestors with string monitoring capabilities and with proper lugs, glands, ferrules, terminations and mounting structures.
- DC and AC cables of appropriate sizes with adequate safety and insulation
- Power Conditioning Units (PCU) with SCADA compatibility, common AC power evacuation panel with bus bars and circuit breakers LT & HT Power Interfacing Panels, Project Monitoring Desk, AC & DC Distribution boards.
- Auxiliary items such as HVAC and fire suppression systems, step-up transformers to match utility grid, ac switchgear, Control Systems etc. with Power and Energy ratings as specified.
- Step – up transformers (inverter duty) in relevance with state grid code and inverter manufacturer requirements.
- Auxiliary transformer (s) for internal consumption.
- Metering and protection system along with battery system.
- LT Power and Control Cables including end terminations and other required accessories for both AC & DC power.
- Internal 415V interconnection & Indoor feeder panels to cater auxiliary needs of project.
- Indoor switchgear and panels having incoming and outgoing feeders with VCBs, CTs, PTs, Bus bars, cables terminals kits and bus section panel. The control and relay panel should form integral part of the switchgear (i.e. should be physically integrated into one unit).
- ABT meters (Main and Check) with all necessary metering rated CT’s and PT’s at the project take off point as well as at the substation as per CEA Metering Regulation 2006 as amended from time to time and state metering code.
- Data acquisition system with remote monitoring facilities. Provision for specific data transfer to the State Load Dispatch Centre (SLDC) shall also be provided.
- Lightning arrestors for entire project area.
- PVC pipes, cable conduits, cable trays and accessories/trenches.
- Earthing of the entire project as per relevant standards.
- Control room equipment
- Testing instruments for maintenance and monitoring of equipment.

- Spares & consumables, as required or recommended, for the complete O&M period.
- CCTV cameras for project surveillance
- Fire protection system in buildings and fire extinguishers.

Data Logger

- Construction of suitable structures for termination of transmission line for taking off from the project end and receipt of lines at the interconnection point of HPSEBL.
- Design & construction of Transmission line/ cable from project take off point to the interconnection point of HPSEBL, including right of way (ROW).
- Materials and accessories, which are required for satisfactory and trouble-free operation and maintenance of the above equipment.
- Any other equipment / material not mentioned but required to complete the installation and commissioning of the Solar PowerProject in all respect.

5. Construction and Erection Works

The items of civil design and construction work shall include all works required for installation and commissioning of the Solar Power Project of 500 kW capacity and should be performed specifically with respect to following but not limited to:

- Conducting geotechnical investigation of the total area.
- Earthwork for sites grading, cutting, filling, leveling & compaction of land.
- Construction and erection of perimeter fence and main/ security gate(s).
- Construction of foundation for mounting structures for SPV panels.
- Civil foundation work of transformers, switchgears, etc.
- Construction of motorable approach road, internal roads if required for carrying material to sites.
- Construction of control room with necessary illumination system and finishing as required.
- **Construction of office cum store room as per requirement**.
- Suitable arrangement of water shall be ensured to cater to day-to-day requirement of drinking water and permanent water supply for module cleaning and other needs of Solar Power Project during the 5 years of O&M period of the project.
- Suitable Communication System for SCADA with remote monitoring capabilities and internet facility.
- Construction of Storm water drainage & sewage network including Rain water harvesting mechanism**.**
- Laying of underground / over ground Cables (all types) with proper arrangements along with appropriate sized ferrules, lugs, glands and terminal blocks. Lying of cables inside the building trench and other locations as required shall be over GI cable trays with proper support and accessories.

- Construction of transmission line, from take-off point at the project to the interconnection point of HPSEBL.
- Suitable earthling for project along with earth pits as per standards.
- All approvals, for equipment, items and works, which are not otherwise specifically mentioned in this document but are required for successful completion of the work in all aspects, including construction, commissioning, O&M of Solar Power Project and guaranteed performance are deemed to be included in the scope of the contractor.

6. Statutory Approvals

Obtaining statutory approvals/clearances on behalf of HIMURJA from various Government Departments, not limited to, the following.

- All approvals, as necessary for setting up of a Solar Power Project including connectivity, power evacuation, etc. as per the suggested guidelines and have been obtained by HIMURJA.
- All other statutory approvals and permissions not mentioned specifically but are required to carry out hassle free Construction and O&M of the project prevailing at the sites.
- Adequate and seamless insurance coverage during EPC and O&M period to mitigate all risks related to construction and O&M of the project to indemnify HIMURJA.

The Contractor shall comply with the provision of all relevant acts of Central or State Governments including payment of Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, **Employee's Compensation** Act 1923, Industrial Dispute Act 1947, Maturity Benefit Act 1961, Mines Act 1952, Employees State Insurance Act 1948, Contract Labour (Regulations & Abolishment) Act 1970, Electricity Act 2003, Grid Code, Metering Code, MNRE guidelines or any modification thereof or any other law relating whereto and rules made there under or amended from time to time.

7. Operation and Maintenance

- Total Operation & Maintenance of the Project and Equipment shall be with the Contractor, after commissioning of the project till final acceptance which shall include deployment of engineering personnel, technicians and security personnel.
- To provide a detailed training plan for all O&M procedures to the concerned beneficiaries and Project Officer, HIMURJA, Shimla and Kinnaur H.P, which shall be approved by HIMURJA headquarter.
- Employ and coordinate the training of contractors' personnel who will be qualified and experienced to Operate and Maintain the project and to coordinate with the HPSEBL authorities.
- Discharge obligations relating to retirement/ Superannuating benefits to employees or any other benefit accruing to them in the nature of compensation, profit in lieu / in addition to

salary, etc. for the period of service with the contractor, irrespective continuance of employees with the project as employees of Contractor, after conclusion of O&M period.

- To maintain accurate and up-to-date operating logs, records and monthly Operation & Maintenance reports at the facility. Contractor shall keep the measured daily data at regular intervals and provide the same to HIMURJA in electronic form, compatible in CSV format. The right to use the data shall remain with HIMURJA.
- Procurement of spare parts, overhaul parts, tools & tackles, equipment, consumables, etc. required for smooth operation and maintenance of the Project and Equipment as per prudent/ standard utility practices, original equipment manufacturer (OEM) recommendations and warranty clauses for the entire O&M period.
- To upkeep all administrative offices, roads, tool room, stores room, equipment, clean, greenand in workable conditions.
- To carry out periodic overhauls or maintenance required as per the recommendations of the original equipment manufacturer (OEM) and to furnish all such periodic maintenance schedules at the time of project commissioning/ start of O&M contract.
- Handover the system to maintain an inventory of spare parts, tools, equipment, consumables and supplies for the facility's operation along-with required details of recommended spares list with all associated information regarding replacement records, firm details, tentative cost, storage details, specifications on the basis of replacement frequency and mean time between failures and mean time to restore at the culmination of penultimate year under O&M period.
- The contractor shall be responsible for all the required activities for the successful running, committed energy generation & maintenance of the Solar Power Project covering:
  - Deputation of qualified and experienced engineers and technicians at the facility.
  - Deputation of Security personnel for the complete security of project.
  - Successful running of Solar Power Project for committed energy generation.
  - Co-ordination with STU/SLDC/other statutory organizations as per the requirement on behalf of HIMURJA for Joint Metering Report (JMR), furnishing generations schedules as per requirement, revising schedules as necessary & complying with grid requirements.
  - Monitoring, controlling, troubleshooting maintaining of logs & records, registers.
  - Furnishing generation data monthly to HIMURJA by 1st week of every month for the previous month to enable HIMURJA raise commercial bills on consumers.
  - Periodic cleaning of solar modules as approved by HIMURJA and water quality as per the recommendations of OEM.
  - Replacement of Modules, Invertors/PCU's and other equipment as and when required during the O&M period without additional cost to HIMURJA.

- Continuous monitoring the performance of the Project and Equipment and regular maintenance of the whole system including Modules, PCU's, transformers, overhead line, outdoor/indoor panels/ kiosks etc. are necessary for extracting and maintaining the maximum energy output from the Solar Power Project.
- Preventive and corrective O&M of the Project and Equipment including supply of spares, consumables, wear and tear, overhauling, replacement of damaged modules, invertors, PCU's and insurance covering all risks (Fire & allied perils, earth quake, terrorists, burglary and others) as required.
- The period of Operation and Maintenance will be deemed to commence from the date of Commercial Operation Date of the project to be declared by Directorate of Energy. O&M contract can further be extended on the mutually agreed terms and conditions for the period of minimum 5 years.
- All the equipment required for Testing, Commissioning and O&M for the healthy operation of the Project must be calibrated, time to time, from the NABL accredited labs and the certificateof calibration must be provided prior to its deployment.
- The Contractor shall ensure that all safety measures are taken at the sites to avoid accidents to his or his sub-contractor or HIMURJA. This will include procurement of all safety gadgets during Construction and O&M period including but not limited to, rubber mats of appropriate grade, PPE, rubber gloves and shoes etc.

8. Operation and Performance Monitoring

- Operation part consists of deputing necessary manpower necessary to operate the Solar Power Project at the designed capacity. Operation procedures such as preparation to starting, running, routine operations with safety precautions, monitoring etc., shall be carried out as per the manufacturer's instructions to have trouble free operation of the complete system.
- Daily work of the operation and maintenance in the Solar Power Project involves periodic cleaning of Modules, logging the voltage, current, power factor, power and energy output of the Project at different levels. The operator shall also note down time/ failures, interruption in supply and tripping of different relays, reason for such tripping, duration of suchinterruption etc. The operator shall record monthly energy output, down time, etc.
- A maintenance record is to be maintained by the operator/engineer-in-charge to record the regular maintenance work carried out as well as any breakdown maintenance along with the date of maintenance, reasons for the breakdowns, steps have taken to attend the breakdown.
- The Schedules will be drawn such that some of the jobs other than breakdown, which may require comparatively long stoppage of the Solar Power Project, shall be carried out

preferably during the non-sunny days. Information shall be provided to Engineer-in-charge for such operation prior to start.

- The contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules.
- If negligence / mal operation of the contractor's operator results in failure of equipment such equipment should be repaired replaced by contractor at free of cost.

SECTION IV: TECHNICAL SPECIFICATIONS

DISCLAMER:

(1) Though adequate care has been taken while preparing the Bidding documents, the Bidders shall satisfy themselves that the document is complete in all respects. Intimation of any discrepancy shall be given to this office immediately. If no intimation is received from any Bidder within a week (7) days from the date of notification of NIT/ Issue of the NIT documents, it shall be considered that the NIT documents are complete in all respects has been received by the Bidder.

(2) HIMURJA reserves the right to modify, amend or supplement this NIT documents including all formats and Annexure.

(3) While this bidding documents have been prepared in good faith, neither HIMURJA or its authorized representatives make any representation or warranty, express or implied, or accept any responsibility or liability, whatsoever, in respect of any statements or omissions herein, or the accuracy, completeness or reliability of information, and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of this bidding documents, even if any loss or damage is caused by any act of omission on their part.

(4) The specifications mentioned for all the equipment which include Solar modules, PCU, combiner boxes, DC cables, module mounting structures, transformer, CT, PT, LT/ HT cables, interfacing panels, switch gears & other associated equipment etc., to complete the power generation and evacuation to the designated substation, in the present bidding documents are for Reference only. It is subject to revision/ alteration as per the design/ planning/ good engineering practices etc., to be carried out by the selected bidder, to the satisfaction of HIMURJA or its authorized representatives. It is advised that the bidders must satisfy him with the prevailing sites conditions before design/ plan. The design must be optimized as per the sites conditions and to achieve the maximum output from the installed capacity at all times. Moreover, the components not separately mentioned, but are required to complete the project for operation is also included in the scope of bidder and shall be vetted by HIMURJA or its authorized representatives.

Design Philosophy

1. The main objective of the design philosophy is to construct the project with in-built Quality and appropriate redundancy to achieve high availability and reliability with minimum maintenance efforts. In order to achieve this, the following principles shall be adopted while designing the system.

- Adequate capacity of SPV modules, PCUs, Junction boxes etc. to ensure generation of power as per design estimates. This will be done by applying liberal de-rating factors for the array and recognizing the efficiency parameters of PCUs, transformers, conductor losses, system losses, sites conditions etc.

- Use of equipment and systems with proven design and performance that have high availability track records under similar service conditions.
- Selection of the equipment and adoption of a project layout to ensure ease of maintenance.
- Strict compliance with approved and proven quality assurance (QA) systems and procedures during different stages of the project, starting from sizing, selection of make, shipment, storage (at sites), during erection, testing and commissioning.
- Proper monitoring of synchronization and recording, to ensure availability of power to the grid.
- The project Data Acquisition and Control System should be designed to ensure high availability and reliability of the project to assist the operators in the safe and efficient operation of the project with minimum effort.
- It should also provide the analysis of the historical data and help in the project maintenance people to take up the project and equipment on predictive maintenance.
- System design shall have intelligent protection mechanism which may include very fast responsive microprocessor-based relays etc., so that any disturbance from the grid will not cause any damage to the equipment of the Solar Power Project.

2. The basic and detailed engineering of the project shall aim at achieving high standards of operational performance especially considering following:

- Solar Power Project should be designed to operate satisfactorily in synchronization with the grid within permissible limits of high voltage and frequency fluctuation conditions. It is also extremely important to safeguard the system during major disturbances, internal and external surge conditions while ensuring safe operation of the project.
- Module Mounting Structures shall be designed for stability under design wind load conditions specified in this document while optimizing energy generation.
- Shadow free project layout to ensure minimum losses in generation during the day time.
- Higher system voltage and lower current options to be followed to minimize ohmic losses.
- Selection of PCUs with proven reliability and minimum downtime. Ready availability of requisites spares.
- Careful logging of operational data / historical information from the Data Monitoring Systems, and periodical analysis of the same to identify any abnormal or slowly deteriorating conditions.
- The designed array capacity at STC shall be suitably determined to meet the proposed guaranteed generation output at the point of interconnection by the contractor in his bid. The contractor shall take care of first year degradation also by installing additional DC capacity as the CUF calculations will not factor the first-year degradation of the modules.
- Each component offered by the bidder shall be of established reliability. The minimum target reliability of each equipment shall be established by the bidder considering its mean time between failures and mean time to restore, such that the availability of complete system is

assured. Bidder's recommendation of the spares shall be on the basis of established reliability.

- Bidder shall design the project and equipment in order to have sustained life of 25 years with minimum maintenance efforts.
- The work execution planning for supply, erection, commissioning and all other allied works for Solar Power Project shall be such, that it is completed within stipulated time from the date of placement of award letter.
- The specifications provided with this bid document are functional ones; any design provided in this document is only meant as an example. The Contractor must submit a detailed design philosophy document for the project to meet the functional requirements based upon their own design in-line with the above. The bidders are advised to visit the sites and satisfy themselves before bidding.

3. **Approval of drawings and documents prepared by the Contractor**:

All documents and drawings shall be submitted to the HIMURJA in soft copies for review and approval. Drawing shall also be submitted in '*.dwg' format, if required. In case of design calculations done in spread sheet, editable (working) soft copy of the spread sheet shall also be submitted along with 'pdf' copies during every submission. HIMURJA shall return, as suitable, either soft or hard copies to the Contractor with category of approval marked thereon. The drawings/documents shall be approved in any one of the following categories based on nature of the comments/ type of drawing or document.

Category-I	Approved
Category-II	Approved subject to incorporation of comments. Re-submit for approval after incorporation of comments
Category-III	Not approved. Re-submit for approval after incorporation of comments
Category-IV	Kept for record/ reference

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

The Contractor shall submit complete Master Document & Drawing list (MDL) to HIMURJA within 2 weeks after issue of LOA, The MDL shall list all the Drawings & Documents envisaged for submission/ approval from HIMURJA and shall also have all the required information like drawing number, title, scheduled date of submission, actual date of submission and approval. The category of approval shall be decided mutually between Contractor and HIMURJA at the time of finalization of the MDL which shall be the basis for drawing & document approval process during project execution.

The construction shall be done only as per drawings approved under Category – I, II & IV.

A Electrical System

Solar Photovoltaic (SPV) Modules

Standards and Codes

Solar Photovoltaic Modules shall comply with the specified edition of the following standardsand codes.

Standard	Description
IEC 61215-1:2016 Ed.1	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements
IEC 61215-1-1:2016 Ed.1	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules
IEC 61730-1:2016 Ed.2	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
IEC 61730-2:2016 Ed.2	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
IEC 62716:2013 Ed.1	Photovoltaic (PV) modules - Ammonia corrosion testing
IEC TS 62804-1:2015 Ed.1	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon (under conditions of 85^{o}C/85% RH for minimum 192 hours)
As per the Solar Photovoltaic Systems, Devices and Components Goods (Requirements for Compulsory Registration) Order, 2017, PV Modules used in the grid connected solar power projects, shall be registered with BIS and bear the Standard Mark as notified by the Bureau of Indian Standards. Further, PV Modules should be listed in the ALMM, as per MNRE Approved Models and Manufacturers of Solar Photovoltaic Modules (Requirements for Compulsory Registration)Order, 2019 including subsequent amendments/order, if any.	

Technical Requirements

Parameter	Specification
Cell type	**Mono-crystalline**
Module Efficiency	≥ 20%
Rated power at STC	No negative tolerance is allowed
Temperature co-efficient of power	Not less than -0.4%/°C
Application Class as per IEC 61730	Class A

The SPV Modules to be used in the project must be as per the list of ALMM**.**

Component Specifications

- The SPV Modules glass panel shall have transmittance of above 90%. The minimum thickness of glass shall be 3.2 mm.
- The encapsulated material to be used for the PV modules should be UV resistant and PID resistant in nature. No yellowing of the encapsulant with prolonged exposure should occur. The encapsulant shall have the following properties.

Parameter	**Value**
Volume resistivity	$> 1\times10^{14}$ Ω.cm
Peeling strength with glass	> 40 N/cm

For Crystalline Silicon Glass/Polymer PV Modules, the back sheet used in the PV modules shall be of three-layered structure durable for humid– hot conditions with properties of moisture barrier, elongation retention and UV resistance. The back sheet shall have the following properties:

Parameter	**Value**
Material Thickness	≥ 300 micron
Water Vapor Transmission Rate	≤ 2 g/m2/day
Partial Discharge Test Voltage	≥ 1500V
Elongation at break	≥ 100%
Adhesion strength with encapsulant	≥ 40 N/cm
Interlayer adhesion strength	≥ 4 N/cm

HIMURJA reserves the right to conduct Pressure Cooker (PC) test/ Highly Accelerated Stress Test (HAST) to confirm the durability of the back sheet in accelerated conditions.

- 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.
- The module frame shall be made of anodized Aluminum, which shall be electrically & chemically compatible with the structural material used for mounting the modules. It is required to have provision for earthling to connect it to the earthling grid.
- 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. Minimum three number of bypass diodes and two number of IEC 62852/EN 50521 certified MC4 compatible connectors with appropriate length of IEC 62930/EN 50618 certified 4 sq.mm copper cable shall be provided. The cable length shall be in accordance with the PV Module wiring strategy and adequate to ensure that the cable bending radius standard is not exceeded.
- Each PV Module shall be provided a RFID code which is embedded inside the module lamination and must be able to withstand harsh environmental conditions. The RFID code data base shall contain the following information.

1. Name of the manufacturer of PV Module
2. Name of the Manufacturer of Solar cells
3. Type of cell: Mono
4. Month and year of the manufacture (separately for solar cells and module)
5. Country of origin (separately for solar cells and module)
6. I-V curve for the module
7. Peak Wattage, Im, Vm and FF for the module
8. Unique Serial No. and Model No. of the module.
9. Date and year of obtaining IEC PV module qualification certificate
10. Name of the test lab issuing IEC certificate
11. Other relevant information on traceability of solar cells and modules as per ISO 9000 series.

RFID code scanner and database of all the modules containing the above information shall also be provided.

Warranty

- PV modules must be warranted with linear degradation rate of power output except for first year (up to 3% including **Light Induced Degradation** (LID)) and shall guarantee minimum 80% of the initial rated power output at the end of 25 years from the date of supply.
- The modules shall be warranted for minimum of 10 years from the date of supply against all material/ manufacturing defects and workmanship.
- The above warranties shall be backed by third party insurance.
- 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 web link along with scope of accreditation shall also be submitted.
- 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.
- The Contractor shall obtain the approval of the proposed module make & model prior to manufacturing/ inspection call.

Manufacturing and Inspection

- The Contractor shall inform the module manufacturing schedule to HIMURJA at least 7 (seven) working days before the start of proposed schedule.

- HIMURJA shall perform material inspection at the Manufacturer's factory before the start of proposed manufacturing schedule. Proof of procurement of components as per the approved BOM mentioning manufacturer name, manufacturing date and relevant test certificate shall be submitted during material inspection for verification.
- The Manufacturing shall start only after the clearance by HIMURJA after the material inspection.
- 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.
- The modules shall be uniformly laminated without any lamination defects.
- Current binning of modules shall be employed to limit current mismatch of modules. Different colour codes shall be provided on the modules as well as pallet for identification of different bins. Note: Current Bin size shall be proposed to HIMURJA for approval prior to manufacturing.
- Pre-dispatch inspection of modules shall be performed as per the inspection protocol to be given during the time of inspection.

Transportation, Handling, Storage and Installation

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.

String Combiner Box (SCB)

The String Combiner Box (SCB) specifications mentioned in this section are applicable in case central inverters are employed.

Standards and Codes

Standard/Code	**Description**
IEC 60529	Enclosure Ingress Protection
IEC 62262	Enclosure Impact Protection
IEC 60296	Fuse
IEC 61643-11	Surge Protection Device
IEC 62852 or EN 50521	Solar cable connector

Construction

- Enclosure shall be made of UV resistant, fire retardant, thermoplastic material. Enclosure degree of protection shall be at least IP65 and mechanical impact resistance shall be at least IK08.
- 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.
- Every SCB input shall be provided with fuses on both positive and negative side. 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.
- DC disconnect or switch of suitable rating shall be provided at SCB output to disconnect
- Both positive and negative side simultaneously.
- Type-II surge protective device (SPD) conforming to IEC 61643-11 shall be connected between positive/negative bus and earth.
- MC4 connector conforming to IEC 62852 or EN 50521 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.
- UV resistant printed cable ferrules for solar cables and punched/embossed aluminium tags for DC cables shall be provided at cable termination points for identification.

Warranty

The SCB unit shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 (five) years from the date of supply.

Tests

Routine tests and acceptance tests for the assembled unit shall be as per the Quality Assurance Plan (QAP) approved by HIMURJA.

Solar and DC Cables

Standards and Codes

Cable	**From**	**To**	**Conductor/ Insulation**	**Voltage Rating**	**Applicable Standard**
Solar Cable*	Module	SCB	Copper/ XLPO	1.5 kV DC	IEC 62930/ EN 50618
DC Cable	SCB	Power Conditionin gUnit	Copper or Aluminium /XLPE	1.5 kV DC	IS 7098 Part II
* Cable used for module interconnection shall also be referred as solar cable.					

- 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.
- 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 should have marking of red line on black outer sheath.

  In addition to manufacturer's identification on cables as per relevant standard, following marking shall also be provided over outer sheath.

  (i) Cable size and voltage grade
  (ii) Word 'FRNC/ FRLS' (as applicable) at every metre
  (iii) Sequential marking of length of the cable in metres at every metre

  Cables shall be sized based on the following considerations:

  i. Rated current of module
  ii. In case of central inverters, average voltage drop in the cables (from PV Modules to PCU) shall be limited to 1.5 % of the rated voltage. In case of string Inverters, average voltage drop (from PV module to string inverter) shall be limited to 0.5% of the rated voltage drop. The Contractor shall provide voltage drop calculations in excel sheet.
  iii. Short circuit withstand capability
  iv. De-rating factors according to laying pattern

Warranty

The cables (Solar and DC) shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 (five) year from the date of supply.

Tests

Type test, routine test and acceptance tests requirements shall be as per IEC 62930/EN 50618 for solar cables and IS 7098-II for DC cables. As part of Routine tests, cables should also be subject to Cold Bend and Cold Impact Tests.

Installation

- Cable installation shall be as per IS 1255.
- Only terminal cable joints shall be accepted. No cable joint to join two cable ends shall be accepted. Cable terminations shall be made with connectors complying IEC 62852/IS 16781. The connectors shall have degree of protection of IP 68.
- Solar cables shall be provided with UV resistant printed ferrules and DC cables shall be provided with punched/ embossed aluminum tags. The marking shall be done with good quality letter and numbers of proper size so that the cables can be identified easily.

- 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.
- Solar cables, wherever exposed to direct sunlight and buried underground, shall be laid through Double Wall Corrugated (DWC) HDPE conduits. The size of the conduit or pipe shall be selected on the basis of 40% fill criteria.
- Solar cables shall be aesthetically tied to Module Mounting Structure using UV resistant cable-ties suitable for outdoor application.
- A.C. and D.C. cables shall be kept in separate trenches.
- Cable Sealing System: Modular multi-diameter cable sealing system consisting of frames, blocks and accessories shall be installed where the underground and over ground cables enter or leave LCR/MCR enclosures/Buildings. Cable sealing system shall consist of multi-diameter type peel-able blocks of different sizes to suit the various cables. It should be simple, easy and quick to assemble & re-assemble the cable sealing system. Solid blocks shall not be used on frame. Frames & stay-plate material shall be of galvanized steel and for compression, single piece wedge with galvanized steel bolts shall be used. 30% spare blocks on the frame shall be provided for expansion in future. Cable sealing system should have been tested for fire/water /smoke tightness.

Power Conditioning Unit

The Power Conditioning Unit (PCU) specifications mentioned in this section are applicable for both string & central inverters.

Standards and Codes

Power Conditioning Unit (PCU) shall comply with the specified edition of the following standards and codes.

Standard	Description
IEC 61683 Ed. 1	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IEC 62109-1 Ed. 1	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
IEC 62109-2 Ed. 1	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
IEC 61000-6-2 Ed. 2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
IEC 61000-6-4 Ed. 2.1	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

IEC 62116 Ed. 2	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC 60068-2-1:2007	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2:2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat
IEC 60068-2-14:2009	Environmental testing - Part 2-14: Tests - Test N: Change of temperature
IEC 60068-2-30:2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)
CEA Technical Standards for Connectivity to the Grid Regulations 2007 with 2013 and 2019 Amendment	
As per the Solar Photovoltaic's, 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.	

Technical Requirements

Parameter	**Specification**
Type	String/Central
Rated AC power	As per design
Maximum input voltage	1500 V
Rated AC output voltage	As per design
Tolerance on rated AC output voltage	+/-10%
Rated frequency	50 Hz
Operating frequency range	47.5 Hz to 52 Hz
Power factor control range	0.9 lag to 0.9 lead
European efficiency	Minimum 98%
Maximum loss in Sleep Mode	0.05% of rated AC power
Total Harmonic Distortion	Less than 3% at 100% load
Degree of protection	Central Inverter – IP 20 (Indoor)/IP 54 (Outdoor), String Inverter – IP 65

The rated/ name plate AC capacity of the PCU shall be AC power output of the PCU at 25°C.

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 to accommodate the output voltage of the PV array at extreme temperatures prevailing atsites.

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.

Construction

- Power Conditioning Unit (PCU) shall consist of an electronic three phase inverter along with associated control, protection, filtering, measurement and data logging devices.
- 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.
- Type-II surge protective device (SPD) conforming to IEC 61643-11 / IEC 61643-31 / EN 50539-11 shall be connected between positive/ negative bus and earth.
- 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.
- Circuit Breaker of appropriate voltage and current rating shall be provided at the output to isolate the PCU from grid in case of faults.
- The PCU shall be tropicalized and the design shall be compatible with conditions prevailing at sites. Suitable number of exhaust fan with proper ducting shall be provided for cooling keeping in mind the extreme climatic condition of the sites as per the recommendations of OEM to achieve desired performance and life expectancy.
- All the conducting parts of the PCU that are not intended to carry current shall be bonded together and connected to dedicated earth pits through protective conductor of appropriate size. DC negative terminal shall be grounded. In case DC negative grounding is not possible, appropriate anti-PID device shall be provided.
- Dedicated communication interface shall be provided to monitor the PCU from SCADA. 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
    (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

- AC combiner box for string inverter configuration shall comply with Clause 10 of the Technical Specifications with exception of the following.

  (i) Rated System Voltage – Inverter Output Voltage

  (ii) IP Rating – IP 55

  (iii) Metering System – Not required

  (iv) CBCT – Not Applicable

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.

- Standby Mode

  The PCU shall continuously monitor the input DC voltage and remain on Standby Modeuntil it reaches the pre-set value.

- MPPT Mode

  When the input DC voltage is above the pre-set value and AC grid connection conditionsare fulfilled, the PCU shall enter into MPPT mode.

- 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.

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

Grid Support Functions

- **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.

- **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.

- **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/absorb reactive power during the period of voltage dip/surge

Warranty

The complete Power Conditioning Unit shall be warranted for **minimum of 5 (five) years** against all material/ manufacturing defects and workmanship.

Tests

Type Tests

The type test certificates as per the standards mentioned above should be from any of the ILAC/IECEE member signatory accredited Test Centres. Laboratory accreditation certificate or weblink along with scope of accreditation shall also be submitted. It is the responsibility of the Contractor to substantiate the compliance for CEA Regulations usingtest reports.

Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP)approved by HIMURJA.

Inverter Transformer

Standards and Codes

Inverter transformer and auxiliary transformer, wherever applicable, shall comply with thelatest edition of the following standards and codes including amendments.

Standard	**Description**
IS:2026, IEC:60076	Specification of Power Transformers
IS 11171	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
CEA Regulations and other statutory regulations with any latest amendments	
CBIP publication no. 295	
Additional for Auxiliary Transformers: MoP Notification on Energy Consumption Standards for Star Labelled Distribution Transformer dated 12th January, 2009 and subsequent amendments BEE (Particulars and Manner of their Display on Labels of Distribution Transformers) Regulations, 2009 and subsequent amendments	

Technical Requirements

Parameters	**Inverter Transformer**	**Auxiliary Transformer**
Type	Oil-Type	Oil Type/Dry-type
VA Rating	As per requirement	As per system design
Voltage Ratio	22 kV/ Inverter output voltage	As per system design
Duty, Service & Application	Continuous Solar Inverter application and converter Duty	Continuous application (Outdoor/Indoor)
Winding	2	2
Frequency	50 Hz	50Hz
Nos. of Phase	3	3
Vector Group & Neutral earthing	As per system/inverter manufacturer requirement	Dyn11

Cooling	ONAN	ONAN/ AN
Tap Changer	OCTC, No. of steps shall be as per system requirement	OCTC, No. of steps shall be as per system requirement
Impedance at 75°C	As per Inverter Manufacturer requirement	As per system requirement
Permissible Temperature rise over an ambient of 50°C (irrespective of tap)		
Top Oil	As per IS/IEC	As per applicable IS/IEC
Winding	As per IS/IEC	As per applicable IS/IEC
SC withstand time (thermal)	2 second	2 second
Short Circuit Apparent Power	As per system requirement	As per system requirement
Termination	As per system requirement	As per system design
Bushing rating, Insulation class (Winding & bushing)	HV side - 24 kV porcelainLV side – 1.1 kV epoxy	As per system requirement
Noise level	As per NEMA TR-1	
Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/-3%, also transformer shall be capable of being loaded in accordance with IEC 60076-7	
Flux density	Not to exceed 1.9 Wb/sq.m. at any tap position with combined frequency and voltage variation from rated V/f ratio by 10% corresponding to the tap. Transformer shall also withstand following over fluxing conditions due to combined voltage and frequency fluctuations:	
	a) 110% for continuous rating b) 125% for at least one minute c) 140% for at least five seconds. Bidder shall furnish over fluxing characteristic up to 150%	
Air Clearance	As per IS/IEC	

Construction

- 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 alarmcontact.

- 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.
- 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.
- The transformer shall be suitable for continuous operation with a frequency variation of ± 2.5% from nominal frequency of 50 Hz without exceeding the specified temperature rise.
- 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.
- Neutral bushing of Inverter duty transformer shall be brought outside the tank for the testing purpose. It shall be covered with MS sheet and a sticker "For testing purpose only. Do not earth". Neutral bushing of auxiliary transformer shall be brought outside the tank and earthed.
- Oil-type Transformers 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.
- 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.
- 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.
- In Oil type transformers, Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting arrangement shall be provided.
- In Inverter transformer shall be provided with spring operated Pressure Relief Device (with trip contacts) with suitable discharge arrangement for oil. For Oil-type Auxiliary transformers, diaphragm type explosion vent shall be provided.

- In Oil-type transformers, filter valve at top the tank and drain cum sampling valve at bottom of the tank shall be provided.
- 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 micron.
- LV and HV cable box shall be provided with disconnecting chamber to facilitate the movement of transformer without disturbing cable box and termination.
- 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.
- Rain hoods to be provided on Buchholz, MOG & PRD, when provided. Entry points of wires shall be suitably sealed.
- 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.

For Dry-type Auxiliary Transformer:

- Transformer shall be cast resin encapsulated, and made of cold rolled grain-oriented silicon steel laminations of M4 grade or better. Winding conductor shall be electrolytic Copper/Aluminium and insulation shall be Class F or better.
- The transformer shall be housed in a metal protective housing having minimum degree of protection of IP 55 (Outdoor). Enclosure shall be of a tested quality sheet steel of minimum thickness 2 mm and shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting. Suitable bi-directional skids with pre-drilled holes shall be provided integral with the enclosure or bi-directional rollers shall be provided with suitable lockingarrangement.
- Neutral earthing shall be done as per system requirement. In case neutral is earthed, it shall be brought outside the cable box through bushing for connection to earth grid

Warranty

The transformer shall be warranted for minimum of 5 (five**)** years against all material/ manufacturing defects and workmanship.

Testing and Inspection

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.

A. Type Tests

(i) Lightning impulse (Full & Chopped Wave) test on windings as per IEC 60076-3 (Oil-type)/ IS 1180-1 or IS 11171 / IEC 60076-11 (Dry-type)

(ii) Temperature Rise test at a tap corresponding to maximum losses as per IEC 60076-2 (Oil-type)/ IS 1180-1 or IS 11171 / IEC 60076-11 (Dry-type)

B. 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.

C. Routine Tests

Each completed transformer (Oil-type) shall be subjected to following routine tests as perthe 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

For completed Dry-type Auxiliary transformers, Routine tests as per the latest edition of IS1180-1 or IS 11171 / IEC 60076-11 shall be conducted.

Tests at Sites

After erection at sites 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 sites testing will be to the Contractor's account and the equipment shall be replaced by him at free of cost.

HT Switchgear

Standards and Codes

All equipment provided under HT switchgear shall comply with latest editions and amendments of the relevant IEC standards and IS codes. In particular, the switchgear shall comply with the following standards and codes.

Standard/Code	**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 andup to and including 52 kV
IEC 61869	Instrument Transformers
IS 3231	Electrical relays for power systems protection
IEC 60255	Measuring relays and protection equipment

IEC 61850	Communication networks and systems for power utility automation
IEC 61131-3	Programmable controllers - Part 3: Programming languages
IS 9385	High voltage fuses
IS 9431	Indoor post insulators of organic material for systems with nominal voltages greater than 1000 V up to and including 300 kV
IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for A.C. systems
IS 3070-3	Lightning Arresters for Alternating Current Systems - Part 3 : Metal Oxide Lightning Arresters Without Gaps
IEC 62052-11	Electricity metering equipment (A.C.) - General requirements, tests and test conditions - Part 11: Metering equipment
IEC 62053	Electricity metering equipment (A.C.) - Particular requirements
IS 14697	AC Static Transformer Operated Watthour and Var-hour Meters, Class 0.2S and 0.5S

Technical Parameters

Parameter	**Specification**
System Parameters	
Highest system voltage	24 kV
Rated system voltage	22 kV
Rated frequency	50 Hz
Number of phases	3
Power frequency withstand voltage	50 kV (r.m.s.)
Lightning impulse withstand voltage	125 kV (peak)
System fault current	As per system requirement
Internal Arc Classification	IAC-A, FLR, System fault current for 1s
Circuit Breaker	
Type	Vacuum type
Operating duty cycle	O – 0.3sec – CO – 3min – CO
Short circuit breaking current	As per system requirement
Re-strike performance class	C2
Mechanical endurance class	M1
Current Transformer	

Accuracy class	0.2 for metering (0.2s for metering at outgoing feeder) 5P20 for protection
Rated VA burden	As per requirement
Insulation class	Class E or better
Voltage Transformer	
Accuracy class	0.2 for metering 3P for protection
Rated VA burden	As per requirement
Insulation class	Class E or better

Switchgear Panel

- 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.
- The circuit breakers shall be mounted on horizontally withdrawable trucks with locking facility in SERVICE and TEST positions.
- 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.
- 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 micron.
- 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.
- 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.
- 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.

- 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.
- Mechanical /Electrical interlocks shall be provided to prevent mal-operation.
- Panel shall be provided with local bus-bar protection.
- 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.
- 240 V, 5 A, SPN industrial socket-outlet with ON/OFF switch shall be provided in eachpanel.
- 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.
- Gapless, metal-oxide surge arrestors shall be provided between line and earth in cable compartment of the switchgear panel.
- Suitable lifting hooks shall be provided for each panel.

Circuit Breakers

- 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.
- 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.
- The rated control voltage of the spring charging motor shall be 110 VDC/220 VDC. Closing coil shall operate at all values of voltages between 85% and 110% of rated voltage. Opening coil shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity and at all values of supply voltage between 70% and 110% of rated voltage.
- 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.

- 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.
- 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.

Relays

- 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.
- The relays shall be capable of operating continuously between 80 – 120% of auxiliary voltage.
- All numerical relays shall have adequate number of freely configurable, optically isolated, Binary Inputs (BI) and potential free Binary Outputs (BO).
- 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.
- All I/O's shall have galvanic isolation. Analog inputs shall be protected against switching surges and harmonics.
- Making, breaking and continuous capacity of the relay contacts shall be adequate enough for the circuits in which they are used.
- 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.

    a) Definite time (DT) phase over current protection
    b) Inverse Definite Minimum Time (IDMT) phase over current protection
    c) Definite time (DT) earth fault current protection
    d) Inverse Definite Minimum Time (IDMT) earth fault current protection
    e) Under Voltage protection
    f) Over Voltage protection

- Each feeder shall have two lock out relays powered through two independent DC supplies. Each lock out relay shall send through two separate potential free output contacts signals to each of the two independent trip coils.
- Transformer feeder protection relay shall have provision for the following protection functions, as applicable (depending on Type of Transformer).

  (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

  All numerical relays shall have provision for measurement and storage of electrical parameters such as voltage, current, frequency, active power, reactive power etc.

  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 – with date and time stamp.

- 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.
- The numerical relay shall have self-diagnostic feature with separate output contact for indication of any internal relay failure.
- The numerical relays and meters at 33kV and above voltage level shall be IEC 61850 compliant for communicating with the SCADA system.
- The numerical relay shall have feature for time synchronization through the SCADA System / networking.
- 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.

Earthing

- 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.

- The earth bus shall have sufficient cross section to carry maximum fault current without exceeding the allowable temperature rise.
- 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.
- 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.
- 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.
- 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.
- 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.

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.

Bus bar

- Bus bar shall be made of copper or aluminum with uniform cross section throughout their length. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit current.
- All bus bars joints shall be thoroughly cleaned and anti-oxide grease shall be applied. Plain and spring washers shall be provided to ensure good contacts at the joints and taps. Wherever aluminum to copper connections are required, suitable bimetallic connectors or clamps shall be used.

- 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.
- 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.
- The Contractor shall submit bus bar sizing calculation for specified continuous and short time current ratings during detailed engineering.

Measuring Instruments

- All the measuring instruments shall be digital, flush mounting type with communication facility. Meters at 33 kV and above voltage level shall be IEC 61850 compliant for communicating with the SCADA system.

  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. 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)

Wiring and Terminal blocks

- 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. Wire terminations shall be made with solder less crimping type tinned copper lugs,which shall firmly grip the conductor. Insulation sleeves shall be provided at all the wireterminations.
- 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.
- The Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

- 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.
- CT and VT secondary circuits shall be terminated on stud type, disconnecting terminal blocks.
- At least 10% spare terminals shall be provided on each panel and these spare terminals shall be distributed on all terminal blocks.

Warranty

The HT panel unit shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 (five) years from the date of installation.

Testing and Inspection

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 IECClause**
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 controlcircuits	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 breakingcapacities	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	IEC 62271-100	6.101.2

temperature (M2 Class)		
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 compatibilityrequirements	IEC 60255-26	
Product safety requirements	IEC 60255-27	
Common requirements	IEC 60255-1	
Functional requirements	Relevant parts of IEC 60255-100 series	
Communication requirements	IEC 61850	
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

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 HIMURJA.

Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP)approved by the HIMURJA.

AC Cables

Standards and Codes

All AC Cables shall conform to the following standards and codes.

Standard	Description
IS 7098-I	Crosslinked Polyethylene Insulated Thermoplastic Sheathed Cables, Part 1: For working voltage up to and including 1100 V
IS 7098-II	Crosslinked Polyethylene Insulated Thermoplastics Sheathed Cables Part 2: For Working Voltages from 3.3 kV up to and including 33 kV

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.

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 HIMURJA approval.

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
(i) Word 'FRLS' at every meter
(ii) Sequential marking of length of the cable in meters at every meter

Cables shall be sized based on the following considerations:

(i) Rated current the equipment
(ii) In case of Central inverters, maximum voltage drop in LT cable (from PCU to inverter transformer) shall be limited to 0.5% of the rated voltage. In case of String inverters, maximum voltage drop (from string inverter to LT combiner panel and from LT combiner panel to Inverter duty transformer) shall be limited to 1.5%. For HT cables (from inverter transformer to project take off point), maximum voltage drop shall be limited to 0.5 % of the rated voltage. The Contactor shall provide voltage drop calculations in excel sheet.
(iii) Short circuit withstand capability as per design.
(iv) De-rating factors according to laying pattern.

Warranty

All cables shall be warranted for minimum of 5 (five) years against all material/ manufacturing defects and workmanship from the date of supply.

Testing

Routine test and acceptance tests requirements shall be as per relevant standards for all cable sizes. As part of Routine tests, cables should also be subject to Cold Bend and Cold Impact Tests.

Installation

- Cable installation on-shore shall be as per IS 1255.
- 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.
- All 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.

Auxiliary supply system

- Scheme for auxiliary supply system shall be submitted by the Contractor during detailed engineering for the approval by EMPLOYER.
- It shall mainly comprise of auxiliary transformer, AC distribution board(s) (ACDB), emergency lighting network, Uninterrupted power supply (UPS), Batteries and Distribution cables and metering & protective devices.
- Following consideration shall be taken into account while sizing the auxiliary transformer:
    i) 20% future load margin
    ii) 20% design margin
    iii) Total connected load at 0.8 power factor

LT Switchgear

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

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
IS/IEC 61439-1	Low-voltage switchgear and control gear assemblies - Part 1: General rules
IS/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 - Electromechanicalcontrol 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 toand including 450/750V
IEC 61869	Instrument Transformers
IS 3043	Code of practice for earthing
IEC 60255	Measuring relays and protection equipment - Part 1: Common requirements

Technical Parameters

System Details	
Rated system voltage	415 V ± 10%, 3 Phase, 4 wire, Neutral SolidlyEarthed
Rated frequency	50 Hz ± 5%
System fault current	As per system requirement
Air Circuit Breaker (ACB)	
Type	Air break
Rated Current	As per system requirement
Rated Ultimate Short-Circuit Breaking Capacity & Rated Service Short-Circuit Breaking Capacity	As per system fault current
Rated short-time withstand current duration	1s
Moulded case circuit breaker (MCCB)	
Rated Voltage	415 V
Release	Thermal-Magnetic/Microprocessor
Rated current	As per system requirement
Poles	4 poles
Rated insulation level	690 V

Rated Ultimate Short-Circuit Breaking Capacity & Rated Service Short-Circuit Breaking Capacity	As per system fault current
Rated Short-Circuit MakingCapacity	2.1 X Short circuit breaking Capacity
Rated short-time withstand current duration	1s
Utilization category	A
Current transformer (CT)	
Type	Cast Resin Bar Primary
Voltage class and frequency	650 V, 50 Hz
CT Secondary Current	1 A
Class of insulation	Class F
Accuracy class & burden	
a) For Protection	5P20, 5 VA PS Class for REF and core balance CT (CBCT)
b) For Metering	Class 0.5, 5 VA (min)
Minimum primary earth fault current to be detected by CBCT	1 A
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 class
Communication with SCADA	RS485 communication with Modbus RTU

Constructional Details

- The panel shall be metal enclosed, free standing, floor mounted, modular type with compartmentalized construction having degree of protection of IP 2X (Indoor) and IP 54 (Outdoor) as per IS/IEC 60529. All doors and covers shall be provided with neoprene gaskets to prevent entry of vermin and dust.
- All switches, push buttons etc. shall be operated front and shall be flush/semi-flush mounted.
- 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 mountedon them.

- 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.
- Earthing bus bar of suitable cross section shall be provided throughout the length of panel.
- 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.
- 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.
- The panel shall be of dead front construction suitable for front operated and back maintained functioning.
- 240 V, 5 A, 3 pin industrial socket-outlet with ON/OFF switch shall be provided in each panel.
- 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.
- Suitable lifting hooks shall be provided for each panel.
- 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.
- 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.

Air Circuit Breaker

- The circuit breaker shall be three pole, air break, horizontal draw-out type.
- The circuit breaker shall have three positions, i.e. SERVICE, TEST and ISOLATED.
- 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.
- The rated control voltage of the spring charging motor shall be 110 VDC. Closing coil shall operate at all values of voltages between 85% and 110% of rated voltage. Opening coil shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity and at all values of supply voltage between 70% and 110% of rated voltage.
- 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.

- 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.
- Mechanical indicators shall be provided to indicate OPEN/CLOSE, SERVICE/TEST positions of the circuit breaker and CHARGED/ DISCHARGED positions of the closing spring. An operation counter shall also be provided.
- The circuit breaker shall be provided with microprocessor based front adjustable protection release for overload, short circuit and earth fault.
- Mechanical/Electrical interlocks shall be provided to prevent mal-operation and in particular to ensure the following.
  (i) It shall be possible to close the circuit breaker only if it is in SERVICE or TEST position.
  (ii) It shall be possible to open the door only when the breaker is in TEST position.
  (iii) Movement of the circuit breaker between SERVICE and TEST positions shall be possible only if the breaker is OFF.
  (iv) Racking in the circuit breaker from TEST to SERVICE position shall be possible only if door is closed.

Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit breaker. The trolley shall be such that the top most breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn/inserted. The circuit breaker shall have suitable provision for integration with SCADA.

Instrument Transformers

- 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.
- Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.
- 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.
- For auxiliary supply switchgear, 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.

Bus bar

- Bus bar shall be made of copper or aluminum with uniform cross section throughout their length. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit current.
- All bus bars joints shall be thoroughly cleaned and anti-oxide grease shall be applied. Plain and spring washers shall be provided to ensure good contacts at the joints and taps. Wherever aluminum to copper connections are required, suitable bimetallic connectors or clamps shall be used.
- 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.
- 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.
- The Contractor shall submit busbar sizing calculation for specified continuous and short time current ratings during detailed engineering.

Earthing

- An earth bus made of copper or aluminum 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.
- The earth bus shall have sufficient cross section to carry maximum fault current without exceeding the allowable temperature rise.
- 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.
- Positive earthing of the carriage and breaker frame shall be maintained when it is in the connected position and in all other positions whilst the auxiliary circuits are not totally disconnected.
- 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.
- 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.

Multi-Function Meter

Digital, flush mounting type Multi-Function Meter (MFM) of 0.5 accuracy class shall be

provided. It shall have provision for integration with SCADA.

MFM 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)

Wiring and Terminal blocks

- 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.
- 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 wireterminations.
- 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.
- The Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.
- 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.
- CT and VT secondary circuits shall be terminated on stud type, disconnecting terminal blocks.
- At least 10% spare terminals shall be provided on each panel and these spare terminals shall be distributed on all terminal blocks.

Warranty

LT Switchgear shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 (five) year from the date of installation.

Testing and Inspection

Type Tests

The switchgear panel shall be of type tested design. Type test reports as per the following standards 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'.

Equipment	Standard
Switchgear Panel	Relevant parts of IEC 61439
Air Circuit Breaker	IEC 60947-2
Moulded Case Circuit Breaker	IEC 60947-2
Current Transformer	Relevant parts of IEC 61869
Voltage Transformer	Relevant parts of IEC 61869

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 HIMURJA.

Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by HIMURJA.

Uninterrupted Power Supply (UPS)

Standards and Codes

Uninterrupted Power Supply shall comply with the following standards and codes orequivalent Indian Standards, wherever applicable.

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
IEC 62619 / IS 16805	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications
IEC 62620 / IS 16822	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial applications
IEC 60896-21	Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test
IEC 60896-22	Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements
IS 15549	Stationary valve regulated lead acid batteries - Specification

General Requirements

The Uninterrupted Power Supply (UPS) system shall be designed to supply power tofollowing loads (but not limited to).

(i) Data logger / SCADA / EMS
(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

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.

System Description

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

The UPS shall meet the following minimum specifications.

Parameter	**Specification**
Topology	Online double conversion UPS
Input	

Voltage	230 V ± 10% AC for UPS Rating of less than 5 kVA 415 V ± 10% AC for UPS Rating of 5 kVA and above
Frequency	50 ± 5 Hz
Power factor	0.95
Output	
Voltage	230 V ± 1% AC
Frequency	50 Hz
Power factor	0.8
Battery	
Type	Off-shore: Lithium-ion battery On-shore: Lithium-ion battery OR Sealed, Maintenance-Free (AGM) battery
Capacity	100% UPS load for 2 hours
Monitoring and communication	
LED Indicators	Load on Inverter, Battery operation, Load on Bypass, Overload, LCD Fault, UPS Fault
Electrical contacts	Closing contacts for each of the following conditions: 1. Unit on Battery 2. Low Battery 3. Summary Alarm 4. UPS On 5. Input Fail
Local Display	LCD/ LED
SCADA communications	RS-485 Interface Port
Overall efficiency	>90%
Electrical Protection	Input/ output under voltage, over temperature, overload, Short circuit, battery low trip

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.

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

Warranty

UPS shall be warranted for minimum of 5 (five) years against all material/ manufacturing defects and workmanshipfrom the date of installation.

Tests

Routine tests and acceptance tests on final product shall be done as per QAP approved by HIMURJA. On completion of installation and commissioning of the equipment on sites tests shall be carried out with the maximum available load, which does not exceed the rated continuous load. An on-sites test procedure shall be submitted by contractor include a check of controls and indicators after installation of the equipment.

Earthing

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 followingstandards and codes.

Standard/Code	Description
IS 3043	Code of Practice for Earthing
IEEE 80	IEEE Guide for Safety in AC Substation Grounding
IEC 62561-2	Requirements for conductors and earth electrodes
IEC 62561-7	Requirements for earthing enhancing compounds
IEEE 142	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
Indian Electricity Rules	

General Requirements

- Earthing system shall be designed based on system fault current and soil/water resistivity value obtained from geo-technical investigation/hydrography report. Earth grid shall be formed consisting of number of earth electrodes sufficient enough to dissipate the system fault current interconnected by earthing conductors.
- The earth electrode shall be made of high tensile low carbon steel rod, molecularly bonded by high conductivity copper on outer surface with coating thickness not less than 250 micron as per relevant standards. Suitable earth enhancing material shall be filled around the electrode to lower the resistance to earth. Inspection chamber and lid shall be providedas per IS 3043.
- Earth conductors shall be made of copper bonded steel or galvanized steel of sufficient cross section to carry the fault current and withstand corrosion.
- 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.

- Earth electrodes shall not be situated within 1.5 m from any building whose installation system is being earthed. Minimum distance between earth electrodes shall be two times the driven depth of the electrode.
- 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.
- 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.

PCU Earthing

DC negative bus bar of the PCU shall be earthed to avoid Potential Induced Degradation (PID). DC negative bus bar and PCU equipment earth shall be bonded to the PCU earth bus and connected to earth electrodes through flexible copper cable of sufficient cross section as mentioned by the manufacturer. The interconnection of PCU earth electrodes with DC earth grid shall be as per PCU manufacturer recommendation. In case earthing of DC negative bus bar of PCU is not allowed by the manufacturer, suitable anti-PID device shall be provided with the consent of PV Module and PCU manufacturer. However, PCU equipment earth shall be connected to earth electrodes through flexible copper cable of sufficient cross section as mentioned by the manufacturer.

Transformer Earthing

Inverter transformer neutral shall be floating, not to be earthed. However, recommendation of inverter manufacturer shall also be taken into account.

Transformer body, cable box, marshalling box and all other body earth points shall be earthed.

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.

Neutral and body of the auxiliary transformer shall be earthed.

Main Control Room Earthing

Metallic enclosure of all electrical equipment inside the main control room shall be connected to the earth grid by two separate and distinct connections.

Cable racks and trays shall be connected to the earth grid at minimum two places using galvanized steel flat.

SCADA and other related electronic devices shall be earthed separately using minimumtwo no. of earth electrodes.

Switchyard Earthing

The metallic frame work of all switchyard equipment and support structures shall be connected to the earth grid by means of two separate and distinct connections.

Switch yard shall be shielded against direct lightning strike by provision of overhead shield wire or earth wire or spikes (masts) or combination thereof as per CEA 2010(Technical standards)-42(2)(c).

Tests

Type test reports for earthing electrode, earth enhancing compound and its associated accessories shall be submitted during detailed engineering for approval. On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. The earth plate shall be provided to facilitate its identification and for carrying out periodical inspection.

Lightning Protection System

Lightning Protection System (LPS) for the entire project against direct and indirect lighting strokes shall be provided as per IS/IEC 62305:2010.Lightning Protection Level for the entire project shall be Level – III. Air terminals, down conductors and earth termination system shall be designed as per relevant parts of IS/IEC 62305:2010.Necessary foundation/anchoring for holding the air terminals in position to be made after giving due consideration to shadow on PV array, maximum wind speed and maintenance requirement at sites in future. The product shall be warranted for minimum of 5 (five) years against all material/ manufacturing defects and workmanship. Type test reports as per IS/IEC 62305:2010 shall be submitted during detailed engineering for approval.

Communication Cables

- Optical Fibre Cables
- Optic Fibre cable shall be 4/8/12 core, galvanized corrugated steel taped armored, fully water blocked with dielectric central member for outdoor/ indoor application so as to prevent any physical damage.
- The cable shall have multiple single-mode or multimode fibres on as required basis so as to avoid the usage of any repeaters.

- 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.
- The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling.
- All testing of the optic fibre cable being supplied shall be as per the relevant IEC, EIA and other international standards.
- The Contractor shall ensure that minimum 100% cores are kept as spare in all types of optical fibre cables.
- Cables shall be suitable for laying in conduits, ducts, trenches, racks and undergroundburied installation.
- Spliced/ Repaired cables are not acceptable. Penetration of water resistance and impactresistance shall be as per IEC standard.

Communication Cable (Modbus)

Data (Modbus) Cable to be used shall be shielded type with stranded copper conductor. Cable shall have minimum 2 pair each with conductor size of 0.5 Sq.mm. Cable shall be flame retardant according to IEC 60332-1-2.

Cable shall be tested for Peak working voltage of not less than 300 V and shall be suitable for serial interfaces (RS 422 and RS 485).

Communication cable shall be laid through suitable HDPE ducts.

Control Cables

Control Cables shall have stranded copper conductor, PVC insulation, PVC inner sheath, FRLS PVC outer sheath according to IS 1554-1. Colour of the outer sheath shall be grey in colour.

The minimum cross section of the conductor shall be 2.5 sq.mm.

At least one (1) core shall be kept as spare in each control cable of 4C, 5C or 7C size whereas minimum no. of spare cores shall be two (2) for control cables of 10C or higher size.

SCADA

General Requirements

The Contractor shall provide complete SCADA system with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation and monitoring of entire solar project and its auxiliary systems.

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

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

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

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

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

(iv) Support for O&M Activities: The interface shall allow integration with Module Cleaning System to monitor the water consumption for Module Cleaning

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

(vi) Interface with different field equipment in the project and work seamlessly with field equipment supplied by different companies.

(vii) Transfer of project data reliably, to a Cloud server on any kind of remote network including low bandwidth and wireless links such as 4G/5G/VSAT

(**Note**: Telecom Lease line connection, if required for transferring data from Project overinternet shall be taken by Contractor in the name of HIMURJA for O&M period)

The Control system shall be designed to operate in non-air-conditioned area.

Architecture

The SCADA System shall be built over Industrial IoT architecture with integrated Analytics, secure web access, enterprise software and Database. The SCADA architecture shall be compliant with principles identified in Article 1 a. of CEA (Cyber Security in Power Sector) Guidelines, 2021. (Note: Appointment of CISO shall be the responsibility of Owner).

Data acquisition shall be distributed across MCR and LCRs while project level data aggregation shall be done in both local and remote server (as specified by Owner).

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

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

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

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

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

Note: Configuration of Cloud server and procurement of associated subscription services shall be in the scope of the EPC Contractor.

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

Internet/Intranet at Project: Public or private network access shall be provided at the project through any broadband/VSAT connectivity of 2Mbps or higher bandwidth. In case no broadband/VSAT connectivity can be provided at the project, a 4G/5G data card from any Internet Service Provider (ISP) may be provided. SCADA system shall be capable of sending all project data in real time to the Remote Server.

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

Industrial IoT Controllers & Data Acquisition

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

- The IIoT Controllers shall be distributed in nature.
- Shall be capable of supporting wide range of field protocols to communicate with different field equipment (Modbus over RS 485/Ethernet, etc.)
- Shall have local storage for a minimum of 2 weeks (in case of network failure).

- Provide web-based interface to configure the controller for various equipment in the field. IO Functionality: Shall support status monitoring of VCBs & Trip relays on GIS/HT & Transformer panels through distributed DI/AI modules.
- Controls: Shall be capable of Controlling breakers (ON/OFF). Both ON/OFF and Parameter control of inverters shall be supported.
- Data Communication with Servers: Shall send the data collected, from all the equipment at Inverter Control Room and/or Main Control Room, to the Monitoring & Control Server. Controllers shall be capable of sending data over Internet connections USB data cards.

Functionalities

- In case of central inverter, SCADA system shall enable PV array Zone monitoring i.e. the total current from each String Combiner Box shall be monitored on the DC side.
- The SCADA system shall monitor instantaneous and cumulative electrical parameters from all DC& AC Equipment including inverters, string combiner boxes, weather station, MFM, Transformer and Switchgear (LT & HT Panels) at regular intervals not greater thanone minute.
- The SCADA system shall monitor Instantaneous and cumulative environment parameters from weather sensors or data loggers at same interval as electrical parameters and provide PR, CUF on the fly. The SCADA shall also monitor water quality and flow parameters.
- The SCADA system shall provide Alarms and Alerts on equipment faults and failure in less than 5 seconds. Alarms on status change of hardwired DI shall also be provided.
- The SCADA system shall provide configurable alerts on any parameter crossing settable thresholds. The list of such parameters shall be finalised in consultation with the Owner. The SCADA system shall have user-friendly browser-based User Interface for secureaccess from anywhere, for minimum ten concurrent connections from the Operator PC orother securely connected laptop/mobile, for project monitoring, O&M, daily reporting, andanalysis. A dashboard providing summary details of total project generation, day's export,irradiance, Inverter Control Room level generation and performance indicators like PR andCUF.
- Reporting: The SCADA system shall provide downloadable reports in Excel/PDF, configurable for equipment parameters across the project.
- Mobile User Interface: summary of project performance and issues should be accessible in a mobile Native UI or browser UI.
- Data Communication to SLDC: SCADA system shall provide required interface to integrate with TRANSCO-SLDC, in compliance with grid code, to send any parameters specified bySLDC.

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

- Power Project Control: SCADA system shall provide required interface to the local SCADA operator to set various power control modes (active/reactive power/frequency/PF) through the inverters over industry standard communication protocols like Modbus over TCP/IP. All programming functionalities shall be password protected to avoid unauthorizedmodification.
- The Contractor shall provide software locks and passwords to EMPLOYER for all operating & application software. Also, the Contractor shall provide sufficient documentation and program listing so that it is possible for the EMPLOYER to carry out modification at a later date.

Earthing

- Two isolated electronic earth pits near to SCADA panel at every Inverter and Control Roomwith < 1 Ohm resistance shall be provided. One earth pit shall be used for protective/body earth and the other to be used for Signal Earth.
- Apart from providing separate earth pits, manufacturer specified earthing recommendations shall be followed for all communicating equipment connected to SCADA. This includes but is not limited to Inverters, WMS and Switchgear panels.

Communication Cable Laying

- All RS485, IO and CAT6 cables shall be laid in separate conduits with a minimum separation of 1.5ft from AC/DC power cables all along.
- Power cables shall be laid deep in the trenches first. Data cables shall be laid in separate conduits after partially filling the trenches to ensure minimum 1.5 ft separation between power and communication cables all along the trench.
- IO Cables between switch gear panels and SCADA panel shall be laid on separate cable trays, with a minimum of 1.5ft separation from trays carrying AC Power cables.
- RS485 & CAT6 cables between switch gear panels or Inverters and SCADA panel shall be laid on separate cable trays, with a minimum of 1.5ft separation from trays carrying ACPower cables.

Control Cabinets / Panels / Desks at Main Control Room

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

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

Software Licenses

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

Hardware at Main Control Room

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

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

Project Server	
Server Hardware	Hex/Octal Core Xeon, 32GB RAM (expandable to 64 GB RAM), 4 X 2TB SATA hard discs in RAID 5 configuration, 2TB external USB hard disc (for backup), dual power supplies, 2 LAN ports, LCD console, keyboard & mouse. The server hardware shall be housed in a rugged fan-cooled, and rodent-proof Server Rack.
Operating System	Operating System and Database shall be of enterprise scale (RedHat Linux or equivalent Linux OS or Windows, Oracle/MySQL or equivalent DB), with required AMC for 5 years.
Accessories	1. Monitor: Min 22" LED Flat Monitor with non-interfacedrefresh rate min. 75 Hz. 2. Keyboard: ASCII type 3. Pointing Device: Mouse 4. Intelligent UPS (on line): Minimum 2 hour battery backup.
Operator Workstation	
Hardware	i7 CPU running at 3.0 GHz or faster with 16GB RAM, 500GB hard disk, 25" LED monitor, keyboard andmouse, 4 USB ports, LAN port
Operating System	Windows operating system with necessary tools, anti-virus software.
Accessories	1. Screen Display Unit: Min 50" LED Flat Monitor with wallmounted arrangement for the display of SCADA screen 2. A4 size monochrome laser printer.

	3. UPS of required capacity with 2 hour battery backup.

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

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 project and same shall be demonstrated during the FAT.

Illumination

Standards and Codes

LED luminaires shall be tested at independent laboratory as per the following teststandards.

Standard/Code	Description
LM 79-08	Electrical and Photometric Measurements of Solid-State Lighting Products
LM 80-15	Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules

General Specification

This specification covers design, supply and installation of Illumination system along the peripheral & internal roads, main control room & inverter rooms, switchyard and other facilities including entry points/gate(s) inside the project area.

The Contractor shall furnish Guaranteed Technical Particulars of the LED luminaires, from renowned brands available in the market for approval of HIMURJA.

Lighting system shall work on the auxiliary supply and same shall be incorporated in auxiliary loads. The Contractor shall provide minimum 20% of total lighting points as emergency lighting points, fed from UPS DB or DCDB as per scheme adopted by the Contractor. Indoor and outdoor emergency lights shall be provided at each inverter room,main control room.

Lighting Levels

The average LUX level of 10 lumen is to be maintained in switchyard. However, a lux level of 20 lumen (comprising of minimum 2 sources of 10 lumen each) is to be maintained in switchyard on transformer.

The lighting system for outdoor and indoor areas of solar power project 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
Internal / Periphery Roads	4
Transformer Switchyard	20
H – pole and metering point	10

The lighting level shall take into account appropriate light output ratio of luminaires, coefficient of utilization maintenance factor (of 0.7 or less) to take into account deterioration with time and dust deposition and luminance uniformity (Uo) shall be minimum 0.3.

LED Luminaries for Outdoor Applications:

LED luminaries shall meet the following parameters.

Parameter	Specification
Input voltage	170 - 260 V
Input Frequency	50 Hz +/-1 Hz
Power Factor	0.90 (Minimum)
Luminaries 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)
Luminaries 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 totallyencapsulated)

- The LED luminaries (outdoor) housing, heat sink, pole mounting bracket, individual LED reflectors and front heat resistant tempered glass should be provided.
- The LED luminaries (outdoor) housing should be made of non-corrosive, high-pressure, die- cast aluminum and the housing should be power coated grey, so as to ensure good weather ability. Each individual LED source should be provided with an asymmetrical distribution high reflectance aluminized reflector, which should ensure that the light distribution of the luminaries is suitable for road lighting applications (wide beam distribution) and should ensure high pole to pole spacing.
- The luminaries should be provided with in-built power unit and electronic driver.

- The luminaries should be suitable for standard street light poles and should be suitable for side entry and bottom entry (post top).
- 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.
- 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.
- 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.
- Junction box for lighting shall be made of fire retardant material. The degree of protection shall be IP 55 for outdoor JB.
- Lighting cables, wherever exposed to direct sunlight, shall be laid through Double Wall Corrugated (DWC) HDPE conduits.
- LED Luminaries/Lamps for Indoor Applications:

  LED luminaries/lamps shall have minimum 3-star BEE rating.

  All indoor LED luminaries/lamps shall be supplied with proper diffuser to avoid direct visibility of LED and suitable heat sink for longer life.

Warranty

All luminaries shall be warranted for minimum of 5 (five) years against all material/ manufacturing defects and workmanship from the date of installation.

Fire Alarm System

Standards and Codes

Standard/Code	Description
IS 2189	Selection, Installation and Maintenance of Automatic FireDetection and Alarm System Code of Practice
IS 2171	Portable Fire Extinguishers, Dry Powder (Cartridge Type)
IS 8149	Functional requirements for twin CO_2 fire extinguishers (trolley mounted)
IS 2546	Galvanized mild steel fire bucket
National Building code 2016	

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.

Firefighting system for the proposed power project for fire protection shall be consisting of but not limited to:

(i) Sand buckets
(ii) Portable fire extinguishers (CO_2 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.

Minimum two numbers of fire extinguishers (CO_2 and Foam type each, of capacity 9 kg having BIS certification marking as per IS 2171) shall be provided at every building/ enclosure, transformer yard and switchyard. However, the Contractor must comply with existing building code for fire protection and relevant IS codes.

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.

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

The Contractor shall submit the plan for fire and smoke detection system for HIMURJA approval.

Testing Instruments

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

Earth resistance tester

Parameter	**Specification**
Display	Backlit LCD or LED display
Range	Earth Resistance: up to 2000 Ω Earth Voltage: 200 V
Accuracy	± (2% + 5)
Safety Ratings	IP 56
Programmable Limits setting	Enabled
Accessories	
Earth Ground Stakes – 4 Nos.	
Cable Reels – 3 Nos.	
Battery – 2 set	
Carry Case with sufficient space for accommodating accessories	

Array tester

Parameter	**Specification**
Display	Backlit LCD or LED display
Functionality	All electrical tests required by IEC 62446-1:2016
Memory	Up to 200 records & USB downloadable to Computer
Accessories	
A set of two, 4mm fused leads for extra protection during installation tests.	
Leads which enable the array tester to connect directly to PV arrays	
Battery – 2 set	
Carry Case with sufficient space for accommodating accessories	

Insulation tester

Parameter	**Specification**
Display	Backlit LCD or LED display
Insulation Test Range	0.1 MΩ to 10 GΩ
Test Voltage	250V, 500V, 1000V, 5000V
Test Voltage accuracy	+20% on positive side only no negative variation is allowed
Accessories	
Heavy duty Test Leads with Alligator Clips – 1 set	
Battery – 2 set	
Carry Case with sufficient space for accommodating accessories.	

Digital Multimeter

Parameter	**Specification**
Voltage Range	1500 V DC / 1000 V AC (True RMS)
Display	4 ½ digits, Backlit LCD or LED
Measuring Category	1000V CAT III as per IEC 61010-1
Additional Functions	Resistance, Temperature, Continuity, Diode, Capacitance, Frequency, Duty cycle measurement
Accessories	
Temperature Probe – 1 No.	
Test Leads with Alligator Clips – 1 set	
Battery – 2 set	
Carry Case with sufficient space for accommodating accessories.	

Clamp meter

Parameter	Specification
Current Range	400 A DC / 1000 A AC (True RMS)
Display	Backlit LCD or LED display
Measuring Category	1000V CAT III as per IEC 61010-1
Additional Functions	Active, Reactive and Apparent Power, THD, PF
Accessories	
Test leads – 1 set	
Battery – 2 set	
Carry Case with sufficient space for accommodating accessories.	

Digital lux meter

Parameter	Specification
Range	0 – 1000 lux
Accuracy	± (2% + 5)
Resolution	1 lux
Display	3½ digits, Backlit LCD/LED
Accessories	
Battery – 2 set	
Carry Case with sufficient space for accommodating accessories.	

All testing equipment shall possess valid calibration certificate issued from approved NABLlabs.

Instruments of superior rating is allowed after seeking consent of HIMURJA.

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

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

Power Evacuation System

- Design, Construction, Testing and Commissioning of the power evacuation system and its integration to the designated interconnection point via either overhead transmission line or underground cables at specified grid voltage with all necessary infrastructure such as protection switchgears and metering systems shall be as per the requirement of the HPSEBL/HIMURJA.
- The Contractor shall get the route approval from HIMURJA prior to start of the construction. Any changes in the route or scheme at any point of the time prior to commissioning shall be complied

without any additional cost to HIMURJA.

- Only HPSEBL approved components shall be used for construction of transmission line and underground cables.

Overhead Transmission Line

In case the power evacuation is planned with overhead transmission line for project external evacuation, the design of tower and its accessories shall be as per HPSEBL requirement and the design shall be submitted to HIMURJA for approval/ accord.

Underground cable

In case the power evacuation is planned with underground cable for project internal evacuation, the cable shall be approved by HIMURJA. However, in case of external power evacuation, the evacuation plan shall be as per HPSEBL requirement and the same shall be submitted to HIMURJA for approval/ accord.

B Civil, Mechanical and Plumbing Works

General Requirement

- This section of Technical Specifications describes detailed technical and functional requirements of all civil, structural, mechanical & plumbing works included in the scope.
- Standards & Codes
- All design and construction of civil works shall conform to relevant Indian standards such as BIS, IRC, MORTH, NBC etc.
- Design of steel structures shall conform to IS: 800, 801 or 802 as applicable. Design of concrete structures shall conform to IS: 456. For design of liquid retaining structure IS: 3370 shall be followed. Only in case of non-availability of Indian standard, equivalent American or British standard may be used for design with prior approval of the Engineer and the contractor shall submit proper justification for the same along with his request to the Engineer for review and approval, and the decision of the Engineer shall be final and binding.
- All the design/ drawings shall be prepared/ approved either by in-house Engineering Team of the contractor (or by his Engineering Consultant) with qualified engineering staff with relevant experience in successful design of solar SPV projects.
- The design calculations for MMS, RCC structure, Steel structure, Foundation system, Road work, Drainage work, etc. shall be submitted for prior approval of Engineer before commencement of construction.
- As per project requirements, the Employer may ask for approval of all civil designs and drawings by a Chartered Civil/ Structural Engineer.
- The design calculations shall be supplemented with a neat sketch showing the structure geometry, node and member nos., lengths of various typical members, support points and type of supports,

types of materials & type of sections with properties considered in analysis & design. The report shall also include back-up calculations for various loads adopted in design, brief write-up on primary load cases and design load combinations considered and conclusions on design results (with supporting sketches) for easy reference and clarity. Where a computer program (other than Structure Analysis and Design Program (STAAD)) is used for analysis and design, the contractor shall include a write-up on the computer program used along with examples for validation check. Design Input (format suitable to the programme used and also in STAAD format) and output file shall also be given in the design report and in soft copy to facilitate its review and approval by the Engineer.

- The methodology for construction of MMS and its foundations, Road & drainage works and procedure for pile load test shall also be submitted for prior approval of Engineer before start of these works

Other Investigations

- The contractor shall also obtain and study other input data at proposed project sites for design of the project from metrological department/ local govt. authorities. This shall include data related to Rainfall, Maximum & Minimum ambient Temperature, Humidity, HFL etc.
- The contractor shall carry out Shadow Analysis at proposed sites and accordingly design strings and array layout with optimum use of space, material and man power. In case of large variations in topography (3^o to the horizontal) the study shall also include the effect of topographical variations on array layout and MMS structure design adequacy and stability. The contractor shall submit all the details/ design to the Engineer for review/ approval.
- The contractor shall also identify potential quarry areas for coarse and fine aggregates to be used for concrete and shall carry out the concrete mix design for different grades of concrete to be used before start of work. The concrete mix shall be designed for each source of cement and aggregates as per provisions of relevant BIS Standard. The concrete mix design shall be carried out through NABL accredited Laboratory or any Govt. agency approved by the Engineer. In case the contractor proposes to use RMC, he shall submit the Concrete mix design report from the RMC firm for review and approval by the Engineer. (In case of RMC, reports for periodic cube tests from the supply batch shall also be submitted for reviewand record)

Area Grading and Land Development

- The Finished Grade Level (FGL) of the proposed project shall be fixed with reference to the highest flood level (HFL) and surrounding ground profile at proposed sites to avoid flooding of project sites. The data regarding HFL at proposed sites shall be obtained from the metrological department by the contractor. In case of absence of this data, the contractor shall assess the required information through local sites reconnaissance. The area at and around all buildings/ open installations (ICR, MCR etc.), transformer yard and switch-yard shall be uniformly levelled

at suitable RL to be finalized considering topography and HFL at sites. The minimum plinth level of all buildings/ open installations shall be 1000 mm above FGL. Module mounting structure foundation/ Pile cap or any other pedestal shall be min. 200mm above FGL.

- A detailed drawing for sites levelling and grading (if necessary) shall be submitted by the contractor before commencement of grading and area development works. The estimated volume of cutting and filling shall also be marked on the Grading drawings for reference. The final grade levels to be adopted for different blocks shall be clearly marked on the Project Layout/ Module Layout drawing.
- The contractor is responsible for making the sites ready and easily approachable by clearing bushes, felling of trees (mandatory permissions/ licenses/ statutory clearances from competent authorities if required for cutting of trees, blasting or mining operations, disposal of waste material etc. shall be obtained by the contractor), cutting, filling with selected excavated earth or borrowed earth including identifying borrow areas. Except in exceptional cases (with approval of the Engineer), filling shall be made up of cohesive non-swelling material. The filling for levelling/ reclaiming the ground/ area shall be done in layers not more than 150mm of compacted thickness in case of cohesive (clayey) soils and 250mm compacted thickness in case of granular (sandy) soils with compaction up to 95% (of modified proctor density) and 80% (of relative density) respectively. The slope at edge of graded areas shall not be steeper than 1:1.5 (1 Vertical: 1.5 Horizontal) in cutting and 1:2 (1 Vertical: 2 Horizontal) in filling. In case of filling with rock material, the edges shall be provided in line with provisions of relevant BIS standard.
- It shall be ensured that the land is graded or leveled properly for free flow of surface run-off and the grade levels shall be fixed with respect to high flood level at sites, drainage pattern and system requirements. It shall be ensured that the land is used optimally to have maximum solar power generation considering full utilization of the plot areas. It is advisable to follow the natural flow of water at the ground as far as possible for drainage design.
- In case the filled up earth is brought from outside the project or borrow areas (when the material inside project area is not found suitable for grading work or if directed by the Engineer), the contractor shall carry out all required soil investigations to ascertain the suitability of the borrowed soil for land development and filling purposes. Contractor's scope shall also include arranging land lease, getting all necessary statutory approvals for mining, payment of necessary challan etc. Excess earth, if any, shall be disposed of properly at location as directed by the Engineer.

Roads

Suitable approach road (as applicable) from nearest public road up to project Main gate, Access road from Main gate to Main control cum office room (MCR), Internal roads connecting MCR and other facilities/ buildings/ open installations like Local control room(s) (LCR)/ Inverter

control room(s) (ICR), Sub-station & Switch yard (as applicable) etc. shall be provided for safe and easy transportation of men, material and equipment during construction and maintenance.

Peripheral Fence & Main Gate

The project peripheral boundary shall be provided with chain link

Project Layout

- The contractor shall submit drawing showing proposed Project and SPV module Layout.
- The Project and SPV module layout shall be a comprehensive drawing showing various requirements of the project like, Reference coordinate grid, Geographical and Project North, Layout of boundary fence including coordinates of all corner points, Location of main entrance gate and any other access gates as per project needs, Block wise FGL, Layout of main approach road to the project, Internal and peripheral roads, Security Room/ cabin (s), all Buildings and Open installations with coordinates, Temporary Storage yard/ facility to be used by the contractor during construction, Proposed Array layout, Lightening arrester, UG/Over ground water Tank(s), Storm water drains, Corridor for buried cables etc.
- The cable corridor shall be laid through clear gap between arrays and shall not be laid below modules for easy maintenance.
- All the facilities and buildings shall be presented with suitable Legend. The drawing shall be in suitable scale to have proper representation of the information.
- The Project & SPV module layout drawing shall be submitted by the contractor for review/ approval by the Engineer.

Design Loads

Unless otherwise specified elsewhere, Dead load, Live load, Wind load, Seismic load and Snow Load for buildings and structures shall be considered as per provisions of relevantBIS standards.

The following minimum imposed load as indicated for some of the important areas shall, however be considered for the design. If actual expected load is more than the specified minimum load, then actual load is to be considered.

S. No.	Area	Imposed (Live) Load
1	Roof(Accessible/Non-accessible)	1.50 kN/ Sqm
2	Building floors (GF) & Grade Slab	10.00 kN/ Sqm
3	RCC Floors (General)	5.00 kN/ Sqm
4	Outdoor platforms, Stairs, Landing and Balconies, Walkway, Chequred plate & Grating (except cable trench cover)	5.00 kN/ Sqm

5	Road culverts & allied structures over drain & pipe crossings subjected to vehicular traffic	Design for Class – 'AA' loading (Wheeled & Tracked both) and check for Class – 'A' loading as per IRC Standard
6	Underground structures such as Sump, Pit, Trench, Drain, UG tank etc.	In addition to Earth pressure and Ground water table at FGL, a surcharge of 20kN /Sqm (10kN/Sqm for drains) shall also be considered. The structure shall be designed for following criteria – (a) Inside empty with outside fill+ surcharge and water table at GL & (b) Insidewater with no fill & water table outside
7	Pre-cast and chequred plate cover over cable trench	4.00 kN/ Sqm
8	Main access & Internal Roads	As per IRC SP 20 corresponding to vehicular traffic of 150 commercial vehicles per day and critical in-field CBR

Primary Loads

(i) Dead Load (DL)

(ii) Live Load (LL)

(iii) Wind Load (WL) – Both along ±X & ±Z horizontal direction

(iv) Seismic Load (EL) – Both along ±X & ±Z horizontal direction

- Seismic Load is to be considered as per as per IS 1893 Part 4.
- Seismic Zone = IV, Zone Factor Z = 0.24
- Importance Factor, I = 1.5
- Response Reduction Factor, R = 3

(v) Temperature Load (TL)

- Minimum Recorded Temperature = -27.5 ˚C
- Maximum Recorded Temperature = 12 ˚C
- Reference Temperature at time of erection for temperature load calculation =5 ˚C
- The structure shall be designed for a rise in temperature of 7 ˚C and for a fall in temperature of 32.5 ˚C.

Basic wind speed (V_b) at project sites shall be taken as per IS 875 (part-3) unless otherwise specified elsewhere.

To calculate the design wind speed (V_z), the factors k_1 (probability factor or risk coefficient), k_2 (terrain roughness and height factor) and k_3 (topography factor) shall be considered as per

IS 875 (Part-3). However, minimum values for k_1, k_2 and k_3 shall be 0.94, 1.0 and 1.0 respectively.

Topography factor 'k_3' shall be taken as 1.0 upto upwards slope of 3°.

In case of project sites within 60 km of sea coast, the importance factor for cyclonic region, 'k_4' shall be taken as 1.15.

To calculate the design wind pressure 'p_d', factors 'k_a' (area averaging factor) and 'k_c' (combination factor) shall be taken as 1.0.

The Seismic Load shall be considered corresponding to Earth quake zone at sites as perIS: 1893 (Part- 4) with Importance factor 1.5. Ductile design and detailing as per IS 13920shall be followed in all RCC structures including MCR, plinth supporting open installationsof inverter transformers and control panels, etc.

Module Mounting Structure (MMS)

- The module mounting structure design shall generally follow the existing land profile. The top of the table shall be in one plane.
- In MMS analysis the column support shall be assumed at EGL/NGL.
- In case of topographical variations more than 3^o, the contractor shall carry out detailed study of its effect on array layout, shadow analysis and structural stability of MMS.
- The structure shall be designed to allow easy replacement of any module and shall be in line with sites requirements.
- The MMS stub/ column, rafter, purlin, ties and bracing members shall conform to following Indian standards.
  - IS: 2062 – Hot rolled Medium and High tensile structural steel
  - IS: 811 – Cold formed light gauge structural steel sections
  - IS: 1161 – Steel tubes for structural purposes
  - IS: 4923 – Hollow steel sections for structural use
  - Minimum grade of steel for sections conforming to IS: 811 & IS: 4923 shall be E350 (quality 'C' conforming to IS 2062:2011.
- The minimum thickness excluding anti corrosive treatment (BMT) of various elements of MMS structure shall be as following:
  - ctub/ column – 3.15mm,
  - Rafter – 2.5mm
  - Purlin – 2 mm.
  - Other members – 2.0 mm
- The primary loads and load combinations for design of MMS structure shall be as specified

under Clause No. 10. The design shall be done by Working stress method and no increase in allowable stress shall be permitted.

- The maximum permissible deflection/ side sway limits for various elements of MMS under serviceability conditions shall be as following:
  - Lateral deflection/ side sway for Column – Span/ 240
  - Vertical deflection for Rafter and Purlin – Span/ 180
  - Lateral deflection for Purlin – Span/240

  In case of natural frequency in first mode less than 5 Hz, the design of the MMS structure shall also be checked against dynamic effects of wind as per provisions of IS – 875 (Part- 3) using gust factor method.
- The purlins shall be provided with min. following tie/sag rods or angles or channels:
  - 1 no., in the mid of each span and shall connect all the purlin members
  - 1 no., diagonal, at each corner in end spans
- Lateral restraint to compression flange if any due to PV panels is not permitted in purlin design.
- The vertical diagonal bracing shall be provided in end spans and every alternate span of each unit (table) of MMS.
- MMS shall support SPV modules at a given orientation & tilt and shall absorb and transfer the mechanical loads to the ground properly.
- Welding of structure at sites shall not be allowed and only bolted connections shall be used.
- The MMS structure shall be hot dip galvanized with minimum GSM 610 kg/ sqm and/or minimum coating thickness of 80 microns for protection against corrosion. Galvanization shall conform to IS-2629, 4759 & 4736 as applicable.
- It is to ensure that before application of this coating, the steel surface shall be thoroughly cleaned of any paint, grease, rust, scale, acid or alkali or any foreign material likely to interfere with the coating process.
- The bidder shall ensure that inner side is also provided with galvanization coating.
- The galvanization shall be done after fabrication of members and cutting of holes toensure galvanization of all cut/ exposed edges.
- In case the proposed section is made up of Aluminum, anodized coating shall be Gr. AC25 and shall conform to IS: 1868.
- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time.
- Two numbers of anti-theft fasteners of stainless steel on two diagonally opposites corners for each module shall be provided. All fasteners and washers (2 round + 1 spring) both for MMS connections and fixing of PV Module shall be adequately protected from atmosphere and weather prevailing in the area.
- Fasteners and washers to be used for erection of mounting structures and fixing of Modules over

MMS shall be of stainless-steel grade SS 304 with property class A2-70 conforming to relevant ISO standard.

- Min. diameter of bolt for MMS connections shall be 10mm (12 mm in case of single bolt connection for seasonal tilt) except at column-rafter connection, where it shall not be less than 12mm (not less than 16mm in case of single bolt connection for seasonal tilt). In case of fixed tilt, min. two number of bolts shall be provided at each joint.
- Modules shall be clamped or bolted with the structure properly. The material of clamps shall be Al / SS having weather resistant properties. Clamp/bolt shall have EPDM rubber washer and shall be designed in such a way so as not to cast any shadow on the activepart of a module.
- MMS column post supported with base plate secured to foundation shall be fixed with galvanized high strength "J" bolts conforming to specifications of IS: 4000/ IS: 1367 and relevant IS code. Installation of foundation bolts and embedment of column leg in foundation concrete shall be done by using template to ensure proper alignment. The underside of base plate shall be provided with anti- shrink grout.
- In case the contractor proposes to extend the column leg to embed it in the pile/pedestal as an alternate fixing arrangement, the column member shall be extended for full depth of the pile (100mm cover at tip of the pile) with an end plate of min. 4mm thickness to be welded at the bottom of column leg. (However, for projects in coastal area or in case of marshy soil the column post shall be supported only with base secured to foundation through base plate and anchor bolt assembly and no embedment of column leg in foundation is permitted)
- The array structure shall be grounded properly using maintenance free earthing kit.
- The bidder/manufacturer shall specify installation details of the PV modules and the support structures with appropriate diagram and drawings.
- The Bidder should design the structure height considering highest flood level at the sites and the finished grade level. The minimum clearance between the lower edge of the module and the finished grade shall be the higher of (i) Highest flood level + 100mm and
  1000 mm, as applicable.
- The length of one unit (Table) of MMS shall not generally be more than 20m.
- The contractor shall submit the detailed design calculations and drawings for MMS structure, bill of materials and their specifications/ standards to the Employer for approval before start of fabrication work as per the engineering work program (L2 schedule) as finalized during kick-off meeting.
- The length of any cold formed section (CFS) shall not be more than 5.5 m.
- In case of seasonal tilt, the front and back bracing members (subject to seasonal rotation) shall be connected to the column through gusset plate and shall not be connected directly to the column.

- The purlin splice shall be near the zone of contra-flexure, i.e. within a distance of 0.15L to 0.25L from the support, where L is the respective span within which splicing is located.
- The purlin splice shall comprise of flange and web splice plates and splice design shall conform to BIS:800. For simplicity in fabrication, the splice member may be of CFS channel section without lips (CU).
- For same member type, same section shall be used.
- When any sag or tie member to the purlin (rod, angle or channel) is provided, it shall not be considered in modelling the structure for analysis except its effect as lateral support to the purlin members in strength design.

Concrete Works

- Construction of all RCC works shall be done with approved design mix as per IS 456 and the materials used viz. Cement, coarse & fine aggregate, Reinforcement steel etc. shall conform to relevant BIS standards.
- The min. grade of concrete shall be M25 for MMS piling works, M30 for other RCC works except liquid retaining structures like underground water tank, septic tank, etc. where minimum grade of concrete shall be M35.
- Cement higher than 43 Grade shall not be used in construction.
- Unless otherwise specified elsewhere, PCC shall be of min. grade M10 (nominal mix 1:3:6) except for mud mat, back filling of ground pockets or leveling course which shall be of grade M7.5 (nominal mix 1:4:8).
- Reinforcement steel shall be of high strength TMT bars of grade Fe500D conforming to IS: 1786.
- Unless specified otherwise for grouting works, anti-shrink ready mix grout of approved make or cement mortar (CM) grout with non-shrink compound shall be used. The grout shall be high strength grout having min. characteristic strength of 35 N/mm^2 at 28 days.

Miscellaneous Steel Works

Unless otherwise specified elsewhere, all structural steel work shall be designed as per provisions of IS: 800 with working stress method of design (WSD).

Structural steel hot rolled sections, flats and plates shall conform IS: 2062, structural Pipes shall be medium (M)/ high (H) grade conforming to IS: 1161, chequered plate shall conform to IS: 3502 and Hollow steel sections for structural purposes shall conform to IS:4923.

Buildings and Plinth for Open Installations

General Requirement

- Project buildings and plinth for open installations are required to be constructed for housing

the electrical equipment/ panel (Local Control Room Building - LCR) and Control room cum office cum store (Main Control Room Building - MCR) for operation and maintenance of Solar Power Project.

- Unless otherwise specified elsewhere, all buildings and plinth for open installations shall have RCC framed structure.
- All buildings shall have provision of adequate windows for natural light & ventilation, fire safety provisions and shall be designed as per provisions of National building code (NBC).
- The contractor shall submit the proposed equipment layout drawings to the Engineer for approval before development of Architectural drawings. The building layout, exterior elevations shall be aesthetically designed following good architectural practices to get a pleasant look. Horizontal/ vertical bands through projections/ groves in external plaster may be provided to break the monotony. Roof slab shall have projection of 450mm beyond external walls with RCC parapet wall of 450 mm clear height all-around which shall form a projected band at roof level. For weather protection all doors and windows shall be provided with 450mm wide RCC chajja.

All items shall be of reputed make. Only Items with approved samples by the Engineer shall be used.

Painting & Other Finishes

Painting and white wash/ colour wash for the buildings shall conform to relevant BIS standards. The make and colour shade of the finish shall be as advised and approved by the Engineer.

Internal Walls except toilets & battery room	Acrylic emulsion (for MCR) & Oil bound distemper (for LCR/ Security Room)
Toilet	Oil bound distemper
External Walls	All weather proof cement based acrylic emulsion paint, exterior grade
MMS foundations/ Earth pit Enclosure	Cement paint
Underside of roof slab	White wash
Air-conditioned areas	Underside of roof slab- Under deck insulation with 50mmthick mineral wool, min. density 45 kg/ m3 and Gypsum board false ceiling with GI grid/ Gypsum tile (600x600 mm x 12 thick) false ceiling with AL grid as per manufacturer's details
Structural steel work	2 coats of synthetic enamel paint over 2 coats of suitable primer

Fire Extinguishers

All buildings shall be installed with required no. of fire extinguishers as per relevant BIS standard

and NBC. Liquefied CO_2 / foam / DCP type fire extinguisher shall be upright type of capacity 9 kg conforming to IS 15683 / IS 2878.

The fire extinguisher shall be suitable for fighting fire of Oils, Solvents, Gases, Paints, Varnishes, Electrical Wiring, Live Machinery Fires, and all Flammable Liquid & Gas.

Sign Boards and Danger Boards

The sign board containing brief description of major components of the power project as well as the complete power project in general shall be installed at appropriate locations of the power project as approved by Engineer

The Signboard shall be made of steel plate of not less than 3 mm. Letters on the board shall be with appropriate illumination arrangements.

Safety signs, building evacuation plan and direction signs, assembly points shall also be placed at strategic locations.

The Contractor shall provide to the Engineer, detailed specifications of the sign boards.

Pipe & Cable Trenches

All trenches inside the building and transformer area shall be of RCC. The min. wall and base slab thickness shall be 100mm for depth ≤ 850mm and 150mm for depths > 850mm.

The trench shall be designed for loads as specified under 'Design Loads'. External trenches shall be kept min. 100mm above FGL to avoid entry of rain water. In case of straight length of the trench being more than 40m, suitable expansion joints with PVC water stop shall be provided.

Internal trenches (inside buildings) shall be provided with chequered plate (min. 8mm thick with stiffening angle ISA 50x50x6 @ 750 mm c/c for trench width greater than 800 mm) covers while external trench shall have precast concrete covers.

Min. thickness of precast cover shall be 50mm. Both bearing edges of the cable trench and all edges of pre-cast concrete covers shall be provided with min. 50x50x6 mm edge protection angle with lugs.

The trench cover (chequered or pre – cast both) shall be provided with suitable lifting hooks.

As required, suitable MS insert plates shall be provided on trench wall to support the cable rack/ pipe.

The trench bed shall have a slope of approx. 1(V):250(H) along and 1(V):50(H) across the length of the trench. The cable trench shall have a dewatering sump(s) of size 450x450x450 mm depth at suitable location to facilitate collection & pumping out of rain water from the trench.

The external buried cables shall be laid in excavated trench as specified under specifications for Electrical works.

PV Module Cleaning System

Wet Cleaning System

The Contractor shall estimate the water requirements for cleaning the photovoltaic modules at

least once in two weeks or at a closer frequency as per the soiling conditions prevailing at sites. Also, the contractor is required to plan the water storage accordingly with provision of a tank of suitable capacity for this purpose. However, min. consumption of 2 Ltr / Sqm of surface area of SPV module shall be considered in estimation of required quantity of water storage.

A regular supply of suitable quantity of water shall be ensured by the contractor to cater day-to-day requirement of drinking water and for cleaning of PV modules during entireO&M period.

Water used for drinking & PV module cleaning purpose shall generally be of potable quality and fit for cleaning the modules with TDS generally not more than 75 PPM. In case of higher salt contents, the water shall be thoroughly squeezed off to prevent salt deposition over module surface. However, water with TDS more than 200 PPM shall not be used directly for module cleaning without suitable treatment to control the TDS within acceptable limits. The water must be free from any grit and any physical contaminants that could damage the panel surface.

Transmission Line Structures

Power will be evacuated from the sitess at 11/22 KV and the transmission line length will be approx 0.5 km to1 km to the interconnection point of HPSEBL.

Quality Assurance and Inspection of Civil & Structural Works

Introduction

This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification.

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

sites, to suit the sites conditions, work progress commensurate with project schedule by the contractor at no extra cost to the Engineer.

QA and QC Manpower

- The contractor shall nominate one overall QA coordinator for the contract detailing the name, designation, contact details and address at the time of post bid discussions.
- All correspondence related to Quality Assurance shall be addressed by the contractor's QA coordinator to the Engineer.
- Employer/ Consultant shall address all correspondence related to Quality issues to the contractor's QA coordinator. The contractor's QA coordinator shall be responsible for co-ordination of Quality activities between various divisions of the contractor and their sub- vendors on one hand & with Engineer on the other hand.
- The contractor shall appoint a dedicated, experienced and competent QA & QC in-charge at sites, preferably directly reporting to the concerned Project Officer, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP.
- The contractor shall finalize and submit a deployment schedule of QA & QC personnel along with their details to Engineer for approval/ acceptance and further shall ensure their availability well before the start of the concern activity.

Sampling and Testing of Construction Materials

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

Purchase and Service

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

Field Quality Plan

Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans to HIMURJA for approval, which shall detail out for all the works, equipment, services, quality practices and procedures etc. in line with the requirement of the technical specifications to be followed by the contractor at sites.

This FQP shall cover all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at sites.

Performance Measurement Procedure

Performance Ratio (PR)

Performance Ratio (PR) test for Operational Acceptance of the project shall be performed as per the standard operational procedure for Solar Project with Battery Energy Storage System .

Capacity Utilization Factor (CUF)

Capacity Utilization Factor of the project shall be calculated as per the procedure of Operations and Maintenance Agreement attached in Annexure B. Operation and Maintenance Agreement.

INSURANCE

Contractor ‘s insurance

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

a) Covering physical loss or damage to the all project facilities at the Sites, with an extended maintenance coverage for the Contractor’s liability in respect of any loss or damage for the entire term of the contract.

b) Workers compensation insurance, as required by the Applicable Law and Contracts made with employees.

c) Group Medical Claim, Group Term Policy & Group Personal Accident Insurances covering the financial consequences cause by damage and loss arising from sickness, disease, injury or death of any person employed by the Contractor in respect of the services performed Automobile Public Liability insurance, as required by the Applicable Laws, for all vehicles and automotive equipment owned hired, rented, leased and non-owned by the Contractor and used in the performance of the Services.

d) Comprehensive General third-party liability insurance including product and contractual liability covering the financial consequences of the liability arising out loss or damage caused to third parties or to the Owner as consequence of the performance of the services.

e) All other insurance like – transit insurance (Marine/ Cargo/ others as applicable), Construction All Risk, Erection All Risk, workmen compensation, fire, third party liability, insurance against Insurance against theft, fire, act of God, Contractor’s Equipments, machinery breakdown policy, business interruption insurance, Property damage Insurance & Environmental risk insurance as required during the O&M period of the Project shall be in the contractor’s scope & shall borne by the Contractor.

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

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

Annual Status Report of Insurance Claims:

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

Contractor's Insurance for the Project Facility

The Contractor shall take out and maintain an insurance policy, seamlessly with CAR policy taken earlier during construction phase, preferably from same insurance company for the project facility during the entire term of the contract. In the event of any incident or damage or loss that would be reasonably expected to result in an insurance claim, the Contractor shall:

a) Notify without delay to the Owner

b) Prepare and conduct all and any claims made under the policies effected by it, and all monies payable by any insurers shall be paid to the Contractor take all reasonable measures to mitigate the loss, its effects and to protect salvage.

c) Collaborate with Owner and the insurer and provide them with all information and documents they may request.

d) Arrange immediate reinstatement of the damage to the Owner's satisfaction, without waiting for the settlement for the corresponding insurance claim.

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

General Insurance Requirements

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

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

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

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

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

- The Contractor shall assist any assessment mandated by the insurance companies.

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

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

a) Machinery Breakdown: Electrical & or machinery breakdown of any machinery or other equipment resulting in costly repairs or even replacement of the solar panel.

b) Business Interruption: Cover for period of operational downtime i.e., covering the cash flow of the solar business as a result of an insured peril, for example fire or storm damage, machinery breakdown or equipment failure.

c) Property Damage: The insurance should cover material damage due to external causes such as fire, theft, vandalism, sabotage, hail damage, snow load, lightning strike, overload, operational mistakes, clumsiness, negligence & theft.

d) Owners Liability: Provides cover against the risk of accident from usual workplace risks such as working at height & manual handling during construction & O&M period.

e) Environmental Risk Insurance: Environmental damage coverage indemnifies solar system Owners of the risk of either environmental damage done by their development or pre-existing damage on the development sites.

SECTION V

Scope of Work for Operation and Maintenance

i) The Contractor shall prepare the initial Annual Operating Plan for the Projects and shall also indicate the proposed resources (manpower, material & machinery) that would be deployed for O&M.

ii) The Contractor shall be responsible for the smooth day-to-day operation of the Projects.

iii) The Contractor shall provide necessary routine and preventive maintenance schedules of the projects for the Owner's approval and shall carry out all routine and preventive maintenance accordingly.

iv) The Contractor shall perform periodic overhauls and preventive maintenance required for the project in accordance with the recommendations of equipment manufacturers and as per the O&M manuals.

v) Contractor shall perform all break down maintenance and other maintenance in the projects. The Contractor shall be responsible for achieving the performance guarantee of the project as indicated in the contract.

vi) The Contractor shall operate and maintain fire protection system and safety equipment for the projects.

vii) The Contractor shall do maintenance of Electricity system including overhead lines in the project area up to the Point of Common Coupling (PCC) to the grid at the sites. Necessary co-ordination shall be made by the Contractor with DISCOM/SLDC and other agencies as may be required during the Operation and Maintenance term for smooth operation of the project.

viii) Contractor shall work in coordination with the Owner or any Owner's designated party to optimize the Project production.

ix) The Contractor shall provide required spare project Equipment, Spare Parts, tools and tackles, consumables required for comprehensive operation and maintenance of the project facility. The Contractor shall make arrangement to procure required spare parts, or equipment/s as required, overhauling of parts, tools and equipment, required to operate and maintain the Project in accordance with the recommendations of individual original equipment manufacturer at his own cost. Cost of imported Equipment & spare parts, if any, shall be included in the O&M quoted cost. The List of Consumables, Spare Parts, tools and equipment shall be finalised in consultation with the Owner or Owner's representative. List of recommended spare parts shall be submitted by the Contractor at the beginning of services, however the complete recommended spares will be in the scope of contractor only. In case any equipment or spares is not listed in the mandatory spares list but is required vitally for the operation of the project, then the same shall be procured and provided by the contractor without any additional cost.

x) It is the responsibility of the Service Provide to store the materials in appropriate stock yard or container at the sites so as to ensure timely availability of the materials.

xi) The Contractor shall employ only such personnel who are adequately qualified and experienced for operating and maintaining such power generating sets. The Contractor shall ensure that such personnel are on duty at the project at all times, 24 (twenty-four) hours a day and 7 (seven) days a week commencing from the Date of Operational acceptance.

xii) Contractor shall carry out all day-to-day operation and maintenance for the Project Facility as set forth herein. Contractor shall perform the Work and supply all required spare parts in a prudent and efficient manner and in accordance with manufacturers and systems designers' specifications, the Annual Operating Plan for the Project and all operation and maintenance manuals, all Indian applicable laws including environmental protection, pollution, sanitary, labour act, factory act, employment and safety laws, ("Government Rules") and Prudent Utility Practice. The contractor shall adhere to all labour laws which are applicable and as specified in the EPC contract document.

xiii) Contractor shall arrange necessary security staff for watch and ward of the Project Facility round the clock at his own cost, the details of which shall be furnished along with the bid.

xiv) Contractor shall be responsible for:

- Maximizing project capacity utilization,
- Reducing project downtime,

xv) The Contractor shall be responsible for conveying following details to the Owner on daily basis as well as on monthly basis (by the end of 5th day of each month) by fax/ e-mail giving the detail of project performance during previous month.

- Power generated from Solar PV Project
- Power fed to the grid
- Internal power loss and internal consumption
- Power consumption for captive use (if any)

EXPERIENCE OF THE TENDERER

Please fill in the information about the similar projects undertaken over the last five years

1. Name of organization by whom work was awarded. Please give Project wise detail of projects installed/ commissioned:-
2. Name and location of the works.
3. Total amount of Contract.
4. Year of Award.
5. Detail of involvement in work as an individual or as a company.
6. Was the work completed satisfactorily and within the stipulated time period.
7. Particulars of evidence enclosed in token of above
8. Whether list of past supplies enclosed
9. Whether past performance obtained from HIMURJAs / utilities enclosed

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(Signature of Tenderer)

with designation

DECLARATION BY THE TENDERER

I/We_____

(herein after referred to as the tenderer) being desirous of tendering for, 500 KW Ground Mounted Solar Power Projects to be installed at Kirti (Theog), Sharog (Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh which includes design, manufacture, supply, erection, testing, installation and commissioning including warranty period of 5 years as shown in scope of tender specification . We have fully understood the nature of the work and carefully noted all the terms and conditions, specifications etc. as mentioned in the tender documents, hereby declare that:-

1 The tenderer is fully aware of all the requirements of the tender documents and agrees with all the provisions of the tender documents.

2 The tenderer is capable of executing and completing the work as required in the tender.

3 The tenderer accepts all risks and responsibilities directly or indirectly connected with the performance of the tender.

4 The tenderer is financially solvent and sound to execute the tender.

5 The tenderer is sufficiently experienced and competent to perform the contract to the satisfaction of HIMURJA.

6 The information and statements submitted with the tender are true.

7 The tenderer has not been debarred from similar type of work by any Govt Dept./Agency/Organization.

8 This offer will remain valid for acceptance for 180 days months from the date of opening of the price bid.

9 The tenderer gives the assurance to execute the tendered work as per the specifications, terms and conditions and in exact configuration of the sample submitted on award of the work.

(Signature of Tenderer)

with designation

PART-II: FINANCIAL BID FOR BHARTI, KENDOL, NAVGAON IN DISTRICT SOLAN

DESIGN, ENGINEERING, SUPPLY, INSTALLATION AND COMMISSIONING OF 500 KW GROUND MOUNTED SOLAR POWER PROJECT AT KIRTI (THEOG), SHAROG (ROHRU) IN DISTRICT SHIMLA AND CHARANG IN DISTRICT KINNAUR IN THE STATE OF HIMACHAL PRADESH				
Sr No.	Description of items	Quantity (LS)	Unit Price including GST (IN INR) (FOR Destination)	Total price including GST (IN INR) (FOR Destination)
	Rates for the supply of material (Must be quoted FOR sites, freight, insurance, including loading, unloading, storage, handling at sites)			
1.	Supply of SPV Modules as specified in the Tender documents	3		
2.	Supply of Inverters as specified in the Tender documents	3		
3.	Supply of Inverter transformer as specified in the Tender documents	3		
4.	Supply of Panels & Switchgears as specified in the Tender documents	3		
5.	Supply of Module mounting structure as specified in the Tender documents	3		
6.	Spare Modules (0.50% of total supply of solar modules)	3		
7.	Mandatory spares excluding modules	3		
8.	Cables (all DC, LT & HT)	3		
9.	Supply of Balance of Systems for the commissioning of the Project as specified in tender documents	3		
	Total Value	**A**		
	DESIGN, ENGINEERING, SUPPLY, INSTALLATION & COMMISSIONING OF 500 KW GROUND MOUNTED SOLAR POWER PROJECT AT KIRTI (THEOG), SHAROG (ROHRU) IN DISTRICT SHIMLA AND CHARANG IN DISTRICT KINNAUR IN THE STATE OF HIMACHAL PRADESH			
Sr. No	**Description of quantity**	**Quantity (LS)**	**Unit Price including GST (in INR)**	**Total Price including GST (in INR)**
	Rates for installation of Ground mounted Solar Power Project of 500 kW capacity at Kirti (Theog), Sharog (Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh.			
10.	Design, Engineering,	3		

	Supply, Installation & Commissioning and performance testing of the equipments supplied and other services specified in the tender document.			
11.	Civil and allied works for construction of Module mounting structure, foundations etc for all the equipment supplied	3		
12	Freight, Insurance, Loading unloading, storage at sites, handling at sites for allied works	3		
	Total Value	**B**		

RATES FOR OPERATION & MAINTENENACE FOR FIVE YEARS

DESIGN, ENGINEERING, SUPPLY, INSTALLATION AND COMMISSIONING OF 500 KW GROUND MOUNTED SOLAR POWER PROJECT AT KIRTI (THEOG), SHAROG (ROHRU) IN DISTRICT SHIMLA AND CHARANG IN DISTRICT KINNAUR IN THE STATE OF HIMACHAL PRADESH.			
Sr No.	Description of items	Year	Total price including GST (IN INR)
1.	Operation and Maintenance of the Solar Power Project for first year	1	
2	Operation and Maintenance of the Solar Power Project for second year	2	
3.	Operation and Maintenance of the Solar Power Project for third year	3	
4.	Operation and Maintenance of the Solar Power Project for fourth year	4	
5.	Operation and Maintenance of the Solar Power Project for fifth year	5	
	Total Cost for five years	C	

Total Bid Value = A+B+C = (INR)

ANNEXURE– A

MANDATORY SPARES FOR EACH SITE

S. No.	Equipment/Material	Quantity (For each type and rating)
1	PV Modules	0.5% of total supply
2	MC4 connectors (including Y-connectorif used)	1% of total supply
3	Solar Inverter/Power Conditioning Unit	1 No. of each rating in case ofString Inverter In case of Central Inverter, 2Nos. of IGBTs.
4	Inverter Transformer	
	(i) HV bushing with metal parts and gaskets	2 set
	(ii) LV bushing with metal parts and gaskets	2 set
	(iii) WTI with contacts	2 set
5	Gas Insulated Switchgear	As per OEM Recommendation
6	HT Switchgear	
	(i) Vacuum pole	2 nos.
	(ii) Closing coil	2 nos.
	(iii) Tripping coil	2 nos.
	(iv) Spring charging motor	2 nos.
	(v) Relay	2 nos.
	(vi) Meter	2 nos.
	(vii) Current Transformer	2 nos.
	(viii) MCCB	2 nos.
	(ix) MCB	2 nos.
	(x) Fuse	10% of total supply
	(xi) Indicating lamp	10% of total supply
	(xii) Rotary switch	10% of total supply
7	LT Switchgear	
	(i) MCCB	2 nos.
S. No.	Equipment/Material	Quantity (For each type and rating)

	(ii) MCB	2 nos.
	(iii) Fuse	10% of total supply
	(iv) Relay	2 nos.
	(v) Meter	2 nos.
	(vi) Current Transformer	2 nos.
	(vii) Voltage Transformer	2 nos.
	(viii) Indicating lamp	10% of total supply
	(ix) Rotary switch	10% of total supply
8	DC Cable	1% of total supply
9	AC Cable	1% of total supply
10	Communication Cable	1% of total supply
11	Control Cable	1% of total supply
12	Fuse	10% of total supply

Spares, if used, during the O&M period shall be replenished by the Contractor. All the mandatory spares shall be handed over to HIMURJA in working condition at the end of O&M period along with list of utilized items and replaced items.

"Annexure B"

Operation & Maintenance Agreement of 500 kW capacity each Ground Mounted Solar Power Projects to be installed at Kirti (Theog), Sharog (Rohru) in District Shimla and Charang in District Kinnaur in the State of Himachal Pradesh.

1 Term of the Contract

This Contract shall become effective upon final signature by the Parties for a term of **five (5) years**. The O&M of the project will commence from the date of Commercial Operation Date (COD) of the projects.

CONTRACTOR'S OBLIGATIONS

Services

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

The Contractor shall be deemed to have allowed correct and sufficient O&M Price to cover all its obligations under the Contract and to have allowed the necessary resources to enable it to perform the Services to the standards and in the manner required. The Contractor's failure to acquaint itself with or assess any applicable condition shall neither relieve it from the responsibility for performing its obligations under the Contract nor entitle the Contractor to any additional costs or any other relief.

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

(i) cause a negative impact on the performance of the safety and reliability of theProject;

(ii) adversely impact the Warranties;

(iii) adversely affect the warranties provided by the Contractors under the Contract;

(iv) conflict with the requirements under the contract; or

(v) bypass any protective equipment.

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

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

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

The Contractor shall ensure that all its Personnel deployed for providing the Services have undergone adequate safety training and are appropriately skilled, qualified and experienced in performing the Services for solar farms of a similar size, scope and complexity as the Project. The Contractor shall be responsible for all matters relating to labour relations, working conditions, training, employee benefits, safety programs and related matters pertaining

to its Personnel. The Contractor shall at all times have full supervision and control over its Personnel and shall at all times maintain appropriate order and discipline among its Personnel.

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

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

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

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

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

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

The Contractor shall make arrangements to provide monthly reports from the SCADA system to HIMURJA. The Contractor shall arrange to connect the Project to the SCADA system operating at the Sites enabling the remote monitoring of the Project by the Contractor and to provide access to information pertaining to the Project to the Owner's Representative at

Sites and SLDC. HIMURJA may collect the data generated by the SCADA system in respect of the Project from the Contractor.

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

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

2. FUNCTIONAL GUARANTEES/WARRANTIES

Technical and Functional Performance Guarantee

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

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

General Repair Warranty

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

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

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

survive the termination or expiry (as the case may be) of the contract for a period of one (1) year.

During Defect Liability Period if any repair and replacement are done, then the warrantee of the equipment shall be extended from the data of such repair and replacement to the period of original equipment warrantee w.r.t. that replaced component. Any latent defect which may not come to knowledge or discovered in the course of normal inspection/operation during two years from the operational acceptance but, may arise within a period of 5(five) years from expiry of warranty period of two years, shall be under warranty by free replacement/rectification.

The acceptance of the equipment by HIMURJA shall in no way relieve contractor of his obligations under the contract**.**

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

The beneficiary may communicate to the Contractor any curtailment plans either linked to acoustic requirements; load management, or Applicable Law. The Contractor shall ensure compliance with all Curtailment Plans provided by the beneficiary in accordance with Performance Standards and Technical Specifications. If either the Contractor or the beneficary detects a variation with respect to the Curtailment Plans or in noise emission the Contractor will, at its own expense, characterize the problem, isolate the source of the problem and propose solutions to solve the problem to the beneficiary (at the beneficiary expenses in all cases other than cases where it's ascertained that the deviation was caused by a non-respect of the obligations under the contract).

Grid Connection and balance of electricity commitments

The Contractor acknowledges that to allow the beneficiary to inject the energy generated by the Project Facility to the Grid and be eligible for the full tariff under the PPA, the Project and the Contractor must comply with the requirements prescribed by Applicable Law, Good Solar Industry Practices, Performance Standards and the Grid documents and that failure to comply with such requirements may cause the beneficiary to either: (i) not be able to collect the tariff energy injected; and/or (ii) be subject to penalties payable to the Grid operator and/or the Discom and/or the power purchaser and/or any Government body. The Contractor therefore undertakes to diligently comply the requirements referred to Grid Connection and balance of electricity commitments, as prescribed under the Grid documents as provided by or on behalf of

the beneficiary from time to time (or of which the Contractor otherwise becomes aware), and/or with the reasonable requests of the beneficiary associated with the compliance therewith.

3. PERFORMANCE STANDARDS

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

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

the Permits and all the related documents;

the terms of the contract;

the functional Guarantee;

the Reference Documents including the manufacturers recommendations;

Beneficiary health and safety manuals and procedures and the Sites Regulations; the Equator Principles and the Equator Principles Requirements;

Good Solar Industry Practice;

Any relevant and reasonable instructions issued by the beneficiary, relevant to the scope of the contract, to the Contractor at least 15 days before the implementation of such instructions without any cost to the Contractor.

The terms of insurances directly relating to the Project and Comply with all operation and maintenance obligations as set out under the PPA or do anything which results in a breach of the beneficiary's obligations under the PPA.

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

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

(a) to save and to the extent that the Contractor is required to do so pursuant to the provisions of Additional Services, to ensure that the Project complies with the requirements of Applicable Law, Permits, if and to the extent that the same are introduced or amended following the Commencement Date; or

(b) subject to Additional Services, to ensure that the Project or the Project (as a whole or in part) complies with any noise or acoustic emissions requirements underApplicable Laws Permits.

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

The Contractor shall not do or omit to do anything in the performance or discharge of its obligations or the exercise of its rights under the contract or in breach of the contract, which would cause any breach of any of the terms of the Supply Contract, Works Contract, the Applicable Law, the Permits or the terms of any Permits or the Direct Contract, and should the Contractor be in breach of the Performance Standards, it shall, on demand of the Owner, indemnify the Owner against any direct Losses arising from a breach of this Clause by the Contractor, always subject to the aggregate liabilitycap of the Contractor (except as otherwise agreed herein).

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

4. EXCLUSIONS

General

(a) Force Majeure events as per GCC

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

Notification of Excluded Risk Event

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

5. Additional Service

HIMURJA may, with respect to the Project, request that Contractor perform work, provide services, or supply other equipment or parts, not included within Services for the successful operation of the project for the duration of this O&M Agreement. Any such requested service or supply that the Parties mutually agree to in writing shall, subject to any specific terms and conditions agreed with respect to such service or supply, bean "**Additional Service**".

6. SERVICE PERSONNEL

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

The HIMURJA may request the Contractor to remove (or cause to be removed) any Person employed on the operation of the Project, including the Contractor's Representative if applicable, who:

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

and threaten public health, safety or security.

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

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

The Contractor shall be responsible for all matters relating to labour relations, working conditions, training, employee benefits, employee drug testing in accordance with the Contractor's standard drug testing policy, safety programs and related matters pertaining to its employees and other Personnel engaged by the Contractor. The Contractor shall at all times have full supervision and control over its employees and other personnel engaged by it and shall at all times maintain appropriate order and discipline among its Personnel and shall cause any Subcontractor (or any subcontractor appointed by such Subcontractor) to maintain similar standards with respect to such Subcontractor's or any subcontractor appointed by such Subcontractor)employees and Personnel.

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

7. SAFETY PRECAUTION

During performance of the Services, Contractor shall:

comply with the safety standards and any safety procedures established by Contractor and same shall be approved by HIMURJA after the Commencement Date;

take all precautions required by Applicable Laws or Sites Regulations, or otherwise according to the Performance Standards, for the health and safety of Contractor, its Affiliates and Subcontractors in the performance of the Services and any other Persons with temporary or

perpetual access to the Sites; provided that the foregoing shall not limit HIMURJA's responsibility for the safety of the Sites as provided in Safety Precautions.

8. CONSUMABLES, SPARE PARTS, TOOLS AND EQUIPMENT

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

Consumables and Tools

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

Equipment and Spare Parts

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

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

Inspection of Replaced Parts

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

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

(ii) must not result in any material increased costs to Contractor or delay Contractor in the performance of its obligations under the contract or any Contract with, or warranty from, its Subcontractors, unless HIMURJA agrees to cover such materialincreased cost.

Tools and Equipment

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

Prices of Consumables, Spare Parts and Contractor's Equipment

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

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

Contractor shall:

(i) be responsible at its own cost for the safe transportation and delivery to Sites and adequate storage; of all Consumables, Spare Parts, and Contractor's Equipment, in each case, required for the carrying out of the Services;

(ii) bear the risk of loss and damage to all such Consumables and Spare Parts during transportation to the Sites and, thereafter up to the date of their incorporation by Contractor into the Project; and

(iii) at all material times bear all risk in any and all Contractor's Equipment on or off the Sites and whether remaining separate or temporarily attached to the Project.

Title

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

(i) incorporation by Contractor in the Project free and clear of any Lien; or

(ii) in the case of Additional Services, the date (if later) on which payment is made infull for such Spare Part or Consumable.

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

9. COMMUNICATION AND REPORTING

During the Term, Contractor shall exchange information and reports on daily, weekly, monthly, quarterly and annual basis as and when sought by the concerned officer in charge:

Monthly Reports

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

Emergency Notices

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

If, by reason of an emergency arising in the course of, as a result of or otherwise in connection with and during the performance of the Services, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Project, the Contractor must

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

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

Meetings

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

(i) to discuss projected dates for performance of the Services and the AdditionalServices in the following quarter;

(ii) to discuss, the calculated Measured Average Availability of the Project Facility for the past quarter under Annexure 2 [Functional Guarantees]; and

(iii) to review the Services and Additional Services performed in the past quarter.

Visitors Log Book

Contractor shall provide HIMURJA with a log book for the Project to record the identity and activity of all visitors to sites. Such log book will be kept at the entry Gate location of Project. The Contractor shall cause that all personnel and representatives of each Party or any third parties visiting the sites]shall be required to record their identity, the date, time and

purpose of any visit to sites, the nature of any work performed thereon and such other details for which log books may reasonably be used. It is clarified that the Contractor shall not permit unauthorized third party access to the Sites unless such third parties have been authorised by the HIMURJA, are required to inspect or access the Sites in accordance with Applicable Law or for performance of Services. Copies of these logs shall be provided to the HIMURJA within ten (10) Business Days following its written request. Contractor shall create a digital back up of such logs at least every month. The log book shall be in English only.

Annual Calendaring of Maintenance Services.

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

Status Reviews

As reasonably required, or requested by the HIMURJA, the Representatives shall meet to discuss and review

(i) the information contained in the Monthly Performance Reports,

(ii) the availability of the Project,

(iii) (iii) any technical issues which may have arisen with respect to the performance, availability or maintenance and servicing of the Project Equipment,

(iv) Maintenance Services and Repair Services performed during the preceding calendar month,

(v) any and all failures by a Project equipment, and

(vi) Maintenance Services to occur during the next following a calendar month.

a. Contractor's Permits

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

b. Contractor's Manager

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

c. Reserved Rights

Project

To the extent Contractor believes, in its reasonable discretion, that it is necessary to enhance the overall performance or safety of the Project, Contractor may propose to HIMURJA changes and improvements to the Project (including the software included with respect thereto) and implement such changes or improvements proposed after obtaining the prior written consent of the HIMURJA; provided that such changes and/or improvements shall not (i) be in conflict with the Performance Standards**;**

(ii) adverselyimpact the technical performance of the Project or the safety of the Project**;**

(iii) adversely impact the Availability Warranty in Annexure 2 [Functional Guarantees]

(iv) increase the cost of operating the Project;

(v) place the HIMURJA in breach of the technical requirements of the Power Purchase Contract;

(vi) impair or vitiate any obligations of the Contractor under the contract;

(vii) adversely affect the Supply Contract Warrantiesand the Works Contract Warranties; or

(viii) result in non-compliance with the Type Certificate**.**

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

d. CERTAIN NOTIFICATIONS BY CONTRACTOR

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

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

(a) to have a material adverse effect on the operation of any of the Project or the performance of the HIMURJA's obligations under the contract; or

(b) to cause an immediate threat to the safe operation of the Project (or any Project therein) and/or the safety of Persons; provided that, in the case of this Clause, the Contractor shall provide immediate verbal notice of such event, fact or observation to the HIMURJA with notice to follow within three Business Days;

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

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

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

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

e. ASSIGNMENT AND SUBCONTRACTING

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

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

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

f. Inspection and Testing

The Contractor must provide the HIMURJA, independent engineer, Grid Operator, Grid Administrator, and any other Contractor or Contractors employed by the HIMURJA and their respective nominees, or other inspectors where required under the Applicable Law, the

Permits, the Finance Documents and/or the Grid documents (collectively hereinafter referred to as the "Project Parties"), with access at any time to any place where the Services are being performed in order to inspect the progress and the manner of the Services, provided that the HIMURJA (or its designated representatives) gives the Contractor twenty four (24) hours prior written notice.

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

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

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

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

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

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

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

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

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

During the Operation and Maintenance period, the Project may be submitted to a general inspection performed by the Third party selected by HIMURJA:

Inspection during the Term

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

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

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

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

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

(i) Contractor shall, promptly following receipt of the report, submit to the HIMURJA

(a) a recovery plan to remedy all breaches, defects and malfunctions detected in the report for which the Contractor is liable and shall perform such remedial actions without delay, and (b) provide detailed measures to be put in place to prevent such defaults from recurring;

(ii) if the Contractor fails to timely complete all remedial actions before the end of the Term, the HIMURJA shall be entitled, at Contractor's cost and risk, to employ a Replacement Contractor to perform the works.

HIMURJA Sites Visit

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

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

If, upon request of the HIMURJA made in accordance with Inspection and Testing, for inspection of the Project, the Contractor provides access to have services in the Project Equipment examined available for inspection and HIMURJA does not carry out such inspection, then any downtime of Project Equipment(s) to perform the inspections thereof shall be considered as available for the purpose of availability calculation described in **Annexure 2 [**Functional Guarantees]

g. HAZARDOUS SUBSTANCES AND HAZARDOUS SITES CONDITIONS

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

(i) does not violate any Applicable Laws, or Permits; and

(ii) is consistent in quantity and with Good Solar Industry Practices for operating and maintaining solar energy conversion projects, such as motor fuels, solvents and lubricants (collectively, “Permissible Materials”).

Contractor shall bear all responsibility and liability for:

(i) any Hazardous Substances that are not Permissible Materials belonging to the Contractor or present on sites; or

(ii) the handling of, or failure to handle, Permissible Materials in violation of Applicable Laws or otherwise in any manner that constitutes negligence or willful misconduct by Contractor or any Subcontractor.

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

(i) utilize, or permit or cause any Subcontractor to utilize, on the Sites such Hazardous Substances as are prohibited under Applicable Law from being used in India; or

(ii) import or use at the Sites such Hazardous Substances as are prohibited underApplicable Law.

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

Contractor shall arrange and agree for the disposal, transportation, reporting and certification (including provision of waste disposal vouchers and other certificates as required by Applicable Law or Permits) of Hazardous Substances, including waste disposal vouchers, brought onto and released at the Sites by Contractor or its Sub Contractors, which are expected to include but not be limited to used oil, grease and ethylene glycol, to the extent required by Laws, in each case, by licensed, insured, competent and professional Contractors in a safe manner and in accordance with Laws. As between the Parties, Contractor shall be solely liable for any response, removal, investigation, clean-up or other remedial action required by any Laws related to any Contractor,

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

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

h. HIMURJA's OBLIGATIONS

During the Term, HIMURJA shall perform the following obligations:

Access

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

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

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

(i) such keys or access codes as may be required by the Contractor to gain unhindered access to the Sites (as the case may be);

(ii) Access to the access roads to and on the Sites If there is any deviation, and such deviations are accepted by the transport contractor, then such deviations shall beaccepted by the Contractor.

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

HIMURJA's Permits

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

i. SITES REGULATIONS

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

j. CERTAIN NOTIFICATIONS BY HIMURJA

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

any events or facts or observations that the HIMURJA believes has determined that would:

(i) have a material adverse effect on the operation of any of the Project or the performance of the Contractor's obligations under the contract; or

(ii) to cause an immediate threat to the safe operation of the Project (or any Project therein) and/or the safety of Persons; provided that, in the case of this current Sub-Clause, the HIMURJA shall provide as soon as possible verbal notice of suchevent, fact or observation to the other;

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

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

k. HIMURJA's OWNERSHIP OF ENERGY, EQUIPMENT, SPARES AND PROJECT BENEFITS

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

The HIMURJA ownership of all item supplied by the Contractor, including under Additional Services shall be transferred to the HIMURJA at the end of the term of the contract:
Such items becoming a permanent part of the Project against the mutually agreed payment by both the parties. The HIMURJA ownership of any item (not including Energy or benefits arising out of the operation of the Project) supplied by the Contractor as part of the Services shall be transferred to the HIMURJA upon such items becoming a permanent part of the Project.

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

l. PRICE AND PAYMENT

Total Annual O&M Cost

Commencing on the Commencement Operation Date of the project and for the remainder of the Operation and Maintenance period, HIMURJA shall, in consideration of the Contractor providing the Services and its prior receipt of an invoice with respect thereto, pay in accordance with Invoices and Payment to Contractor an annual O&M cost in INR in equal quarterly installments at the end of every quarter for each year till the Term of the Contract in the amounts set forth in and payable in accordance with Price Schedule [Schedule of Rates] of the bidding documents for the project facilities. The yearly breakup of the Total O&M price shall be in line with the Price Schedule .

The Contractor acknowledges that the Total Annual O&M cost forms the sole and exclusive consideration and reimbursement due to the Contractor for the performance of the services included under the Services and Spare Parts and that the Contractor shall not be entitled to any additional amount for their performance, for whatever reason, including, amount others due to increased costs, changes in applicable GST, customs or duties (including, without limitation

those set forth in GST, Taxation and Import Duties below), and except as may be specifically provided in the contract.

Payment of amounts due to the Contractor:

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

m. INVOICES AND PAYMENT

Contractor shall submit Goods & Service Tax (GST) compliant invoices to HIMURJA for the amounts due under Total Annual O&M cost above and for any other amounts that may be due under the contract.

The Total Annual O&M Cost shall be invoiced by the Contractor quarterly against the completion of concerned quarter and each invoice may be submitted by Contractor no later than the day after the completion of the quarterly period in question and, subject to the terms of the contract, shall be paid by the HIMURJA no later thirty (30) days from the date of submission of the invoice along with all other requisites documents (If so required). The HIMURJA shall make payments by wire transfer to the bank account designated from time to time and owned by Contractor. The payment of any invoice shall be subject to the Contractor submitting to the HIMURJA the Monthly Performance Reports.

Additional Services may, for purposes of this Invoices and Payment, be invoiced upon full and proper completion of each individual task and shall, subject to the terms of the contract be paid by the HIMURJA within thirty (30) days from the date of submission of the invoice along with all other requisites documents (If so required).

To the extent permitted by Applicable Laws, if the amount of an invoice is disputed by the HIMURJA, the HIMURJA shall be entitled to withhold payment of the disputed amount for the next invoice (or part thereof), until the dispute is resolved between the Parties under Law Dispute Resolution or otherwise. The HIMURJA shall pay at the applicable time the undisputed amount of such invoice including any undisputed portion of the invoice item in dispute. Further, the HIMURJA shall be entitled to withhold payment of any amount due to the Contractor, if, at the

time, the Contractor is in breach of one or more of its materialobligations in terms of the contract.

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

(i) assessing all risks which it is assuming under the Contract; and

(ii) ensuring that the O&M Price contain allowances to protect it against any of these risks eventuating, and that it will not make a claim for an increase in the **O&M Price** if any of those risks eventuate.

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

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

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

n. SCADA, EMS

Contractor shall be required from time to time to update the SCADA and EMS software, as required for the ongoing adequate operation of the Project Facility. Such updates shall also be provided to the HIMURJA at no additional costs.

o. INSURANCE

Contractor ‘s insurance

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

a) Covering physical loss or damage to the all project facilities at the Sites, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage for the entire term of the contract.
b) Workers compensation insurance, as required by the Applicable Law and Contracts made with employees.

c) Group Medical Claim, Group Term Policy & Group Personal Accident Insurances covering the financial consequences cause by damage and loss arising from sickness, disease, injury or death of any person employed by the Contractor in respect of the services performed Automobile Public Liability insurance, as required by the Applicable Laws, for all vehicles and automotive equipment owned hired, rented, leased and non-owned by the Contractor and used in the performance of the Services.

d) Comprehensive General third-party liability insurance including product and contractual liability covering the financial consequences of the liability arising out loss or damage caused to third parties or to the HIMURJA as consequence of the performance of the services.
e) All other insurance like – transit insurance (Marine/ Cargo/ others as applicable), Construction All Risk, Erection All Risk, workmen compensation, fire, third party liability, insurance against Insurance against theft, fire, act of God, Contractor's Equipments, machinery breakdown policy, business interruption insurance, Property damage Insurance & Environmental risk insurance as required during the O&M period of the Project shall be in the contractor's scope & shall borne by the Contractor.

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

The HIMURJA shall be named as co-insured under all insurance policies taken out by the Contractor, except for the Third-Party Liability and Workers' Compensation Insurances, and

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

Annual Status Report of Insurance Claims:

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

Contractor's Insurance for the Project Facility

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

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

a) Notify without delay to the HIMURJA
b) Prepare and conduct all and any claims made under the policies effected by it, and all monies payable by any insurers shall be paid to the Contractor take all reasonable measures to mitigate the loss, its effects and to protect salvage.

c) Collaborate with HIMURJA and the insurer and provide them with all information and documents they may request.
d) Arrange immediate reinstatement of the damage to the HIMURJA's satisfaction, without waiting for the settlement for the corresponding insurance claim.
e) Claim in pursuant to the contract to the insurance agencies, if the claim is accepted or rejected or not accepted or partly accepted by the insurance agency then it will not limit the contractor obligation in any case and also if any losses on account of this shall be in the scope of contractor.

General Insurance Requirements

The Contractor shall, provide copies of the corresponding insurance certificates mentioned above. If the Contractor fails to effect or maintain any insurance policy required hereunder, or fails to produce copy of the corresponding insurance certificates**,** the HIMURJA may (but as no obligation), without prejudice to any other right or remedy available to it under the

contract, procure the insurance for the relevant coverage and/or pay the premiums due. Such payments shall be recoverable and deducted from the payments to be made to the Contractor by the HIMURJA under the Contract. In the event if Contractor does not pay the premium, then the HIMURJA may pay the premium however in such case the obligations of Contractor to undertake the coverage shall continue as envisaged, irrespective of premium being paid by HIMURJA. The Premium if paid by HIMURJA shall be recovered from the Annual O&M Fees payable by the HIMURJA to the Contractor.

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

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

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

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

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

a) **Machinery Breakdown**: Electrical & or machinery breakdown of any machinery or other equipment resulting in costly repairs or even replacement of the solar panel.

b) **Business Interruption**: Cover for period of operational downtime i.e., covering the cash flow of the solar business as a result of an insured peril, for example fire or storm damage, machinery breakdown or equipment failure.

c) **Property Damage**: The insurance should cover material damage due to external causes such as fire, theft, vandalism, sabotage, hail damage, snow load, lightning strike,overload, operational mistakes, clumsiness, negligence & theft.

d) **HIMURJAs Liability**: Provides cover against the risk of accident from usual workplace risks such as working at height & manual handling during construction & O&M period..

e) **Environmental Risk Insurance**: Environmental damage coverage indemnifies solar system HIMURJAs of the risk of either environmental damage done by their development or pre-existing damage on the development sites.

ANNEXURE 1:

Scope of Work for Operation and Maintenance

i) The Contractor shall prepare the initial Annual Operating Plan for the Project Facility and shall also indicate the proposed resources (manpower, material & machinery) that would be deployed for O&M.

ii) The Contractor shall be responsible for the smooth day-to-day operation of the Project Facility.

iii) The Contractor shall provide necessary routine and preventive maintenance schedules of the project for the HIMURJA's approval and shall carry out all routine and preventive maintenance accordingly.

iv) The Contractor shall perform periodic overhauls and preventive maintenance required for the Project in accordance with the recommendations of equipment manufacturers and as per the O&M manuals.

v) Contractor shall perform all break down maintenance and other maintenance in the Project Facility. The Contractor shall be responsible for achieving the performance guarantee ofthe project as indicated in the contract.

vi) The Contractor shall operate and maintain fire protection system and safety equipment for the project.

vii) The Contractor shall do maintenance of Electrical system including overhead lines in the Project Facility area up to the Point of Common Coupling (PCC) to the grid at the sites. Necessary co-ordination shall be made by the Contractor with DISCOM/SLDC and other agencies as may be required during the Operation and Maintenance term for smooth operation of the project.

viii) Contractor shall work in coordination with the HIMURJA or any HIMURJA's designated party to optimize the Project production.

ix) The Contractor shall provide required spare project Equipment, Spare Parts, tools and tackles, consumables required for comprehensive operation and maintenance of the project facility. The Contractor shall make arrangement to procure required spare parts, or equipment/s as required, overhauling of parts, tools and equipment, required to operate and maintain the Project in accordance with the recommendations of individual original equipment manufacturer at his own cost. Cost of imported Equipment & spare parts, if any, shall be included in the O&M quoted cost. The List of Consumables, Spare Parts, tools and equipment shall be finalised in consultation with the HIMURJA or HIMURJA's representative. List of recommended spare parts shall be submitted by the Contractor at the beginning of services, however the complete recommended spares will be in the scope of contractor only. In case any equipment or spares is not listed in the mandatory spares list but is required vitally for the operation of the project, then the same shall be procured and provided by the contractor without any additional cost.

x) It is the responsibility of the Service Provide to store the materials in appropriate stock yard or container at the sites so as to ensure timely availability of the materials.

xi) The Contractor shall employ only such personnel who are adequately qualified and experienced for operating and maintaining such power generating sets. The Contractor shall ensure that such personnel are on duty at the project at all times, 24 (twenty-four) hours a day and 7 (seven) days a week commencing from the Date of Operational acceptance.

xii) Contractor shall carry out all day-to-day operation and maintenance for the Project Facility as set forth herein. Contractor shall perform the Work and supply all required spare parts in a prudent and efficient manner and in accordance with manufacturers and systems designers' specifications, the Annual Operating Plan for the Project and all operation and maintenance manuals, all Indian applicable laws including environmental protection, pollution, sanitary, labour act, factory act, employment and safety laws, ("Government Rules") and Prudent Utility Practice. The contractor shall adhere to all labour laws which are applicable and as specified in the EPC contract document.

xiii) Contractor shall arrange necessary security staff for watch and ward of the Project Facility round the clock at his own cost, the details of which shall be furnished along with the bid.

xiv) Contractor shall be responsible for:

- Maximizing project capacity utilization,
- Reducing project downtime,
- Optimizing the useful life of the equipment of the power project.

xv) The Contractor shall maintain all accounting records regarding the facility in accordance with the generally acceptable accounting principles under the Laws of India.

xvi) The Contractor shall maintain accurate and up-to-date operating logs, records and monthly reports regarding operation and maintenance of the Project facility (Such records shall be distinctly recorded for Solar PV Project, in order to have clear data for assessment of any individual component of the Project Facility) which shall include details of power output, other operating data, repairs performed and status of equipment. All such records to be maintained for a minimum of 60 (sixty) months after the creation of such record or data and for any additional length of time required by regulatory agencies with jurisdiction over the Parties. Upon expiry of term, the Contractor shall hand over all such records to HIMURJA. However, HIMURJA shall have access to all such records at any time. Generation and O&M reports should be made available to HIMURJA on daily and monthly basis in required formats as well as the Quarterly and Annual Performance Reports shall be provided. Contractor shall provide communications as well as daily, weekly, monthly, quarterly and annual reports to the HIMURJA in the desired format as per the Contract with the HIMURJA or HIMURJA's Engineer.

xvii) The Contractor shall develop and implement plans and procedures including those for firefighting, maintenance planning, procuring and inventory control of stores and spares, plan to meet emergencies, project safety and security; and such other facilities and systems as may be necessary to commence Contractor's ongoing responsibilities.

xviii) The Contractor shall provide copies of all necessary documents including the following:

- Operation and maintenance manuals shall be prepared and approval shall be accorded from HIMURJA within three months from the date of Operational acceptance.

- Failure Analysis/history/trouble shooting details of all the Equipment

- Identification of Equipment needing preventive maintenance

- List of Vendors indicating name and addresses during operation and maintenance with credentials
- Root cause analysis report for any major failure.
- Record of consumables / spare parts

xix) The Contractor shall be responsible for conveying following details to the HIMURJA on daily basis as well as on monthly basis (by the end of 5th day of each month) by fax/ e-mail giving the detail of project performance during previous month.

- Power generated from Solar Power Project
- Power fed to the grid
- Internal power loss and internal consumption
- Power consumption for captive use (if any)
- Reactive power consumption

xx) The Contractor shall be responsible for liasioning with statutory authorities–and local authorities in order to ensure smooth operation of the Power Project.

xxi) Contractor shall provide constant remote surveillance to the Project Facility

xxii) Contractor shall provide updates and revisions to Reference Documents, as and when applicable.

xxiii) Shall implement software updates to control and monitoring systems including EMS/SCADA in order to meet the project facility operating requirement in consonance with the grid operations and in compliance with the grid codes as applicable during the operation.

xxiv) Duly and timely provide the HIMURJA (or parties designated by the HIMURJA) with all notifications required under the Contract including in particular such notifications set forthin Certain Notifications by Contractor;

xxv) Contractor shall provide access to the HIMURJA to all data for the Project Facility from the EMS including the SCADA system.

xxvi) Contractor shall at all times allow and provide HIMURJA all necessary information for the operation of EMS including the SCADA system (with no notification or approval of access being required unless specifically and otherwise agreed to by the Parties) full, free, unconditional, safe and complete access to the EMS including the SCADA system. Contractor shall monitor and operate the Project in accordance with the contract and shall ensure smooth operation of the project.

xxvii) Provide the training to the HIMURJA's personnel in relation to the operation of the complete project facility. Training shall be provided to the HIMURJA within 190 days before endthe contract.

xxviii) Contractor shall provide the insurances prescribed in insurance. The Contractor shall, with prior intimation of 5 Business Daysat regular business hours, allow persons duly authorized by the HIMURJA including but not limited to the officials of the insurance company of the HIMURJA, to inspect the Project and provide to such personnel, access to all information which is necessary for their inspection, and is reasonably requested by the HIMURJA. All representatives of the HIMURJA shall strictly adhere to the Applicable Laws and the Health, Safety and Environmental (HSE) practices of the Contractor as provided in theReference Documents;

xxix) Contractor shall provide for the watch and ward of the Project at all times during the Term. The watch and ward deployment plan shall take care of comprehensive Project level security and the Contractor shall take necessary steps to prevent sabotage, theft, vandalism and malicious damage of the assets comprising the Project, and shall also coordinate and liaison with law enforcement authorities. The Contractor shall take all possible measures to keep the project operational and secure.

xxx) Contractor shall coordinate with SLDC and other related entities/departments/local Panchayats as required for proper operation of the Project Facilities. Also coordinate with relevant agencies for monthly Joint Meter Readings, meter testing, and any other requirements such as any audit or inspection by the government agencies or authorities, financiers, any designated third-party agency etc. for the Project operations.

xxxi) Contractor shall be responsible for appointing a Qualified Coordinating Agency at the Pooling Substation Level and shall be responsible for carrying out the forecasting and scheduling of the energy generation from the project facility (In accordance with the Deviation Settlement Mechanism Regulations, as applicable). Scheduling given by the Contractor is such that no penalty is levied on the HIMURJA due to any deviation of actual generation from scheduling beyond the allowed limit. If any penalty is imposed on the HIMURJA due to such deviations beyond allowed limit the same shall be passed on to the Contractor and the recovery of the same will be done from the O&M Price payable to theContractor.

xxxii) Water requirement for module cleaning arrangement and the cost for the same shall be borne by Contractor. The Contractor shall arrange for water on it's own, by ensuring ESIA norms.

xxxiii) Contractor shall be responsible to comply with all applicable National and International Standards as well as local statutory provisions related to Environmental Protection Regulations, Health and Safety requirement.

xxxiv) Contractor will be responsible for coordinating with the OEMs for securing warrantee conditions and services from OEMs as per the warrantee of each equipment, as well also for the Project insurance claims.

xxxv) Contractor shall carry out the performance monitoring for the Project Facility on continuous basis and in case of any deviation, the Contractor shall perform the due diligence appropriately to find out the actual root cause of such deviation. Any test or inspection required such as thermal imaging, IV characteristics test etc. to analyse such deviation will be the responsibility of the Contractor. Thereafter the corrective action required to mitigate such deviation shall be undertaken by the Contractor without any additional cost.

xxxvi) Contractor shall be responsible for maintenance of all each and every civil infrastructure parts like Building, cable trench, fencing, drain, plumbing system fire-fighting system, CCTV system, security arrangement, road, earthing, any foundations, anti- weeding, clearing bushes in the solar field etc., as per the direction of HIMURJA's EngineeringIn-charge.

ANNEXURE 2

Functional Guarantees

1. Annual Energy Generation Guarantee

A. The Contractor will have to ensure 8 Lakh units per annum from the Solar Power Project of 500 kW capacity in consonance with the technical specifications and parameters mentioned in the bid document.

B. In consideration for the payment of the O&M Price, from the Commencement Date until the end of the Term, the Contractor grants to the HIMURJA, minimum energy generation Guarantee on the terms and conditions set forth in the contract.

C. The Contractor guarantees the annual minimum energy generation committed herein over the O&M Period from the date of Operational Acceptance. In the event the energy generation is less than the Guaranteed generation, the Contractor shall immediately, upon demand, indemnify the HIMURJA, as liquidated damages and not as penalty, amounts equivalent to remuneration of the equivalent Energy, subject to a maximum of hundred (100%) percentof the Total Annual O&M Price.

D. Liquidated Damages for Shortfall in Annual energy generation for the Solar Power Project.

If the Contractor fails to achieve guaranteed annual generation at the end of First Year, the Contractor shall pay compensation to HIMURJA, at a tariff of Rs. 4.00 per unit (kWh) for the shortfall in energy generated.

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

F. Penalty during O&M period against breakdown of other Infrastructure of Project Facilities that don’t affect the generation of power directly, such as but not limited to, civil infrastructure, water supply system/network, other Infrastructure developed by the Contractor as a Scope of Work for the Project (Section-III & IV: Scope of Works & Technical Specifications) shall be penalised **@** Rs. 1000/day, for non-compliance with

PM Schedule (Initiation/Completion of Scheduled maintenance Activity as agreed under this Contract) beyond 48 hours. Cumulative value of such penalty shall be limited to 50% of yearly O&M cost. For the purpose of this Clause, the PM shall be inclusive of, but not limited to, the following PM activities:

Item	**Scope of Maintenance Activity**	**Periodicity**
Environmental/Corrosive Protective Coatings	White-washing/Application/Re-application of Distemper, Epoxy coatings	Once in every 2 years under the O&M Contract period, in consultation with the HIMURJA
Roads and Access paths	Repair and maintenance of all roads – Access, Internal and Periphery roads, walkways as well as fences, gates, cable-trenches and outdoor equipment platforms.	Once every year prior to Monsoon season, in Consultation with the HIMURJA
Water Supply Network	Repair and Maintenance of Water Supply Network including piping network, valves, pumps, RO system etc.	Once Every Year in Consultation with the HIMURJA.
Periphery Lighting	Repair and maintenance of Peripheral Lighting including replacement of non-functional lighting fixtures, Junction Boxes, Conduits etc.	Once every Six Months

Rodent Entry Points	Application/re-application of Anti-rodent protection measures like PUF filling, sealant etc. at Checker/Gland Plates, Cable Entry Points (in PCU/SMU, Switchgear Panels, Buildings, Enclosures)	Once every Six Months
All bolted/tightened structures	Tightening/fastening of bolts that are exposed to winds/vibrations like MMS members/foundation bolts	Once every Year before onset of Windy season, in consultation with the HIMURJA.
Enclosures of Equipment requiring Temperature and Dust Controlled environment for Normal Operation	Application/re-application of insulation/Dust-Filters/Temperature-control equipment at Enclosures/Buildings housing PCU, Switchgear	Once every Year, consultation with the HIMURJA.
Entire Project Facility	Oversight management of the hazardous/toxic materials including its handling and disposal as per Government of India Rules and environmental and safety assessments	Once every Year, in consultation with the HIMURJA.

Note : The Contractor shall ensure intimation and submission of requisites Reports to HIMURJA at least 15 days prior to initiation of maintenance action for the activity.

Annexure-3

Format of Bank Guarantee (BG)

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

In consideration of the ----- [Insert name of the Bidder] submitting the response to Tender document inter alia for setting up SPP of 500 kW at ------- sitess in response to the Bid No_____ dated…… issued by HIMURJA. Considering such response to the Tender document of ……[insert the name of the Bidder] (which expression shall unless repugnant to the context or meaning thereof include its executers, administrators, successors and assignees) As per the terms of the Bid document, the _____ [insert name & address of bank] hereby agrees unequivocally, irrevocably and unconditionally to pay to HIMURJA at_____ [Insert Name of the Place from the address of the HIMURJA] forthwith on demand in writing from HIMURJA or any Officer authorized by it in this behalf, any amount upto and not exceeding Rupees------ [Total Value] only, on behalf of M/s _____ [Insert name of the selected Bidder] This guarantee shall be valid and binding on this Bank up to and including…….[insert date of validity in accordance with Bid document].and shall not be terminable by notice or any change in the constitution of the Bank or the term of contract or by any other reasons whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations or alternations made, given, or agreed with or without our knowledge or consent, by or between parties to the respective agreement. Our liability under this Guarantee is restricted to Rs._____ (Rs._____ only). Our Guarantee shall remain in force until…….HIMURJA shall be entitled to invoke this Guarantee till ……. The Guarantor Bank hereby agrees and acknowledges that HIMURJA shall have a right to invoke this Bank Guarantee in part or in full, as it may deem fit. The Guarantor Bank hereby expressly agrees that it shall not require any proof in addition to the written demand by HIMURJA, made in any format, raised at the above mentioned address of the Guarantor Bank, in order to make the said payment to HIMURJA. The Guarantor Bank shall make payment hereunder on first demand without restriction or conditions and notwithstanding any objection by ----------[Insert name of the Bidder] and/or any other person. The Guarantor Bank shall not require HIMURJA to justify the invocation of this

Bank Guarantee, nor shall the Guarantor Bank have any recourse against HIMURJA in respect of any payment made hereunder. This Bank Guarantee shall be interpreted in accordance with the laws of India and the courts at Shimla shall have exclusive jurisdiction. The Guarantor Bank represents that this Bank Guarantee has been established in such form and with such content that it is fully enforceable in accordance with its terms as against the Guarantor Bank in the manner provided herein. This Bank Guarantee shall not be affected in any manner by reason of merger, amalgamation, restructuring or any other change in the constitution of the Guarantor Bank. This Bank Guarantee shall be a primary obligation of the Guarantor Bank and accordingly HIMURJA shall not be obliged before enforcing this Bank Guarantee to take any action in any court or arbitral proceedings against the Bidder, to make any claim against or any demand on the Bidder or to give any notice to the Bidder or to enforce any security held by HIMURJA or to exercise, levy or enforce any distress, diligence or other process against the Bidder. Notwithstanding anything contained hereinabove, our liability under this Guarantee is restricted to Rs. _____ (Rs. _____ only) and it shall remain in force until …….. We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only if HIMURJA serves upon us a written claim or demand.

Signature _____ Name_____

Power of Attorney No._____

Email ID_____

For _____[Insert Name of the Bank]__ Banker's Stamp and Full Address.

Dated this ____ day of ____, 20__

Witness: 1. ……. Signature Name and Address

Witness: 2…….. Signature Name and Address

Notes: The Stamp Paper should be in the name of the Executing Bank and of appropriate value.

List of Sites where 500 kW capacity Ground mounted Projects is proposed to be installed in first phase.

Name of sites	Gram Panchayat	Distt	Lat/Long	Electrical sub division of HPSEBL	Contact Details of HIMURJA for sitess
Kirti	Kirti	Shimla	31. 19 49 N 77. 27 31 E	22 kV HPSEBL Sub-Div. Thanadhar	94185-82499
Sharog	Sharog	Shimla	31.11 40 N 77.44 09 E	22 kV HPSEBL Sub-Div. Rohru	94185-82499
Charang	Charang	Kinnaur	31.6008066 N 78.4496098 E	HPSEBL sub division at Reckong Peo, Distt Kinnaur	85804-16860